The Influence of Learner Factors on the Level of Achievement in the Extended Essay (EE) and the Theory of Knowledge (ToK).

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Submitted in total fulfilment of the requirements of the degree of Doctor of Philosophy.

March, 2010

Melbourne Graduate School of Education
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ABSTRACT

This thesis examines the extent to which learner variables, including beliefs about knowledge, predict achievement in the Extended Essay (EE) and Theory of Knowledge (ToK). Two subjects in the International Baccalaureate Diploma, the ToK and the extended essay, have the potential to develop an explicit understanding of knowledge and its enhancement. The ToK is an interdisciplinary course that develops an understanding of the nature, structure and functions of knowledge, while the EE is a means of teaching students how to create a question, research, organise and enhance knowledge.

This study examines the role of subject knowledge, thinking skills, motivations and the extent to which these learner variables predict the acquisition of an understanding of knowledge and enhancement of knowledge. In particular, it examines the extent to which various learner variables predict successful achievement in the EE and ToK outcomes. Furthermore, this study will investigate the emergence of the creative process in the EE.

The results of this thesis suggest that students perceive the EE as being a more demanding task than ToK. Lack of familiarity with heuristic strategies and their use in problem representation and problem solving were found to be the reason. It was shown that strong associations exist between subject area knowledge and achievement and creativity outcomes in the EE and ToK. Associations between the learner variables and the EE and ToK achievement outcomes were found with a range of learning strategies required to ensure successful achievement. These findings also suggest the learning context and influence of language play an important role in influencing the achievement outcomes in the ToK and EE. More explicitly, there are alternative international perspectives on how knowledge is understood and enhanced. This further indicates these learning factors need to be explicitly understood by classroom practitioners, EE supervisors and the school organisation.
DECLARATION

This is to certify that:

(i) the thesis comprises only my original work towards the PhD;
(ii) due acknowledgement has been made in the text to all other material used;
(iii) the thesis is less than 100,000 words in length, exclusive of tables, maps, bibliographies and appendices;

David Hamer

Date:
ACKNOWLEDGEMENTS

I wish to acknowledge and thank the contribution made to this thesis by:

Associate Professor Dr John Munro, of the Early Learning, Development and Inclusion centre (Melbourne Graduate School of Education), from The University of Melbourne, who encouraged and inspired me to present for a Ph D. John’s discussions, his knowledge, suggestions, and understanding of research methodology and reporting, along with his constructive feedback have been invaluable.

Dr George Pook, Director of Assessment with the International Baccalaureate in Cardiff Wales, for making data available without which this research would not have been able to be completed. Dr Sue Finch, Statistical Consultant from the Statistical Consultant Centre at The University of Melbourne, for her helpful advice and direction on statistical issues.

To my colleagues, Dr Julie Wetherbee, Mr Brian Keyte, Mr Peter Hartley, Mr Mark Lewis, Mr Michael Fitzpatrick, Mr Richard Cartwright and Dr Paul Allsopp for their helpful comments and discussions, at different stages of the research on the development and trialling of questionnaires, and feedback at different stages of writing.

To International Baccalaureate Coordinators and their Principals who made possible the administering of questionnaires, Mr Geoff Connor, Ms Susan Jarrett, Ms Merryn Dawnborn-Gundalach, Dr Matthew White, Mr Neil McBurney, Ms Jeanne Valdmere, Ms Annette Rome, Mr Craig Boyce, Dr John Green, Dr Linda McPheron, Mr Roger Lewis, Ms Christine Bradbeer, Mr Simon Foley, Ms Duane Yorke and Ms Marilyn Copeland.

To my wife Elizabeth for her continued support, patience and encouragement and who has been a true partner in this endeavour over a long period of time. To Myfanwy and Andrew Little for their contribution in entering data and marking questionnaires and to Christopher and Rhonwen who contributed ably in entering data. I am appreciative to my family for their understanding and am indebted to them while I completed the task.
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Chapter 1
Introduction

1.1 Overview – the knowledge society

The role of knowledge acquisition, an understanding of knowledge, a positive disposition to knowledge change, and the process involved in information to knowledge conversion is increasingly seen as an essential element of a knowledge-based society. The development of an awareness of knowledge and its enhancement, and the learning factors that influence this understanding have not been sufficiently studied.

The proposed study examines the factors involved in understanding knowledge, the conversion of information to knowledge, and the extent to which learner variables predict the acquisition of knowledge about knowledge, that is, an understanding of knowledge and how knowledge is enhanced. In particular, it examines the extent to which various learner variables predict achievement in these outcomes. Furthermore, this study will investigate the emergence of creative processes and products.

The development of an awareness of knowledge and its enhancement are key outcomes for education in contemporary knowledge-based societies. The capacity to convert information to knowledge, to change and enhance it, use and display the knowledge in a range of ways (Munro, 2002) is a key component of a knowledge-based society. A knowledge-based society requires access to an education that assists learners to optimise their knowledge of knowledge, and how to use and enhance this knowledge. A knowledge-based society requires the development of new and complex skills (Murtonen & Lehtinen, 2003).

Technological and scientific developments have ensured the quantity and form of information has both increased and changed over recent decades (Passig, 2003; Murtonen & Lehtinen, 2005), while information based on research is increasing swiftly (Greer, 2000). Collection methods and techniques of analysis combining with the complexity ‘… and wealth of information requires that citizens of the information
society develop more advanced, and complex knowledge handling skills’ (Murtonen & Lehtinen, 2005; and see Bereiter & Scardamalia, 1993). This knowledge based age requires a unique set of cognitive skills to access and add value to the exchange of information (Harkins, 1992; O’Dell, 1998; Passig, 2003).

In this knowledge based society, information is no longer available to small elites, but rather, available to many, ‘… who will compete globally for its use’ (Passig, 2003). The ability to make use of this information is becoming one of the key issues for future practice (Munro, 2002; Passig, 2005; Murtonen & Lehtinen, 2005). The World Wide Web has given access to, and allowed its users to reshape information, creating the problem of ‘information overload’, and with so much information available, ‘... many now identify information with knowledge itself’ (McNeely, I. & Wolverton, L., 2008, p.269).

A creative society is supported by emerging new structures that consist of ‘... (1) new systems for technological creativity and entrepreneurship, (2) new and more effective methods for producing goods and services, and (3) a broad social, cultural and geographic milieu conducive to creativity of all sorts’ (Florida, 2003, p. 48).

Societies are moving toward information-based, knowledge-driven economies, ‘… the basic economic resources – ‘the means of production,’ to use the economist’s term is no longer capital, nor natural resources, … nor labour. It is and will be knowledge,’ (Drucker, 1993, p.8)

We are starting to pay a lot of attention to the question of how we capture the output of knowledge workers within the frameworks of intellectual property law, but we have paid far less attention to the human capital which produces this output. How do we nurture a growing body of creative workers, the engines of wealth creation within the dominant industries of the 21st century? How do we create innovative enterprises which attract and nurture people with that inner spark that makes the difference? (Cutler, p.xi)

The cause of this change in society ‘… can now be discerned.’ ‘...the driving force is the rise of human creativity as the key factor in our economy and society. Both at work and in other spheres of our lives we value creativity more highly than ever, …’ (Florida,
...the fundamental source of creativity, people are the critical resource of the new age’ (Florida, 2003, p. 6). The implication is that ‘... creativity involves distinct kinds of thinking and habits that must be cultivated both in the individual and in the surrounding society’ (Florida, 2003, p. 22).

The role of knowledge acquisition, an understanding of, and a positive disposition to knowledge change, and the process involved in information to knowledge conversion is examined in this study. Strategies for optimising the effectiveness of teaching programmes that assist students to manage and direct their learning more efficiently will be identified. At the broadest level it can contribute to the re-conceptualisation of instruction and curriculum that improves students’ understanding of knowledge and their ability to research, organise and enhance it.

1.2 Learning in the knowledge society

Students conception of the nature of knowledge and learning, and of themselves as learners have been determined as important influences on their study and learning processes (Murtonen & Lehtinen, 2005; Lonka & Lindblom-Ylanne, 1996; Vermunt & van Rijswijk, 1988). Additionally, the domain specific preconception students bring to a learning situation can limit their understanding of new conceptions and ideas in areas of knowledge like biology, physics, mathematics and history (Limon & Carretero, 1999; Mereluoto & Lehtinen, 2004; Mikkila-Erdmann, 2001).

Students may also conceive of the enhancing of knowledge in a negative light that may be explained ‘... for different reasons, such as weak prior knowledge, conceptions of self as learner, and experienced difficulties in learning. Conceptions of scientific paradigms and different methods may also be crucial’ (Murtonen & Lehtinen, 2005). In addition the process of research can be difficult for a beginner due to the complexity of the subject area and sub domains (Lehtinen, 2002; Lehtinen & Rui, 1995).

To help upper secondary students develop ‘flexible and complex knowledge structures’ (Murtonen & Lehtinen, 2005), based on an understanding of how to convert information
to knowledge, to change and enhance this knowledge, and use and display it in a number of different ways, it is important students gain an understanding of the complexities of these tasks early in their studies (Lehtinen, 2002; Murtinen & Merenluoto, 2001). There is presently little understanding of how students conceptualise this process.

1.3 The International Baccalaureate Diploma (IBD)

The IBD was founded in the 1960’s for students in their final two years of secondary schooling, aged 16 to 19, and designed to create a common curriculum and means of university entry for mobile international students. The Diploma is a demanding pre-university course of study for highly motivated students supported with rigorous assessment (IBO, 2002a, p.3). It is designed as a comprehensive curriculum “... that allows its graduates to fulfil requirements of various national education systems” (IBO, 1999, p. 1). The curriculum model is presented in the “... form of the hexagon with the six academic areas surrounding the core” (IBO, 1999, p. 1). The diploma programme is offered in English, Spanish and French, with subjects being studied concurrently.

Figure 1.1 IB Hexagon
Diploma programme students are required to select one subject from each of the six subject groups or domain areas of knowledge; a first language or mother tongue (Group 1 Language A1), a second language (Group 2 Language B), humanities and social sciences (Group 3 Individuals and Societies), sciences (Group 4 Experimental sciences), mathematics (Group 5 Mathematics and computer science), and the arts (Group 6 The Arts). Group 6 incorporates the opportunity of choice where a student may forgo an arts subject but rather select an additional subject from Groups 1 to 4 or a further mathematics or computer science from Group 5 (IBO, 2002a, p. 9). At least three and not more than four subjects are taken at higher level (HL) with the other subjects studied at standard level (SL). HL courses are taught for a recommended 240 hours of classroom instruction and SL courses, 150 hours of teaching. In this model students are able to realize depth of study in the context of breadth and a reasoned curriculum (IBO, 2002a, p. 9, 10). This approach ensures the humanities orientated student must study a science subject while a student with a preference for the languages becomes familiar with science and mathematics.

This in itself does not distinguish the IBD but rather the three requirements placed at the centre of the Hexagon. The Theory of Knowledge (ToK) is an interdisciplinary subject that is fundamental to the philosophy of the IB. It encourages both student and teacher to critically reflect on the ways of knowing and areas of knowledge within the Diploma, and the role and complexities of knowledge in a contemporary society (IBO, 1999). The ToK leads to an understanding of knowledge and ensures coherence in the Diploma programme.

The EE is defined as “... an in-depth study of a limited topic within a subject” (IBO, 1998, p. 7). The EE requires students to engage in original and independent research and communicate their findings in a logical and coherent manner of less than 4000 words (IBO, 2002a, p. 5). The purpose is to introduce students to the expectations of university through developing independent research and writing skills. The choice of topic comes from an area of study within the chosen subject based on student personal interest. It is recommended that this subject should be one that the student is studying.
The formulation of a specific research question must be clearly and precisely stated and able to be effectively treated within the word limit, the approach used being appropriate to this question (IBO, 1998, p. 19). The EE is written to general assessment criteria and subject specific criteria outlined in The Extended Essay Guide (IBO, 1998), under the guidance of a supervisor. The role of the supervisor is to support the student throughout the research, to assist in defining the topic and question development, access appropriate resources, provide guidance in research skills and acknowledgement of sources, and provide appropriate advice to the candidate (IBO, 1998, p. 5).

Creativity, Action and Service (CAS) helps fulfil the IBO’s goal of educating the whole person and encourages students to share their talents and abilities with others. In so doing students are facilitated in becoming responsible and compassionate citizens who not only develop a greater awareness of themselves but concern for others (IBO, 2001). CAS aims to develop students who are reflective thinkers, active participants in project work and balanced in their approach to life. They are required to be aware of themselves as members of communities with responsibilities towards others and the environment, willing to accept new challenges.

Creativity is interpreted broadly to include such activities as singing in a choir, playing in an orchestra, participating in a drama production, through to designing and implementing service projects. Action requires participation in sport activities, expeditions, and local and international projects. Service incorporates community and social service activities. A self evaluation programme supports student reflection on their participation, understandings and insights gained for themselves and others (IBO, 2002a, p. 7).

It is to this end that the IBO aims to develop students who “... become critical and compassionate thinkers, lifelong learners and informed participants in local and world affairs” (IBO, 1996).
1.4 The knowledge society and the International Baccalaureate Diploma

Assisting students to become self-managing and self-directed learners, able to operate effectively in the information age is a major consideration for contemporary curricula. The International Baccalaureate (IB) Diploma programme provides a unique opportunity to examine the extent to which formal curriculum and pedagogy achieves this outcome and the learner instructor factors that influence it.

Two subjects, the Theory of Knowledge (ToK) and Extended Essay (EE) are essential subjects in the IB Diploma, and have the potential to develop an explicit awareness of an understanding of knowledge, knowledge enhancement and innovation. The ToK is intended to lead students to improve their understanding of knowledge while the EE develops their ability to research, organise and enhance knowledge.

The ToK and EE provide a context for examining this acquisition, understanding of, and positive disposition to knowledge change and the process involved in information knowledge conversion. ToK is an interdisciplinary course that develops an understanding of the nature, structure and functions of knowledge, through a thoughtful and purposeful inquiry into the ways of knowing and the different areas of knowledge (IBO, 1999). The ToK is represented visually by the ToK diagrams (Appendix 1.1, ToK Diagram). The EE aims to assist students to increase their knowledge of how to manage knowledge and facilitate the process of knowledge enhancement through directed research.

Successful completion of ToK requires students to reflect creatively on the role and problems of knowledge on two specific topics or issues and communicate this in a coherent way (Theory of Knowledge Guide, 1999), thus providing the opportunity for the learning of these outcomes. Successful completion of the EE requires the coordinated use of a range of learning strategies, attitudes to learning and beliefs about knowledge, information and how one operates as an information processor. Students research critically by identifying a novel or original perspective on a problem or issue,
engage in innovative thinking and present the outcomes of thinking in a coherent way (IBO, 2002).

1.5  **Achievement in the ToK and EE**

Achievement outcomes in education ‘... are artificial, designed deliberately to equip students with a repertoire of appropriate responses to the complex settings and symbols of our culture’ (Haertel, 1985). These outcomes are defined in terms of the required behaviours and cognitive processes that relate to the instructional situation being assessed.

The notion of achievement has been linked with gender and used to account for underachievement with boys since the early 1990’s (Jones & Myhill, 2004), while previous discussion had focused on the underachievement of girls (Weinar, 1971; Leder, 1980), socially disadvantaged groups (Floud et al., 1970; Halsey et al., 1980); and more recently, socio-economic status (Collins et al., 2000; Gillborn & Mirza, 2000); and the achievements of students from minority ethnic groups (DfES, 2003).

The focus of the achievement debate has further broadened to include factors that differentiate underachieving gifted students and high achieving gifted students (McCoach & Siegle, 2001), achievement between different cultural groups (Nasser & Birenbaum, 2005), and factors affecting academic achievement in higher education (Jansen & Bruinsma, 2005).

A major focus for students in schools is to learn and perform well in the curriculum, which is reflected in their level of achievement. Learning outcomes as explained by Entwistle (1997, p.3) occur when ‘... students can demonstrate … increases in knowledge and changes in understanding as a result of their experiences in school or college’. The growth of student comprehension from these learning experiences occurs in a performance context (Forster, 1997), and ‘... their ability to demonstrate this understanding, is commonly represented by their performances in assessments and examinations’ (Byrne, 2004).
Most definitions characterise academic achievement as high or low levels of performance as measured by the grades or scores received (Nasser & Birenbaum, 2005; McCoach et al., 2001; Yip & Chung, 2005; Jones & Myhill, 2004; Jansen & Bruinsma, 2005; Ram, 2004). This notion of achievement refers to the measured level of performance, not whether the level of performance was higher or lower than expected (Jones & Myhill, 2004), or whether the achievement level differed between the potential or ability of a student (McCoach et al., 2001).

Research has tended to examine academic achievement from the point of view of gender, prior knowledge, educational ability, and mathematical ability (Byrne et al., 2004; Koh & Koh, 1999; Hoefer & Gould, 2000; Boyle et al., 2002) and the learning environment (Gagne, 1985). This approach to student learning provides the opportunity to increase understanding of the learning factors that affect high achievement in the EE and in ToK as increasing an understanding of knowledge, and the enhancement of knowledge.

Achievement in this context refers to the cognitive learning outcomes that are the products of instruction and student supervision associated with the EE and ToK. In the ToK, high levels of achievement are shown through (1) the score for the ToK oral presentation, (2) the ToK essay score, and (3) the total score for ToK. In the EE, high levels of achievement are displayed through (1) the score given for the general criteria, (2) the score for the subject specific criteria, and (3) the total score for the EE.

The proposed study examines the cognitive factors involved in influencing an understanding of knowledge, the conversion of information to knowledge, the extent to which learner variables predict the acquisition of this knowledge about knowledge, and how knowledge is enhanced. In particular, it examines the extent to which various learner variables predict successful achievement in these outcomes. Furthermore, this study will investigate the emergence of creative processes and products in the EE.
1.6 An understanding of knowledge through the ToK

An understanding of knowledge is being increasingly recognised as an important issue in educational circles. Education deals with knowledge and greater consideration needs to be given to what is often implicit in educational policy and practice, what counts as knowledge, where is knowledge located, and how can students understand knowledge.

For ToK, a score for measuring an understanding of knowledge is given by external examiners through the holistic mark for each of the oral and written assessment tasks. These learning outcomes are assessed in terms of the changes in student conception and development of thinking skills and strategies. It is measuring more than student recall of facts, but rather the extent to which information has been analysed, evaluated and understood. This approach is congruent with constructivist learning.

To understand knowledge a learner will comprehend the meaning of an event, an idea, or concept. It is the process through which symbols are constructed, modified, connected to other symbols, reorganised, prioritised and applied to new situations. In the ToK, an understanding of knowledge is displayed through (1) a recognition and understanding of the problems of knowledge, (2) critical reflection and insight, and (3) a demonstration of an understanding of the role of knowledge, through interdisciplinary connections between Ways of Knowing and Areas of Knowledge, recognising cultural diversity and differences. Students choose 1 of 10 prescribed essay titles (Appendix 1.2, Theory of knowledge prescribed titles) for the written essay, and make an oral presentation on a contemporary issue that demonstrates the problems of knowledge and application of ‘ToK thinking skills’ to that issue. The ‘ToK thinking skills’ refer to the student ability ‘… to identify problems of knowledge, to analyse and evaluate claims and counter-claims, to draw inter-disciplinary links, and to be aware of differing underlying values’ (IBO, 1999, p. 53). The proposed study examines the learning factors that influence the acquisition of this understanding of knowledge.
1.7 Creativity in the EE

Creativity is the production of outcomes that are novel, relevant and effective in terms of particular criteria. The outcomes can be knowledge, procedures or operations, or products (Morgan, 1953; Bruner, 1962; Amabile, 1983; Mumford & Gustafson, 1988; Engle, Mah and Sadri, 1997; Cropley 1999; Cropley and Urban, 2000; Simon 2001; Gruber and Wallace, 2002; Martindale, 2002). These products can take the form of new ways symbolising an area of knowledge, along with products such as works of art, product design, a solution method or production process (Cropley, 1999). Creativity also requires social recognition and acceptance through a judgement that these outcomes are creative (Csikszentmihalyi, 1996).

Creativity is ‘… useful and necessary in all realms of human activity’ (Urban, 1995). The importance of creativity becomes ever more significant as a means of maintaining human progress (Csikszentmihalyi, Mihaly, Wolfe, & Rustin, 2000; Sternberg & Lubart, 1999), and is important at an individual level when one is solving problems in daily life (Urban, 1995). In society creativity can lead to new scientific findings (Datta, 1963; Goodale, 1970), artistic development (Simonton, 1975), while economically creativity is important for the long term survival of organisations (Oldham and Cummings, 1996), with new goods and services that create jobs; where ‘… individuals, organisations and societies must adapt existing resources to changing task demands to remain competitive’ (Sternberg & Lubart, 2002).

The danger in defining creativity as a set of processes, irrespective of the individual involved, ignores the level of prior knowledge, the educational context, and the goals and motives underlying creativity. Furthermore, it is not clear whether novelty is situated to a specific time and place, which implies that novelty is also influenced by the external context, and not restricted to the cognitive processes. Likewise, is the product or process that is novel, novel to the individual or to a society over time, or time specific. The term creativity can be used in at least two ways, in relation to people who have been recognised as individuals with exceptional achievements in a specific area
Gardner, 1995; Simonton, 1994), in terms of creativity amongst the public who may never produce original or useful products or processes, and creativity amongst children and students who have as yet to ‘achieve fame.’ (Nichols, 1972). Nichols (1972) described this as ‘… creativity as a normally distributed trait’, more commonly known as ‘everyday creativity’.

In the present context of student learning the focus is on individual academic creativity. Students generate outcomes that would not have been taught to them, or that would not be expected to be learnt by them. Students are confronted with a situation of creating a question and developing a solution for which they have no learned and practical experience or solution. Academic creativity (Munro, 2002), can be displayed in various ways in the EE through the:

1. development of a novel research question;
2. transfer of an established concept;
3. creative operation or processes;
4. re-prioritisation of ideas.

Creativity as discussed in this thesis, examines students who are in the final two years of secondary school, where increasing cognitive development in thinking, reasoning, critical and evaluative skills, problem creating and problem solving, occur. Through the use of existing information, and converting this information into knowledge, academic creativity takes place. Various learning factors are hypothesised as influencing creativity in enhancing knowledge through the EE.

The level of creativity displayed in the EE is scored by independent examiners in terms of a ‘holistic’ judgement that assesses qualities such as ‘intellectual initiative’ ‘depth of understanding’, and ‘inventiveness’. Of the total score allocated to the essay, 8 per cent is available for this component. This score is measuring the extent to which students enhance their knowledge and demonstrate the trait of creativity, their ability to enhance their knowledge.
These learning outcomes are assessed in terms of the changes in student conception and development of thinking skills and strategies. It is measuring more than student recall of facts, but rather a measure of the extent to which information has been understood and enhanced. This approach is congruent to constructivist learning. The proposed study examines the learning factors that influence the acquisition of this understanding of knowledge. The aim is to contribute to the debate about knowledge enhancement and innovation by examining the variables that influence these processes.

1.8 International learning

Learning in an international context requires consideration of the influences on learning in this context. The notion of an international education is more than “... a curriculum based in the cognitive domain” (Hayden & Thompson, 1995), and has developed to include “... an ideology of international understanding and peace, responsible world citizenship and service” (Cambridge & Thompson, 2004). This progression is now represented in all curriculum documentation which requires an international perspective to be taught in all subjects (Hill, 2007, p. 32, 33), and the development of the IB learner profile (IBO, 2006) that clearly states the values that an IB education promotes. The ideology of an international education is “... the culmination of using the knowledge and skills to fashion individual values” (Hill, 2007, p. 34). Two key influences in the international context are schools and language.

The role of the school is to provide the environment and work towards the expected standards in relation to the practice of international education (DP, 2003), not only for international schools but “... an experience that was an inherent part of the formal curriculum wherever it was taught” (Hill, 2007, p. 32). This change was to recognise that an international education was no longer for international schools alone, but also inclusive of schools with a relatively homogenous culture (Hill, 2007, p. 32).

Language as a tool for “... categorizing, ordering and representing the world” (Halliday, 1969) is to understand language in terms of its use and function, a means of “... personal development cultural identity and intercultural understanding” (IBO, 2008b, p 1). This
suggests language is closely associated with cognitive development, the construction of knowledge and the process of information to knowledge conversion. Language informs learning and is closely linked to achievement in the EE and ToK.

The IB was founded to meet the needs of a culturally diverse group of students (Peterson 1987, p. 16, 17) whose language profile may include “... two or more languages in his or her learning continuum” (IBO, 2008b, p. 1). Increasing population and student mobility associated with increased intercultural diversity within the so-called international and nations school systems (Hill, 2007; Sylvester, 2002) has lead to many students constructing knowledge in a language other than their mother or native tongue (IBO, 2008b, p. 1).

The IBO encourages students to “… relate ... to their own language” and respect for their literary heritage in the context of internationalism (IBO, 1997). To this end the IB offers some 46 Language A1’s in Group 1, presented for at either HL or SL (IBO, 2007, p. C22, C23, C32). In Group 2 students have the option of three language alternatives, 15 languages in Language A2, 23 language B subjects (at HL or SL) and 11 Ab Initio (SL) 46 (IBO, 2007, p. C22, C23, C32), for the May and November examination session. Language B assumes some prior experience in the language while ab initio assumes no previous experience of learning in that language (IBO, 2002c, p. 4).

A bilingual diploma is awarded to successful students who have presented for two Language A1s’, or studied a Language A1 and a Language A2, presents for their Group 3 or Group 4 examinations in a language that is not the same as his or her language A1 nominated for Group 1, or submits and EE in a Group 3 or Group 4 subject written in a language that is not the same as his or her language A1 nominated for Group 1 (IBO, 2007, p. A21). Thus, built into the Diploma programme is the development of language and literacy for all learners, that to communicate in more than one language is an indispensable part of international education, intercultural understanding and international learning (IBO, 2008, p. 3).
1.9 The role of criteria

Assessment in the IB Diploma is through the use of criterion referenced testing, designed to assess the mastery of relevant domain areas. Testing is distinguished by selecting ‘criterion–referenced test items ... to represent discrete units of student learning’ and ‘the outcome of the test depends on whether the student has reached a theoretically pre-determined cut off score...’ (IBO, 2004, p. 7). The notion of criterion referencing is to measure learner achievement ‘... with respect to a well defined behavioural domain’ (Popham, 1978). This understanding of criterion referencing has criteria acting as ‘... the behavioural yardstick that describes the desired achievement, and of which the assessment outcome is to be a measure’ (Sizmur & Sainsbury, 1997). In this sense, criterion in the IB Diploma acts as the measure of the learning behaviours that portray the achievement levels in the EE and ToK.

Essential to an understanding of an achievement outcome or measure, is,

... the notion of a continuum of knowledge acquisition ranging from no proficiency at all to perfect performance. An individual’s achievement level falls at some point on this continuum as indicated by the behaviours he (or she) displays during testing. ... the standard against which a student’s performance is compared when measured in this manner is the behaviour which defines each point along the continuum.


Criterion referencing seeks to achieve greater accountability in the awarding of achievement outcomes, transparency in the grade award process, and a recognition that in assessing student tasks a degree of subjectivity exists that requires professional judgement.

1.10 Rationale

This study presumes that student achievement in completing the ToK and EE is supported by an arrangement of learning and motivational processes that act as a frame of reference guiding student thinking. Higher quality outcomes are associated with particular combinations of learning factors used in a self-regulating and self-managing
way. For students, a heightened awareness of these factors should improve the quality of their understanding and disposition to knowledge change, the process of information knowledge conversion. Supervisors who recognise each approach to learning or motivation orientation will be more effective in their comments to students in helping them manage their learning.

The outcomes of this research have implications for instruction and pedagogy in subjects similar to ToK and the EE. More broadly this investigation can add to our knowledge of the extent to which formal studies assist students to learn explicitly about knowledge and enhancement and use, and how this can be improved. Strategies for optimising the effectiveness of teaching programmes that assist students to manage and direct their learning most efficiently are identified. At the broadest level it can contribute to the re-conceptualisation of instruction and curriculum that improves student understanding of knowledge and their ability to research, organise and enhance it. As an experienced teacher of the International Baccalaureate, the researcher is aware of the need to identify the conditions and pedagogic needs for improving students’ ability to convert information to knowledge, to proceduralise and contextualise it.

The research is intended to achieve several purposes:

(1) To increase understanding of the learning factors that affect achievement in extended projects and research studies and examine this from a number of dimensions. Central to this discussion is the issue of complexity of the EE in enhancing knowledge. Complexity arises when the characteristics of the task have additional components, and both an increase in the number and diversity of relationships between these components (Dorner, 1996; Spector, 2000; Elen & Clark, 2006, p.1). Suggested in this approach is that complexity is best understood in terms of the characteristics of the learning task and the degree of novelty of these tasks for the learner. Complexity need not arise from the task, but can alternatively be viewed as the features of the task and the interactions with the attributes of the learner. From this perspective previous knowledge and experience of a task when applied in a similar or new situation, can vary according to the traits and past experiences of the learner. This implies that complexity can vary from one person
to another. Student perception of which task, the EE or ToK is the more demanding will also play a role. Complexity is understood in relation to the task and the characteristics of the learner.

(i) Learning characteristics of student achievement in the ToK and EE

This will allow an identification of the characteristics that support the understanding and enhancement of knowledge that enable students to be better assisted and prepared. The extent to which the EE and ToK favours particular motivational styles and thinking skills that align with the EE and ToK, what students learn about learning, the nature and structure of knowledge, the enhancement of knowledge and the extent to which the EE and ToK encourages self management and the opportunities for learning this, will be examined.

(ii) The display of knowledge by students

This raises issues on how student’s existing ways of displaying knowledge influence their learning in the IB Diploma, what they know about this, and how student preferences for displaying this in assessment (summative) and during learning (formative) influences achievement in learning in the IB Diploma. Additionally, the extent to which the IB teaches students to display what they know, and new ways of displaying their knowledge is examined.

(2) To increase the understanding of academic creativity in extended projects and research studies and the contribution of domain specific and domain general knowledge to these creative outcomes.

(3) To examine the extent to which language variables contribute similar or alternative perspectives to an understanding of knowledge and the enhancement of creative academic outcomes. Studies in this area are limited but it is hypothesised that language influences have a stronger impact on student beliefs about whether they are likely to be successful, than on strategy use (Munro, 2002).
Students who study the IBD in a language other than their own native tongue, may have comparative difficulty implementing self-regulated learning behaviours. It is suggested these students may require directed strategy teaching to modify their self regulatory skills. Supervisors may need to help students to be explicit about what aspects of self-regulation they know and to then help modify these skills. Students may need to be encouraged to have positive self-perceptions of their ability to learn successfully in their host country (Munro, 2003).

(4) To examine the supervision conditions most likely to facilitate academic creativity. The EE and ToK facilitate the learning of improved self-management regulation, with required supervisor guidance to help students show what they know and structure student understanding to specified outcomes. The supervisor who can recognise each approach to a student’s learning orientation will be able to provide more effective feedback, and modify their teaching of students, to help them manage their learning.

(5) To examine the extent to which students are aware of knowledge change and the process involved in information-knowledge conversion. Students when displaying their knowledge during the development of, and in the final version the EE and ToK, may differ in their skills on how to align their knowledge with the assessment criteria, how to use supervisor feedback, and how to modify their knowledge. By examining the supervision process, supervisors can be shown how to encourage students to show what they know, how to research, and to synthesis and structure this information into an essays, academic creative outcomes can be enhanced.

(6) These findings will help improve supervision. These outcomes will help supervisors in their supervision of students at particular stages along the EE pathway. The outcomes will focus on optimising the effectiveness of teaching programs that assist students to manage and direct their learning. They will also help supervisors handle individual differences in learning and to overcome obstacles in student progress.
1.11 Overview

The aim of this study is to examine the extent to which learner variables, including beliefs about knowledge predict achievement and creativity in the EE as a way of enhancing knowledge and ToK as a means of understanding knowledge. There are multiple ways of conceptualising factors that affect student outcomes. These outcomes are seen as mutually exclusive and can be viewed as the additive effect of curricular, pedagogy and assessment practices that vary between domain areas and schools. An alternative perspective is that student knowledge is part of past curriculum, pedagogy and assessment practices. This study takes the later view.

Chapter 2 examines the nature of knowledge from the perspective of learning theory reviewing the relevant literature. Three models were chosen that are relevant to an understanding and enhancement of knowledge, Anderson’s Control of Thought Model (ACT*), Sternberg’s Theory of Successful Intelligence and Gardner’s theory of multiple intelligences. It is suggested that the learning factors may interact differently with an understanding of knowledge, and enhancement of knowledge. Chapter 3 investigates the purpose of ToK and the implied view of knowledge proposed within the ToK course. The student view of knowledge as developed through the ToK essay and oral presentation are examined in terms of Conceptual change model and The Reflective Judgement model.

Chapter 4 examines the learning factors that influence student enhancement of knowledge through research (EE). This learning activity requires students to have motives or intentions for learning, to frame questions concerning knowledge, to think through these questions, to operate as an information processor and to display the outcomes of these investigations.

The present study is outlined in Chapter 5 where the learning demands made on students in completing the EE and ToK are compared. It is hypothesised that the cognitive processes to enhance knowledge call for a higher level of skill and make greater demands than the cognitive processes needed to represent knowledge about
knowledge. The learning factors and cognitive processes that influence achievement in completing these 2 tasks are examined.

The orientation of this research is grounded in the behavioural tradition of cognitive psychology. Chapter 6 presents the research methodology that guides the researcher in testing the hypotheses. The study design is presented, study population, methodology, instrument description and approach to analysis.

Chapter 7 presents the findings of the comparative difficulty of the EE and ToK and the learning influences of various knowledge and cognitive factors on the achievement outcomes in the EE and ToK. Chapter 8 provides an analysis and interpretation of the results and examines why the trends in relative difficulty arise between the ToK as understanding knowledge and the EE as a means of enhancing knowledge. Chapter 9 examines the implications of these results for international learning in the context of international education.

Chapter 10 summarizes the findings and makes recommendations, with reference to each hypothesis, that are directed to supporting the EE as a means of enhancing knowledge and the ToK as a means of understanding knowledge. Suggestions are also made for teachers, professional development, and the IBO.

1.12 Chapter summary

An awareness and understanding of knowledge and its enhancement are seen as key outcomes for education in contemporary knowledge based societies. The capacity to convert information to knowledge, to change and enhance it, and display this knowledge in a range of ways is a key component of a knowledge based society.

Two subjects, the ToK and EE, are essential to the IB Diploma and have the potential to develop an explicit understanding of knowledge and of knowledge enhancement. The ToK is intended to lead students to improve their understanding of knowledge while the EE develops their ability to research, organise and enhance knowledge. These cognitive
learning outcomes are the products of instruction and student supervision associated with the EE and ToK.

This study assumes that student achievement in completing the ToK and EE is supported by an arrangement of learning and motivational processes that act as a frame of reference guiding student thinking. Higher quality outcomes are associated with particular combinations of learning factors used in a self-regulating and self-managing way.

The outcomes of this research have implications for instruction and pedagogy in subjects similar to ToK and the EE. More broadly this investigation can add to our knowledge of the extent to which formal studies assist students to learn explicitly about understanding knowledge and knowledge enhancement and use and how this can be improved. Strategies for optimising the effectiveness of teaching programmes that assist students to manage and direct their learning more efficiently will be identified. At the broadest level it can contribute to the re-conceptualisation of instruction and curriculum that improves student understanding of knowledge and their ability to research, organise and enhance it.
Chapter 2
A knowledge of knowledge

2.1 Overview

Students begin school with a set of beliefs that knowledge is certain, objective and passively received, then move on to recognise that knowledge is less certain, complex, and constructed and understood in the context in which it was generated. Students acquire an understanding of knowledge through their experience of school, and in particular, student participation in the ToK and EE that alters these beliefs further in a transformative way.

This chapter examines the nature of knowledge from the perspective of learning theory. It is suggested that these learning factors may interact differently with the development of an understanding and enhancement of knowledge. Three models are chosen that are relevant to an understanding and enhancement of knowledge, and that represent the changes in models of knowledge over the last fifty years. Anderson’s Adaptive Control of Thought Model (ACT*) cognition for higher level processing, was used to explain higher level cognitive processes such as problem solving and decision making. Sternberg’s Theory of Successful Intelligence assesses the ability to recall and recognise information, and the analytical abilities, to understand and enhance knowledge, while Gardner offers a more holistic understanding of individual potential and talents. The role of schemata in problem finding and creativity, solving and domain learning will also be examined.

2.2 Knowledge defined

Research in cognition and learning places much significance on the construct of knowledge, and explanatory power of the learning factors relevant to knowledge. In explaining cognitive processes reference, ‘implied or otherwise’, is made to an individual’s existing knowledge. There is a growing appreciation of the effect of culture and context on knowing and knowledge (Lave, 1988; Rogoff, 1990; Saxe,
1991), which has lead to an understanding of knowledge as ‘… complex, multidimensional, fallible, and dynamic’ (Alexander, 2000), that can affect both processes and outcomes.

An individual’s knowledge has been shown to be aligned to their perspectives and perceptions (Alexander & Dochy, 1995, Pichert & Anderson, 1977); student academic achievement (Ackerman et al., 1997; Stanovich, 1986); problem solving (Alexander et al., 1988; Reimann et al., 1996; Weinstein et al., 1986); openness to convincing arguments or evidence (Murphy, 1999; Petty et al., 1986); judgements of consequence or relevance (Jetton et al., 1997; Stahl, 1991); learner motivations, including goal setting and self-efficacy (Bandura, 1993; Meece et al., 1993; Pintrich et al., 1996); comprehension and memory (Alvermann et al., 1985; Anderson et al., 1977); and search for knowledge as a goal in itself (Alexander, 1997).

In the area of cognition, the meaning of knowledge is implied rather than explicitly stated. In a review of terms used to designate knowledge constructs (Alexander, Schallert & Hare, 1991), only ten per cent of journal articles explicitly defined the term ‘knowledge’, and thirteen percent provided a definition of ‘prior knowledge’. For researchers in the area of cognition and literacy, knowledge was commonly referred to as ‘an individual’s stock of information, skills, experiences, beliefs and memories’ (Alexander et al., 1991). Knowledge in this sense is portrayed as a conceptual scaffold, idiosyncratic, a base for ensuing learning that filters one’s experiences through school and beyond, that a person believes or knows to be true whether it is verified or not in some objective way (Alexander, 2000). This definition contrasts with epistemology where ‘knowledge’ is used as justified true belief, and for universal or absolute truths, while in the area of cognition knowledge ‘encompasses all that a person knows or believes to be true, whether it is verified as true in some sort of objective or external way’ (Alexander et al., 1991).

To study knowledge, a working definition that allows us to observe knowledge is required. I propose that knowledge is the body of information possessed by a person, a group of people, or a culture. It is the mental components that result from any and all
processes, innately given or experientially acquired. Knowledge is a person’s representation of the world consisting of:

1. Conceptual knowledge;
2. Factual information;
3. Processes;
4. Attitudes and beliefs (Munro, 2002).

Conceptual knowledge is the internal, cognitive representation of objects which have shared attributes or properties. It is the mental representation(s) of the concept which eventually determines the behaviour. Conceptual knowledge is what the ideas mean and how they are related to other ideas. This knowledge is used during learning to recognise an idea and categorise and classify that idea, to know when to use that idea, to understand ideas and their relationship with other ideas, and to transfer and generalise our knowledge. Conceptual knowledge in this sense allows the recognition, understanding and interacting with the objects perceived.

Factual information is information about the world that is represented as consciously known. More broadly, information can be thought of as any input, an idea, image, fact or knowledge that counts as information. It is de-contextualised and requires manipulation. The phrase information is used here to quantify the assortment of items or objects in terms of the choices that can be made in converting this information to knowledge. Any operation that is an element of organising, coding, storage, retrieval, decoding and interpreting of information requires cognitive processes that include thinking skills, interpretation, evaluation, problem creating and problem solving among others. A contemporary understanding of the word, attitude, encompasses the notion it is the disposition or manner we believe or think about a person, a situation or an event. Attitude requires an internal affective orientation, which is evaluative and conative to explain the behaviours of a person. This generally assumes a consciously held belief (Reber & Reber, 2001).

This study focuses on the academic learning, the understanding of knowledge and the conversion of information to knowledge in the context of the ToK and EE. The focus of
the ToK course is on understanding knowledge, while the focus of the EE is on changing and enhancing this knowledge.

2.3 Types of knowledge

Learning involves understanding and changing what we know. A student receives information not seen before, makes sense of this information and uses this information to change and enhance their knowledge, displaying it in various ways. Key issues relating to the storing of this information in terms of its meaning, are how the information is coded, secondly, how information is stored and most effectively accessed, and thirdly, how students should be taught to use episodic memory to build semantic networks. Students can represent knowledge as declarative knowledge that can be further broken down to semantic, episodic and conditional knowledge. Representing knowledge in this way is to organise and prioritise it.

Declarative knowledge is knowledge about the world that is represented as consciously known or factual knowledge. It is knowledge about which a person can make a declaration, the ability to identify and recall factual information, sometimes described as ‘knowing what’ (Anderson, 1983; Alexander & Judy, 1988). Declarative knowledge, or as it is sometimes known, conceptual knowledge, is knowledge about ideas and how these are related to other ideas and understood.

Episodic knowledge, is a form of declarative knowledge where knowledge is stored in terms of where, when and how it was learnt. It allows learners to recognise that a new situation is similar to an earlier experience, and that knowledge relevant to that experience may now be relevant in this new situation or event. Additionally, it decides how to proceed, through the transfer of procedures from previous experience to the new situation, but not requiring information to be re-organised in a significant way. The limitation of episodic knowledge is its incapability to explain, evaluate, summarise, synthesis or analyse.
Semantic knowledge or knowledge of meanings where information is coded and stored in the form of words, concepts or propositions, on the basis of information received and stored in the long term memory. This knowledge is more abstract and not linked to particular experiences, rather combining concepts into networks. The higher levels of semantic networks are defined by its culture through its language. Conditional knowledge is knowledge of when and where knowledge, declarative and procedural knowledge, could and needs to be applied.

More complex learning leads to process or procedural knowledge, the ability to act on declarative knowledge. Procedural knowledge maps into motor actions or mental actions. Procedural knowledge is knowledge about how to do something, knowledge that is practical or operational, and lies behind complex actions that are characteristically acted out, often without conscious thought, having being automatized. Declarative knowledge permits the knower to behave strategically through conditional knowledge, the ability to decide when to attempt particular procedures. Conditional knowledge or strategic knowledge, is knowing when and how to access the requisite facts or procedures (Alexander & Judy, 1988).

In this study the focus of the ToK course is on forming an understanding of declarative knowledge, while the focus of the EE is on changing this knowledge, an examination of the procedural knowledge required to effectively enhance knowledge. It is assumed that skills and knowledge are developed through the ToK and transferred to the new task in the EE where procedural knowledge is used for knowledge enhancement. It is in this procedural overlap, with skills and knowledge understood in one learning environment and applied to a new task, that schemata are built.

2.4 Why a knowledge of knowledge matters

As learners develop in their cognitive ability and the construction of meaning, greater complexity in student thinking and conceptualisation of domain specific content transpires, reflecting the interaction between them and their environment. A key aspect of this development requires qualitative change to student thinking and the
conceptualisation of context-specific domain content. Crucial to this development is the realisation that learner perceptions’ of how knowledge itself is viewed, affects their thinking and learning. As Ramsden (1988) noted, ‘… that the learning difficulties experienced by new college students were not rooted in their lack of motivation, their study skills, or their ability; they sprang from their view of knowledge itself’.

Conceptually, it is persuasive that students have an understanding of knowledge, as daily learners make knowledge judgements, judgements concerning knowledge claims, knowledge perspectives, and the use of knowledge in solving ill-structured problems. Evidence exists to the association between epistemological understanding and the thinking displayed in everyday reasoning (Kuhn et al., 2002, p. 134). This was suggested (Kuhn, 1991) in a study of argumentative reasoning skills that also assessed epistemological understanding with adolescents and adults, and further confirmed in a study of juror reasoning and reaching a verdict judgement (Kuhn et al., 1994; Weinstock, 1999).

This study seeks to examine the learning factors that influence an understanding of knowledge. ToK is central to the educational philosophy of the International Baccalaureate, challenging student and teacher to reflect critically on the different ways of knowing and areas of knowledge, encouraging students to become aware of the complexities of knowledge. As a course of study, TOK seeks to develop a student view of knowledge that consequently affects their thinking and learning.

2.5 The Adaptive Control of Thought Model (ACT*)

The ACT* is an influential model of cognition for higher level processing, a conceptual tool for describing knowledge at a point in time and for understanding how knowledge can expand, focusing on the memory processes. The ACT* adopts a unitary approach, assuming ‘… that all higher-level cognitive functions can be explained by one set of principles’ (Anderson, 1983, p. 2). The central issue is what gives thought its direction and what controls the transition from thought to thought. Basic to the ACT* structure is
the distinction between declarative and procedural knowledge that interacts in complex
cognitive processes.

Declarative knowledge encodes factual knowledge while procedural knowledge
encompasses cognitive skills, including problem solving. Declarative knowledge is
represented by cognitive units while procedural memory is modelled in the form of
production or action rules that encode the problem solving operators (Anderson, 1993).
It is assumed that when a learner arrives at the situation where no plausible solving
problem operators can be found, the learner, will by analogy, seek a similar problem
situation (Anderson & Thompson, 1989), interpret this problem situation, encode the
procedure through knowledge compilation and solve the question or issue through the
influence of this corresponding problem state (Anderson, 1993).

These productions, control cognitive behaviours and specify a conjunction of features
that must be true of declarative memory, specifying a set of temporary structure(s) to be
added to memory. All knowledge begins in declarative form and is interpreted through
general procedures. Procedural knowledge is learned by making deductions from
existing declarative knowledge which provides the context for cognitive processes to
occur. The ACT* model supports three types of learning, first, where productions
increase their range of applications, second, discrimination, where the range of
applications become narrower, and third where productions are strengthened through
being applied more often. The ACT* has been used to explain a range of memory
effects and higher level cognitive processes such as problem solving and decision
making (Anderson, 1993, 1997), language learning and programming (Anderson, 1983,
1990) and used as a basis for intelligent tutoring (Anderson et al., 1987).

The assumption made in the ACT* model is that knowledge can be represented as
declarative and procedural, and for this study the framework of cognitive architecture
provides the means for an understanding of how cognition is stimulated and the use of
memory in higher order thinking skills. The problem solving methods, as outlined in
ACT* theory, provide the means of understanding the cognitive behaviours for the
conversion of information to knowledge (Anderson, 1993).
2.6 Sternberg’s Theory of Successful Intelligence

Sternberg’s Triarchic Theory of Intelligence (1980), or expanded theory of successful intelligence (2005), defines the notion of intelligence in a more complex way. In this definition, intelligence is, ‘… 1) the ability to achieve one’s goals in life, given one’s socio-cultural context; 2) by capitalizing on strengths and correcting for weaknesses; 3) in order to adapt to, shape, and select environments; and 4) through a combination of analytical, creative and practical abilities’ (Sternberg, 2005). This construct of intelligence recognises the differences between individuals through the goals they may select, their strengths and weaknesses within their pattern of ability, and that changes in their environments occur over their lifetime, with a broad range of intellectual and academic abilities and skills not easily measured with current testing instruments. These tests, in relation to memory, assess the ability to recall and recognise information, and analytical abilities, all of which are added to over a lifetime.

Sternberg’s theory of successful intelligence assumes an underlying set of processes that are common and hypothesised to be universal. Through this set of processes, knowledge is described (see Figure 2.1) and the learning processes that transpire within this framework. The theory comprises of three sub-theories, first, a componential sub-theory specifying the information processing components (or mental mechanisms of an individual’s internal world) underlying intelligent behaviour; second, an experiential sub-theory that deals with the novelty and automatization of information processing; and third, a contextual sub-theory which connects intelligence to the external world through the constructs of adaptation, shaping and selection.
2.6.1 The Componential or analytical sub-theory

The componential or analytical aspect specifies the information processing components. Knowledge is used to gain information and to process and analyse this information. The meta-components or executive processes recognise the existence of a problem, define the character of, and the strategies needed to solve the task, monitor the solution and evaluate the solution to the problem once it has been solved. This aspect uses a learner’s stored linguistic, nonverbal, logical-mathematical knowledge and abilities, while the monitoring and evaluation of the solution uses meta-cognitive processes or strategies, which are used to generate task performance behaviours. The context for these processes is general and domain specific knowledge. Meta-components are a major reason for individual differences in general intelligence as many aspects of
academic behaviour necessitate meta-componential functioning to guide them (Sternberg, 1980).

Performance components execute the instructions, or plans and strategies, of the meta-components. That is, the meta-components direct performance components as to what to do, and it is the performance components that execute the instructions (Sternberg, 1987). Knowledge-acquisition components are used in learning new information, and how to solve problems or to acquire declarative knowledge (Sternberg, 1985). The encoding process selects relevant information, assimilates and organizes this information to a usable cognitive structure, compares this information to old information and produces a solution to the problem in the context of the learning creating new knowledge (Sternberg, 2005). This provides an understanding of knowledge enhancement in the EE process.

The education of students has been more concerned with problem solving, not in problem finding. There is a need to develop student ability to understand and define the nature of the problem to be solved. Students in the upper secondary level of school, have not learnt the appropriate meta-components, or executive skills, in problem definition and solution processes.

### 2.6.2 The creative or experiential sub-theory

The experiential sub-theory posits how well a learner responds in a task or situation. It is based on the assumption that there are two broad classes of abilities associated with intelligence, novelty and automatisation. Components operate within the context of the learner’s past experience and applied to new situations that differ in terms of the degree of familiarity. The task or situation confronting the learner, if new, or a familiar task in a new situation, requires the use of one’s ability to deal with novelty. Familiarity with the task or situation is the result of experience, giving the learner an automatized response in terms of information processing strategies and task performance. Dealing with a novel situation requires dependence on past experience and the use of information processing strategies being adapted to the new situation. The processing of
information can be viewed as an experiential continuum ranging from a point of novelty to full automatisation. The measure of intelligent behaviour is the extent to which a learner approaches and responds to a novel situation. Skills, such as reading, can progress from being a novel task to being more or less automatic, enabling a greater availability of mental resources for higher level tasks such as comprehension. In this way, past information and knowledge can be used to create new processes, procedures enabling the opportunity to be creative.

The experiential sub-theory is relevant to the enhancing of knowledge in the EE, where students are confronted with a novel situation and the processing of information in a context that is teaching innovation.

2.6.3 The contextual sub-theory

According to the contextual sub-theory knowledge is used in a culturally discreet way, aligned to the situation or life experience. This application to life experience can occur in three ways, by adapting to an environment, shaping an environment, and selecting a new environment (Sternberg, 1984). Sternberg (1984) conceptualises these process as hierarchical stages. In the first instance a learner endeavours to adapt to their environment through self-modification of their cognitions and behaviours with the aim of achieving a match between their needs, interests and motives and their situated environment. If this adaptation is unsuccessful then the learner will attempt to shape or select a new environment. In shaping one’s environment, the aspects of self are not altered, but efforts are made to alter the environment in which the learner operates. Should this fail, then an alternative environment that has greater alignment with a learner’s interests, skills, and ability would be chosen. In this situation, intellectual development occurs through the component interactions that lead to contextual adaptation.

These processes are applied to diverse tasks and behaviours, depending on whether the situation:

… requires analytical thinking, creative thinking, practical thinking or a combination of these kinds of thinking. In particular, analytical thinking is
invoked when components are applied to fairly familiar kinds of problems abstracted from everyday life. Creative thinking is invoked when the components are applied to relatively novel kinds of tasks or situations. Practical thinking is invoked when the components are applied to experience to adapt, to shape, and select environments. One needs creative thinking skills and dispositions to generate ideas, analytical skills and dispositions to decide if they are good ideas, and practical skills and dispositions to implement one’s ideas and convince others of their worth.

(Sternberg, 2005)

Sternberg’s triarchic theory of successful intelligence has many components and is complex in structure. It provides a multifaceted understanding of intelligence that recognises individual differences in which the learning processes occur within a framework of three sub theories, specifying the behaviours that connect intelligences in the ToK and the EE tasks through adaption, shaping and selection.

2.7 Gardner’s Multiple Intelligences theory

Gardner’s (1983) theory of multiple intelligences offers a more holistic understanding of individual potential and talents. He hypothesised that human intelligence is composed of at least seven relatively independent competencies which may work together in a number of different ways according to innate abilities, experiences and culture. Gardner (1994, p. 577), defined intelligence, as the ‘… biopsychological potential that is drawn on within a culture for a variety of purposes’, such as solving problems. Gardner proposed these intelligences appear in areas such as; verbal-linguistics, logical/mathematical, spatial, musical, body/kinesthetics, interpersonal and intrapersonal. A further two intelligences have been added since the model was initially theorised, naturalistic and existentialist (Gardner, 1993). Gardner believed that a unitary concept of intelligence was an inadequate measure of an individual’s ability, which varies from culture to culture. What was valued in one society was of little relevance in another, while the instruments of measurement were themselves limited in their design and capacity to interpret the true performance potential. Gardner believed that most Western societies continued to emphasize the linguistic and logical-mathematical intelligences in their formal curriculum, ignoring students with dominant abilities in one or more of the other intelligences. For the purposes of this study, verbal-
linguistic, mathematical/logical and spatial intelligences will be considered as important
foci in this investigation.

The verbal linguistic intelligence is displayed by people across cultures, encompassing
the use of words, spoken and written. This representation of intelligence concerns the
use of language and one's understanding of words and properties of language. While
some display a rudimentary facility with communication, others display skills with
reading, writing and oratory through to competence in the learning of foreign languages.
This requires high verbal memory and recall, and the ability to understand and
manipulate syntax and structure.

Logical-mathematical intelligence is the cognitive faculty of mentally processing with
logic, abstractions, inductive and deductive reasoning and numbers. This area has less
to do with mathematical ability but rather reasoning capacity, abstract pattern
recognition, thinking and investigative ability and the talent to execute complex
calculations. This suggests that logical ability is not only correlated with mathematical
ability where symbolic logic plays a significant role, but may be more closely related to
verbal-linguistic intelligence, where skills of constructing arguments based on logic
becomes more noteworthy.

Spatial intelligence focuses on the role of visual imagery in creative problem solving.
Gardner theorised that within spatial intelligence there are a number of capacities that
include an ability to accurately perceive the visual world, to manipulate and transform
mental images based on these perceptions, and to recreate internalised objects without
the aid of external stimuli. This allows for a range of abilities associated with visual
perceptions, proposing a close link between the expressions ‘visual’ and ‘spatial’, but
where spatial intelligence can function without visual intelligence.

Gardner argues that spatial capacities play a part in a number of areas, presenting
evidence of the value of personal orientations in a variety of situations. Examples used
by Gardiner to illustrate the role of spatial capacities, include the need to identify scenes
and places for navigational purposes, in more subtle ways, interpreting the feelings
represented in a picture, and in its use of metamorphic terminology with the imaging of scientific data, as in the case of an atom being represented as a small solar system. Other experimental evidence suggests that spatial capacities are functional when creating new visual images. Gardner acknowledged the importance of spatial intelligence as the preferred means by some for the solving of problems through the manipulation of mental images, while for others the logical-mathematical or verbal linguistic intelligences play an important part in the understanding and enhancement of knowledge, as is being examined in this thesis.

Gardner (1983) also argues the relevance of culture in the development of intelligence and the differing values that cultures place on the intelligences. By placing differing emphasis on differing types of intelligence and the associated tasks, culture gives the motivation to value the skills in that area, resulting in differing societies prioritising these intelligences in alternative ways.

2.8 The role of schemata

Bartlett (1932) hypothesized that memory is organised around schemas that hold recognizable and memorable stories or situations. These schemas are stimulated when confronted with a new situation, assimilating the new information into cognitive structures that constitute the basis for building a picture of knowledge. In Bartlett’s theory, schemata hold and organise past experiences and guide the recollection of these. Unusual elements in a new situation or event that do not fit existing schemas are changed to fit more closely to the existing schemas. The adaptation of new information occurs in the encoding of this information in memory, so some elements are lost or modified in the ‘new’ schema. Piaget (1952) further developed the idea of schema, to include not only cognition but also action, tying schemas to behaviour. Modification of schema is the result of ‘assimilation’, repetition, recognition and generalisation (Piaget, 1952 p. 257). With numerous repetitions of situations or events, individual schemas become generalised, and have greater applicability to an increased range of situations and experiences. With greater stimuli, schema become more generalised, but discrimination is also developed, and consequently recognition and discrimination
become part of the schema. Thus a schema, both structures an experience and is structured by that experience (Mandler, 1985, p. 36). Thus individuals work with and in their environment, constructing their own perceptions as new experiences are assimilated into existing schemas and adapted and accommodated to the constraints of those experiences. In this way an internal representation of the world; an organization of concepts and actions that can be revised through new information about the world, is developed by individuals. Both Bartlett and Piaget argued a holistic view of schema, that schema as a memory structure originates from various experiences or situations and directs the learner’s response to further environmental stimuli, providing a conceptual outline of what schemata are.

In cognition schema plays an important role, where it is assumed that schemata have a common structure or form, encompassing memory which is highly organised, arising from experience that may or may not be part of schema knowledge, and that schema capture the essence of a concept, situations or experience (Gick & Holyoak, 1983; Kieras, 1992; Minsky, 1975; Rumelhart, 1975; Schank, 1975).

A schema, as defined by Marshall (1995, p. 39), ‘… is a vehicle of memory, allowing organisation of an individual’s similar experiences in such a way that the individual

- Can easily recognise additional experiences that are also similar, discriminating between these and ones that are dissimilar;
- Can access a generic framework that contains the essential elements of all of these similar experiences, including verbal and non-verbal components;
- Can draw inferences, make estimates, create goals, and develop plans using the framework; and
- Can utilize skills, procedures, or rules as needed when faced with a problem for which this particular framework is relevant’.

Schemata in this sense are mental constructs that recognise patterns or configurations from a previous learned category and specify what category specific procedures are to be used in a new event or experience.
Marshall (1995) hypothesizes four functions to schema instantiation, each with its own knowledge type. Identification knowledge, the function of which is pattern recognition, is knowledge that recognises a situation, event or experience. Elaboration knowledge, that is primarily declarative in nature, specifies individual experiences with abstractions that describe these experiences. It is postulated that verbal and visual information is stored here. Marshall (1995, p. 51) argues that schema do not fit neatly into either category of declarative or procedural knowledge, ‘… instead transcends both of them’. Identification and elaboration knowledge provide a framework that allows a learner to create a tentative hypothesis about a situation and test it. The hypothesis forms as a result of recognising a situation or event, through the application of the identification of knowledge. Elaboration knowledge is used to evaluate the hypothesis and determine the sufficiency of evidence in recognising or not recognising a situation. Planning knowledge is a way of thinking, and refers to schemata that make plans and goals, recognising that a schema may be used in a distinct problem-solving situation. This schema is updated and added to with use. Execution knowledge, or procedural knowledge, ensures the action or performing of a skill, being shared among many schemas.

Students begin the ToK course with domain specific knowledge, not having considered their role as a ‘knower’, the ‘ways of knowing’ and the interconnected nature of knowledge, what knowledge is, how knowledge is gained, linked and synthesised and understood. Schema enable an understanding of how students in the ToK course organise the mental constructs’ that recognise patterns or configurations from previously learned categories and specify what category specific procedures are to be used in a new event or experience in understanding knowledge.

2.8.1 Schema in problem finding/creating

In the various subject domains one of the objectives of good teaching and learning is to develop student understanding of finding or creating a problem or question. There is little research into the role of schemas in student problem creating or finding in an academic context, the problem to be researched and communicated in the form of
writing. In the EE, the problem being formed is the construction of a hypothesis or question for a subject domain that requires the formation of schemas around this idea or event, and the interfacing of multiple schemas in creating or finding this problem. The creating of a schema is underpinned by prior knowledge, which is the foundation for constructing new schemas in creating or finding a hypothesis. Prior knowledge provides the store or background information that is necessary, but not the only condition for learning. In constructing new schemas it is postulated that a learner will abstract general properties from previous relevant situations such as previously used skills and procedures and apply these modified schemas to the new situation. These abstractions become an essential part of the schema in forming a hypothesis or question.

2.8.2 Schema in Problem solving

An important pre-requisite for problem solving is the development in the learner of abstract problem type schemata for successful problem solving (Gick & Holyoak, 1983; Reed, 1993). This requires representations of familiar examples or principles from problem categories that share underlying solutions which can be applied to unfamiliar problems.

In identifying a problem with a known problem category, the schema is retrieved from the memory, instantiated with the specific information to the presented problem and the category specific solution procedure is attached to the schema to produce a solution to the problem (Gerjets et.el, 2004). This bears similarity to ‘… several groups of researchers (who) have shown that students try to find out what ‘type’ of problem is presented and then to use a solution strategy appropriate for that type’ (Mayer, 1981). To facilitate schema construction, opportunity must be given to process diverse problems that share similar goals (Chen & Siegler, 2000; Gick & Holyoak, 1987), in various learning situations. This facilitates subsequent classification of novel situations or events (Elio & Anderson, 1984; Fried & Holyoak, 1984), encourages transfer of performance across problems (Gentner, 1983; Reed & Evans, 1987), and enhances the refinement of essential information among problems, and with transfer between problems (Gentner & Gunn, 2001; Markman & Gentner, 2000). The assumption in
schema theory is that problem solving schemas are formed through induction as a result of experiencing instances of numerous general principles or rules (Chen et al., 2004). Dealing with situations that have similar goals or solution principles, but different contexts, enables transfer.

There are many aspects to problem solving, including recognition of the problem, whether created or found, creating a mental model linking the situation to an internal representation, making goals and subgoals to solve the problem and implementing the plan to achieve a solution. Answers to the questions arising from schema based problem solving are found in Marshall’s (1995) four knowledge areas. Recognition of the problem is served through identification knowledge. Elaboration knowledge enables the linking of the problem to the schema, and the creation of a mental model specifying the key elements of that model. Planning knowledge enables the schemata to make plans and goals, while execution knowledge ensures the performance of a skill or action between the various schemas.

Analogical reasoning allows the learner to make use of abstractions and previous instances that create a schema, forming a cohesive pattern and allowing the schema to function. In this way a learner can include current experiences with previous experiences and develop the elaboration knowledge of a schema.

2.8.3 Domain learning and schemata

In the formal teaching of subject domains, an aim is to develop a student’s understanding of the abstract principles and procedures used to solve problems in that subject area and apply these principles and procedures to new analogous problems. Research suggests that from analogous problems, abstract principles and procedures can be obtained and represented independently of that abstract information (Reeves & Weisberg, 1994). This allows for the development of schemata as a ‘… wide range of problem–specific factors such as the content domain of the problem, superficial or surface elements of the problem, and the problem-solving context play an important role in the development of schemas’ (Bernardo, 2001). Evidence from various studies
suggest the effects of problem content on the retrieval of source problems for analogical problem solving (Blessing & Ross, 1996; Novick & Holyoak, 1991), that content may affect domains to varying degrees (Bassock & Holyoak, 1989), that content can affect the mapping process between the source and target analogous problem (Bassock, 1990; Bassock, Chase & Martin, 1998) and content can affect both experienced and expert problem solvers (Blessing & Ross, 1996; Novick, 1988). These results suggest that aspects of the content of the problem and problem solving episode, is retained in the memory representations developed after analogical problem solving.

2.9 Chapter summary

These models and theories indicate there are at least three frameworks to conceptualise and develop an understanding of knowledge and its enhancement. Anderson’s ACT* theory of cognition, Sternberg’s triarchic theory of intelligence (1980), and Gardner’s multiple intelligences serve as unique ways of understanding the role of ToK as a means of understanding declarative knowledge and the role of procedural knowledge in the enhancement of knowledge through the EE.

Schemata are stimulated when a student faces a new situation, assimilating new information into cognitive structures that enable the recognition of these new experiences as similar or dissimilar in a framework that can draw inferences, create goals and develop plans using the framework. It is argued that schemata play a role in problem finding, problem solving, and domain learning, and have a particular significance for this study.
Chapter 3
ToK and understanding knowledge

3.1 Overview

An understanding of knowledge is increasingly being recognised as a significant issue, and with an increasing interest in knowledge management, it can be expected that school curricula will need to examine ways of fostering an understanding of knowledge.

This chapter examines the purpose of the ToK, and the implied view of knowledge proposed within the ToK course. The ToK is central to the educational philosophy of the International Baccalaureate, challenging student and teacher to reflect critically on the different ways of knowing and areas of knowledge, encouraging students to become aware of the complexities and limitations of knowledge. Student views of knowledge developed through the ToK essay and presentation are examined in the context of epistemological models and the role schema play in the development of an understanding of knowledge.

3.2 The purpose of ToK

The Theory of Knowledge course is a compulsory requirement for all IB Diploma candidates (IBO, 2002a, p. 5). The course was proposed and adopted at the Sevres Conference (France) in 1965, embodying the IB vision of a course of study that unified knowledge and reflection for students participating in its programme (Doll, 2002, p. 1, 20; Peterson, 1987, p. 28). One of the creators and founders of the IB, and associated with designing the ToK curriculum, Alec Peterson (1972), argues the original concept of ToK was not only to encourage students to understand the links between the various domain subject areas, but also to make explicit the different ways in which knowledge is created or the associated methodologies with these domains.
Jerome Bruner, expressed the rationale for introducing ToK in this way:

… Teaching specific topics or skills without making clear their context in the broad fundamental structure of a field of knowledge is uneconomical in several deep senses. In the first place, such teaching makes it exceedingly difficult for the student to generalise from what he has learned to what he will encounter later. In the second place, learning that has fallen short of a grasp of general principles has little reward in terms of intellectual excitement. The best way to create interest in a subject is to render it worth knowing, which means to make the knowledge gained usable in one’s thinking beyond the situation in which the learning has occurred. Third, knowledge one has acquired without sufficient understanding to tie it together is likely to be forgotten. An unconnected set of facts has a pitiable short half-life in memory. Organising facts in terms of principles and ideas from which they may be inferred is the only way known of reducing the quick rate of loss of human memory.

Bruner, as quoted in Peterson, 1987, p. 48

Thus the ToK course was conceived as a central and unifying element, representing a means to understand and connect between the different subjects, encouraging students in a wide range of ‘ways of thinking’. Peterson goes further:

The intention of the course was to help students think about questions which underlie the nature of knowledge as presented in the school disciplines and his (or her) daily life, about such questions as the grounds for accepting as valid a proposition in logic, in mathematics, in physics, in sociology, or in history; as the importance and limitations or quantification in different academic disciplines; as the basis and interrelation of moral, aesthetic and religious beliefs.

Peterson, 1987, p.48

Again, (IBO, 1996), the ToK seeks to ‘… develop a personal mode of thought … (and) … a coherent approach to learning which transcends and unifies the academic subjects and encourages appreciation of other cultural perspectives’ (p. 2).

More recently (IB World, September 2007), Nicholas Alchin, Chief Examiner for the ToK expressed its value in this way:

In any curriculum, students need to develop critical thinking skills or higher order thinking skills to distinguish between good and bad reasoning. In ToK, we develop these skills, not in isolation but in the context of how they are used in academic subjects and in the wider context of the world. So as well assessing the course via a traditional essay, students are assessed on their ability to identify and analyse a case study from the ‘real world’ to show their understanding of knowledge issues.
There’s also a second, equally important aspect to ToK. The intellectual tools mentioned are double-edged, and so we want students to develop more than powerful minds; we want them to adopt affective dispositions. Among these are a willingness to challenge our own convictions, to entertain opposing views charitably and to hold ourselves to the same intellectual and moral standards to which we hold others. Central to this is the notion of perspectives; that as limited humans our perspective is always one among many. Our perspectives may be ‘the right one’, ..., or it may be just one we picked up from the culture into which we were born. Either way, we have a duty to examine our own perspectives, to compare them to those of others, and to see what we can learn from this. In our increasingly pluralistic societies, this shouldn’t be a rarity, but an automatic reaction.

Alchin, 2007, p. 17

ToK is a unique course with no model or equal in Australia, or in overseas curricula (Doll, 2001, p. 4). The early days of the IBO saw the ToK curriculum stating what the ToK is not about, rather than what it stood for (Doll, 2001, p. 44, 45; IBO, 1994). The ToK Guide (1994) maintains the course is not a philosophy or an epistemological subject although these issues will be confronted, and is not a review of the various ‘-isms’ such as rationalism or empiricism. In the ToK Guide, 1999 (and 2006), there is a clear and detailed description of the ‘Nature of the Subject’ (ToK Guide, 1999, p. 3, 4), followed by the ‘Aims and Objectives’ (ToK Guide, 1999, p. 5). For the purposes of this study I have used the ToK Guide 1999 as the basis for discussion, as the achievement data collected for the ToK oral (ToKO) and ToK essay (ToKE) were assessed in terms of the criteria as outlined in this handbook.

The ToK Guide (1999), places the student at the centre of ‘The ToK Diagram’ as the ‘knower’, reflecting critically on the areas of knowledge, the ways of knowing and the role of knowledge. More specifically, the aim of the ToK programme is to engage students ‘… to reflect critically on diverse ways of knowing and areas of knowledge …’, and ‘to recognise the need to act responsibly in an increasingly interconnected world’ (IBO, 1999, p.3). The course encourages reflection and questioning of the bases of knowledge, to critically examine why knowledge claims are important and evaluate these beliefs and knowledge claims. Interdisciplinary connections are made across the Ways of Knowing and Areas of Knowledge and the interpretative nature of knowledge is examined. An understanding of the strengths and limitations of individual and cultural perspectives are developed.
Knowledge is understood as playing a central role in the global society and is viewed as expanding, progressively more specialised and fragmented, unpredictable, and complex (IBO, 1999, p. 3). Knowledge can be made sense of by asking questions such as, what counts as knowledge, how does knowledge increase, what limits there are and who owns knowledge, what is the values of knowledge and what are the implications of having or not having knowledge (IBO, 1999). The ToK develops a student’s understanding of knowledge, through their organization of concepts and actions that are revised through new information, and expanded by them as they build a picture of knowledge.

Two central questions are asked in relation to knowledge. The first is ‘… How do I, or how do we, know that a given assertion is true, or a given judgement is well grounded?’ These assertions or judgements are termed ‘knowledge claims’ in the ToK schema (IBO, 1999, p. 3). The second central question arising from the first relates to the ‘the problems of knowledge’ or the difficulties arising in answering the first question. These ‘problems of knowledge’ refer to the assertions or judgements made and the possible biases and uncertainties in approaching this knowledge (IBO, 1999, p. 3). Consideration is given to the methods of verification and justification, consistent to the area(s) of knowledge being considered.

The Areas of Knowledge are the subject areas or disciplines into which knowledge is frequently classified. These areas include Mathematics, Natural Sciences, Human Sciences, History, The Arts, and Ethics (IBO, 1999, p.6, 7). Each area of knowledge can be viewed as an application of the ways of knowing (perception, language, reason and emotion) and shaped by the methodology particular to that subject or domain area. With each area of knowledge there is a series of questions which seek to examine the rationale of knowledge classification in that domain area, and to further clarify and challenge. The questions proposed intend to stimulate student reflection on the understanding of knowledge. These questions cover the definition of the domain area, methods of gaining knowledge in that area, knowledge claims and values relevant to that domain and questions that reflect the nuances of that subject. Each area of
knowledge is preceded with a short introductory paragraph commenting on the nature of that domain and its relationship to the subjects in the IB subject groupings (IBO, 1999, 16–29).

Through questioning, students build up an understanding and picture of declarative knowledge, of what ideas mean and their relationship to other ideas in the various subject domains. Conceptual knowledge in the ToK is used in various ways, first, to categorise and classify different ideas. The ToK course specifically suggests that students question existing subject divisions which are regarded in the course as being arbitrary and to understand the strengths and limitations of ideas in the different area of knowledge (IBO, 1999, p. 16). Second, in recognising when to use an idea, students become aware of the interpretative nature of knowledge. In recognising when to use ideas, an understanding of personal and ideological biases is developed that exist in the bases of knowledge (IBO, 1999, p.8, 9). Third, explaining links between ideas develops a students’ conceptual knowledge through making interdisciplinary connections, and through the ways of knowing (IBO, 1999, p. 30-34). Finally, the transfer and generalisation of this knowledge is encouraged by developing a cultural perspective on ideas and the ability to demonstrate an understanding of knowledge at work in the world (IBO, 1999, p. 9). In the ToK, concepts are combined to form more general and more abstract concepts. There is a requirement to place ideas into categories, to change the boundaries of these concepts and transfer knowledge to new situations. Knowledge in the ToK course is treated as teaching declarative knowledge.

3.3 ToK and the concept of knowledge

An important aspect of the ToK course is the reluctance to define the notion of knowledge explicitly, but rather develop an implied understanding of the meaning of this construct. The descriptive view of knowledge as suggested by the ToK Guide (IBO, 1999), is one of growing ‘complexity’ in an increasingly ‘interconnected world’, with a diversity of ways of knowing. Different kinds of knowledge exist for which knowledge claims are made that require justification. Knowledge is divided into particular subject domains for the purpose of conceptual clarity, these subject divisions,
according to the ToK syllabus, being contestable (IBO, 1999, p. 16). In forming a view of knowledge, students reflect critically on the ways of knowing that help form this knowledge and the role it plays.

The ToK course, in building an understanding of knowledge, encourages students to reflect on and discuss knowledge issues focusing on:

1. What knowledge is (IBO, 1999, p.3);
2. How knowledge is changed (IBO, 1999, p. 16, 17, 18, 20, 21, 22, 24, 27);
3. The context for knowledge (IBO, 1999, p. 3);

From these discussions, students are encouraged to develop their own understanding and definition of knowledge, and in so doing, ‘... develop a critical capacity to evaluate ... knowledge claims’, and be aware of ‘... the interpretative nature of knowledge’ (ToK Guide, 1999, 5).

3.4 Assumptions underlying the ToK course

To examine the assumptions underlying the ToK course, a focus group of experienced ToK teachers was established to discuss the nature of these issues. The discussion was open ended and consensus was reached on the view that the ToK course was predicated on the following:

- That knowledge is a human construct;
- The means to understanding how knowledge is constructed in the ToK course is reason. Recognition is given to emotion, language and perception as alternate WofK;
- Knowledge is generated by the academic disciplines (AofK) and can be interpreted from the perspective of practical knowledge through the use of examples;
• All one’s faculties, reason, emotion, language and perception, are used for generating knowledge;
• A cross disciplinary understanding of knowledge is developed. Without ToK, students would gain a fragmented view of knowledge;
• An ongoing focus of the ToK is the integration of AoIFK within the Diploma course.

These form the basis for the spirit of enquiry that underlies the ToK course.

3.5 Relationship of ToK to Diploma subjects

The curriculum model for the IB Diploma requires students to select a subject from each of six different groups, the visual representation of the curriculum model being commonly known as the ‘IB Hexagon’ (Figure 1.1, IB Hexagon). The IBO seeks to offer a pre-university course of study that is ‘rigorous’ and ‘… designed for highly motivated secondary school students’ (IBO, 2000). The expectation is at the end of two years of study, an IB Diploma student would be able to, through:

1. Group 1, Language A1. Relate to their national identity, through a study of their native language or mother tongue, literature and culture (IBO, 2002a);
2. Group 2, Second language. Be able to communicate, in a range of contexts and purposes, to a group of people other than their own language area (IBO, 2002a);
3. Group 3, Individuals and societies (humanities). Understand the rudiments of human behaviour (IBO, 2002a);
4. Group 4, Experimental sciences. Inquire scientifically into the physical sciences, develop collaborative learning skills through an interdisciplinary group project, and cultivate an awareness of moral and ethical issues and sense of social responsibility (IBO, 2002a);
5. Group 5, Mathematics. Have a deepened understanding of Mathematics as a discipline, with a greater confidence in the use of mathematical language (IBO, 2002a);
This programme has the strengths of a traditional liberal arts curriculum, with three additional features in the centre of the hexagon curriculum model, the ToK, EE and CAS.

As explained in Chapter 1.3, ToK is regarded as the essential element designed to unify the IB programme and provide coherence to the Diploma. The ToK diagram is a visual representation of how knowledge is viewed within the IB Diploma curricula, the areas of knowledge being subject or domain fields into which knowledge is often classified. The ToK curriculum develops an understanding of the nature of knowledge, and more specifically, the areas of declarative knowledge, with linking questions.

These ‘linking questions’ are provided within the ToK Guide (1999), enabling interdisciplinary connections to be made between subject domains, and to ‘… challenge the division of knowledge into areas’ (IBO, 1999). The intention of the ToK course is not to deliver the content which is taught and assessed in the six groups of the IB hexagon, but rather ‘to engage students in reflection on, and in the questioning of, the bases of knowledge’ (IBO, 1999). This methodology enables a variety of approaches in developing an understanding of knowledge.

As the ToK course guides states, ‘Questions are the very essence of ToK, both ageless questions on which thinkers have been reflecting for centuries and new ones, often challenging to accepted belief, which are posed by contemporary life (IBO, 1999, p. 3). The ToK seeks to develop a student understanding of knowledge and in the context of this study, more specifically, declarative knowledge.

3.6 Assessment in the ToK

The assessment of the ToK essay (externally assessed) and ToK presentation (internally assessed) centre on the ‘problems of knowledge’, matters relating to the uncertainties and biases in approaching and understanding knowledge and the verification and justification of this knowledge in the different domain areas (3.1, ToK Assessment
Descriptors). A significant proportion of the mark in both tasks relates to the quality of analysis and the development of ToK thinking skills. Students are encouraged to draw on the IB subjects being studied and from their own experiences for appropriate examples that reflect a high degree of cultural diversity.

The student understanding of knowledge is assessed in the ToK through the selection of an essay from a choice of ten, the prescribed titles being generic questions about knowledge and cross-disciplinary in nature. The chosen title is not intended to be treated in the abstract, but related back to ‘real life’ knowledge issues, where arguments are justified and relevant and counter claims and original examples cited to illustrate the arguments. The oral presentation is chosen by the student (with teacher approval), or assigned by the teacher (IBO, 1999, p. 40) and may be on any topic relevant to the ToK course, provided it can meet the demands of the criteria. Students are required to write a self-evaluation report on their presentation that requires reflection and comment on such things as the way in which the chosen topic addresses the problems of knowledge and reaches truth or gains evidence for the position taken, the main objective of the presentation and aspects of the oral relating to the presentation, its organisation, ability to be thought provoking among others (IBO, 1999, p. 40).

Both tasks are ill defined problems in the sense of being open ended and requiring a student response that uses evidence, expert opinion, reason, argument, evaluation and synthesis of material to be examined in the light of the issue chosen. There is no procedure that can ensure a correct or absolute solution. The solution for both assessments is constructed by integrating or synthesising diverse data and opinion, making judgement about arguments and evidence that may originate from different and imperfect sources, and developing and arguing a reasonable viewpoint as the solution (Kitchener, 1983). This ‘reasonable viewpoint’ is one that the student creates as a ‘best fit’ with current knowledge of the issue, or is redefined in such a manner that differing perspectives are synthesised into a new framework.

For the ToK, Criteria A descriptors for the essay and oral presentation are similar in intent with students assessed in terms of their recognition and understanding of what is
termed ‘knowledge issues’, an examination of the ‘problems of knowledge’. The central question posed in the ToK course is the extent to which one can know that a given assertion is true or judgement well grounded (IBO, 1999, p. 3). Such assertions or judgements are termed ‘knowledge claims’, and the difficulties in addressing these questions are known as the ‘problems of knowledge’. The ToK requires the application of this central question to different and inter-related topics or issues. Criteria A seeks to evaluate this student outcome. In the selected essay topic, the prescribed title implies a problem(s) of knowledge which must be recognised and understood and ‘…maintained throughout the essay’ (IBO, 1999, p. 45), while in the oral, the topic chosen by the student must also recognise and understand the problem(s) of knowledge, but develop these ideas in a relevant and imaginative way(s), a reference to the candidate’s original thinking.

Criterion B, quality of analysis, requires critical reflection and analysis in addressing the problems of knowledge relevant to the chosen essay and oral topic. The essay requires the analysis and treatment of counter claims to demonstrate critical reflection, while the oral places emphasis on critical reflection in the divergent points of view on the chosen topic. Both the essay and oral require arguments that are logical, the main points justified and evaluated. While the essay entails an acknowledgement of the implications of these arguments and the identification of counter-claims, the oral necessitates a treatment of divergent points of view, with an appreciation of personal viewpoints, values and biases.

There is a divergence in the requirement for criterion C which tests the breadth and links with the different Ways of Knowing and different Areas of Knowledge in the essay while the oral calls for an application of ToK thinking skills in relation to a contemporary issue. These skills align closely with the skills required for criterion B in the oral. The intent is to ensure that the abstract nature of this aspect of the ToK programme are applied to a contemporary issue.

Criterion D has similar requirements for both the essay and oral, where the intention is not to assess linguistic skills, but rather the degree to which the main ideas are clearly
and coherently structured and conveyed. Additionally, the essay requires the distinction and clarification of concepts with an effective and coherent conclusion. The essay has two further descriptors, Criterion E, which requires examples to support the presented arguments, these examples reflecting ‘a high degree of cultural diversity’, and Criterion F that tests the candidate’s ability to make factually accurate statements and cite sources to enable the tracing of these ideas.

A student’s understanding of knowledge is an integration and synthesis of the above outcomes. The present investigation examines the learner factors that influence a student’s construct of knowledge.

### 3.7 A knowledge of knowledge

An area of growing interest is the significance and role of cognitive development and epistemological beliefs (Hofer & Pintrich, 1997). In the ToK Guide (1999), the consideration of how beliefs are formed is an objective of the course, ‘… candidates should be able demonstrate an understanding that personal views, judgements and beliefs may influence their own knowledge claims and those of others’ (1999, p. 5). In the aims of the ToK course there is a requirement to ‘… engage students in reflection on, and in the questioning of, the bases of knowledge, so that they: become aware of the interpretative nature of knowledge, including personal and ideological biases’ and ‘understand the strengths and limitations of individual and cultural perspectives’ (IBO, 1999, p. 5). The 2006 ToK Guide aims to ‘… develop an awareness of how knowledge is constructed, critically examine, evaluated and renewed, by individuals and communities’, and later, ‘… encourage an interest in the diversity of ways of thinking, … and an awareness of personal and ideological assumptions’ (2006, p.5).

These explicit statements in the Aims and Objectives (IBO, 1999, 2006), require a consideration of how beliefs are formed, and are points of emphasis in epistemological models, including Perry (1970), King & Kitchener, (1994) and Schommer, (1990, 1993), and the significance of Conceptual Change Models in the learning process.
Further, many of the same views and phrases used in the ToK language appear in these epistemological models.

The role of epistemic beliefs, or individual beliefs about the nature of truth and knowledge and its justification has gained in importance since the influential work of Perry (1970). Perry (1970) postulated how students interpreted the ‘pluralistic intellectual’ environment of university leading to a theory of student development in their ‘knowing and valuing’ (p. 14). Researchers have tended to posit models that are structural with a predictable sequence in student epistemological growth (Chandler, 1987; King & Kitchener, 1994). Students initially hold simple and dichotomous views of knowledge, becoming more complex and relativistic, that develop further with a focus on the evaluation of different points of view (King & Kitchener, 1994). This research has further investigated thinking and reasoning processes as part of epistemological awareness (King & Kitchener, 1994; Kuhn, 1991), examined the dimensions of epistemological beliefs (Schommer, 1990 & 1994), and began to assess the relationship of these beliefs to other cognitive and motivational processes (Butler & Winnie, 1995; Ryan 1984 a, 1984b; Schommer, 1990, 1993).

While there is little agreement on the construct under investigation, the dimensions encompassed, and whether these beliefs are domain specific (Hofer & Pintrich, 1997), the intention is to examine these issues in the context of the ToK course. Consideration needs to be given to how a student’s understanding of knowledge can occur.

3.7.1 Conceptual change

Conceptual change models of learning (Hewson & Hewson, 1984; Posner, Strike, Hewson & Gertzog, 1982), tend to rely on a domain specific view of individuals’ schemata in the learning process, analogous to the features of change in scientific methodology. Learning is described as the interaction between the students’ experiences and their current conceptions and ideas. A framework for interpreting and understanding gathered information is created through current conceptions, which can produce a problem for the student, where a divergence exists between experience and
current beliefs. The current conceptions or understandings provide the framework for judging the legitimacy and sufficiency of solutions to these problems. This can lead to a dilemma for the student, where current conceptions can oppose conceptual change, but simultaneously provide the framework whereby the student can interpret and understand possible conflicting information.

The learning process in this model depends on the degree of integration between new information and the students’ current conceptions. If a novel situation or event is faced, the new information can be easily assimilated with existing ideas (Posner et. el., 1982). In contrast, if a student has well developed concepts about the situation or event, these concepts and understandings may be in conflict and contrary to what is regarded as true by experts in that domain. Such ideas can be resistant to change and require a transformation of the student’s conceptions or framework. In this situation, where ideas are in conflict and referred to alternative frameworks, accommodation of ideas and concepts occurs (Posner et. el., 1982). The process of assimilation and accommodation is directed by the principle of equilibration where students seek a balance between internal conceptions and new information in the environment (Pintrich et. el., 1993).

The process of accommodation relies on prior conceptions of knowledge, and enables the conceptual development of learners. Current conceptions can influence a learner’s view of new information and have several implications (Posner et. el., 1993). First, concepts exist in inter-related networks and a change in one concept will shape how other concepts are viewed. A change in conceptions can lead to a divergence between current conceptions and a learner’s current view of information, suggesting that significant consequences can exist if conceptual change does not occur. A second implication is that learners hold certain representations or beliefs about knowledge which act as a foundation for what can or cannot be true or the validation of an explanation of a problem whilst incorporating new information into a learner’s conceptual framework. This can influence whether conceptual change occurs or not. Third, there is the prospect of ideas in new information competing for the same conceptual niche. In this situation the idea that is accepted will be the one that most
closely conforms to the student’s prior conceptions and beliefs about the nature of knowledge and truth.

For accommodation to occur in the conceptual change model, four conditions must be met. These conditions are taken from an examination of change in scientific paradigms, and applied by conceptual change theorists to individual earning (Posner et. al., 1982). The first condition for conceptual change requires student dissatisfaction with current conceptions, that is, current beliefs are no longer adequate, and this therefore will encourage a student to consider alternative understandings and ideas. Second, that new conceptions must be intelligible to the student. For a student to consider and accept a new conception as better than the one currently held, implies an understanding by the student. The third condition for the student is to find the new concept plausible, understandable, relevant and applicable for conceptual change to occur. The fourth condition is the new concept must appear to be fruitful, that is the new beliefs lead to further learning, suggesting new areas for investigation. This model for conceptual change, with the associated conditions, suggests an approach to how learners might come to change their understanding of knowledge (Pintrich, et. el., 1993).

Alternative views to knowledge structure coherence in conceptual change models can be found in the work of Clark (2006), diSessa, Gillespie & Esterly, (2004); Harrison, Grayson & Treagust (1999), and Linn, Eylon & Davis (2004). This approach hypothesizes that multiple conceptual elements form naive knowledge structures. These conceptual elements consist of phenomenological primitives, facts, concepts and mental models at differing stages of advancement and complexity (Osdemir & Clark, 2007) which, according to the learning situation, are stimulated and activated. In this conceptual change process the interactions between the various conceptual elements lead to the revision, removal and creation of new elements that occurs in a gradual and uneven process rather than the broader knowledge as theory perspective (Osdemir & Clark, 2007).

While the conceptual change model suggests a way for students to assimilate and accommodate new information, it assumes ‘a rational process of cognitive change’,
which fails to satisfactorily consider self-efficacy beliefs, motivational beliefs, the extent of self-determined behaviour and the extent to which context and the interaction between student and teacher can influence change (Pintrich, et. el., 1993). It is contestable that students approach classroom learning in a rational manner, as many have social goals (Wentzel, 1991) and for those focusing on academic achievement, adopting mastery goals leads to greater cognitive engagement, while focusing on performance grades in academic tasks can result in additional surface processing and less cognitive engagement (Dweck & Leggett, 1988; Pintrich & Schrauben, 1992). Kruglanski (1990) suggests that individuals goals towards knowledge will also influence their knowledge acquisition and Hofer and Pintrich (1997) point to the need for studies into the more affective side of epistemological development.

While there are significant limitations to the conceptual change model in explaining learning in the classroom and in particular, the ToK, it provides a useful means for examining the process involved in student understanding and representation of knowledge.

### 3.7.2 Issues in epistemology

Piaget (1950) in his theory of intellectual development initiated an interest in developmental psychologists to the juncture between psychology and philosophy. Epistemology is concerned with the nature and justification of knowledge from a philosophical view, and the interest of psychologists and educators have been the issues of how individuals come to know, theories and beliefs that students hold about knowing, and the extent to which epistemological assumptions influence the cognitive processes of thinking and reasoning (Hofer & Pintrich, 1997).

In Table 3.1 a two-part framework is proposed by Cunningham and Fitzgerald (1996, p. 41), for identifying epistemological viewpoints of either personal or theoretical outlooks on knowledge. It consists of three general issues in epistemology: what constitutes or counts as knowledge, where knowledge is located and how knowledge is attained. Within each general issue, seven more specific problems are posed as questions, each
with a continuum along which epistemologies will differ. This framework provides a
means of examining theory and practice of fundamental philosophical issues. A striking
feature is the similarity between this framework and the ToK Guide, ‘Nature of the
Subject’ (1999, 2006).

Table 3.1: Seven Main Issues and Three Overriding Concerns in Epistemology

What counts as knowledge?
1. Can we have knowledge of a single reality independent of the knower?
2. Is there such a thing as truth?
3. What primary test must proposed knowledge pass in order to be true?
4. Is knowledge primarily universal or particular?

Where is knowledge located?
5. Where is knowledge located relative to the learner?

How is knowledge attained?
6. What are the relative contributions of sense data and mental activity to
   knowing?
7. To what degree is knowledge discovered versus created?

Table from Cunningham & Fitzgerald, 1996, p. 41

In Appendix 3.2 (Seven Main Issues and Three Overriding concerns in Epistemology
compared to ToK Guide, 1999), the knowledge issues raised by Cunningham and
Fitzgerald in the above Table 3.1 are compared to the ToK Guide,(IBO, 1999), by
heading and page number. There are varied approaches to the teaching of ToK, and in
the ToK Guide (IBO, 1999, p. 30 – 34), an approach is suggested through what is
termed ‘Linking Questions’, that raises the issues and concepts central to the course.
The course does not, as such, seek to provide answers or a position on these
epistemological issues, but seeks to ‘… engage students in reflection on, and in
questioning of, the bases of knowledge, …’ and in so doing, develop the students ‘ToK
thinking skills’. The key element in terms of this course is the justification of the
student’s view, and an awareness of the problems of knowledge associated with this understanding.

The first overriding epistemological concern of what constitutes knowledge is raised in the ToK course (IBO, 1999, p. 3, 8, 9, 16, 33). In considering the first issue, ‘can we have knowledge of a single reality independent of the knower’, the ToK syllabus raises this question as ‘… whether knowledge comes from inside or outside? Do we construct reality or do we recognise it’ (IBO, 1999, p. 8), and later, ‘is knowledge even a ‘thing’ that that resides somewhere?’ Importantly, the syllabus provides no direction in answering these questions, but rather poses more questions. The second and third issues, ‘is there such a thing as truth’, and ‘what primary test must proposed knowledge pass in order to be true’ is at the heart of the ToK syllabus. These questions can be traced back to the Sophists in ancient Greece, issue three placing students at the heart of current epistemological debate. While there is general agreement on the notion of there being a truth, what constitutes truth is not a settled issue. Methods of verification and justification of the ‘problems of knowledge’ in the different areas of knowledge is an essential requirement in the course. While holding to a permanent and absolute truth may be contestable, an evaluative discussion takes place on the usefulness of the truth tests of coherence, correspondence and pragmatism in determining knowledge (IBO, 1999, p. 33). Issue four, ‘is knowledge primarily universal or particular’, has most philosophers from antiquity seeking universal knowledge, while some epistemologists argue that all knowledge is knowledge of particulars or instances. This issue is not directly dealt with, within the ToK course, but hinted at when considering whether knowledge claims transcend different communities or cultures (IBO, 1999, p. 9).

The sources of knowledge are not dealt with from an epistemological view point where dualism, monism and pluralism are central issues. The ToK course (IBO, 1999), takes a broader view challenging teachers and students ‘to reflect critically on … the areas of knowledge’ (p. 3), and raising questions such as: the extent to which a distinction can be made between individual and group or community knowing(p. 8); in what sense, if any, can a machine be said to ‘know’ something (p. 9); are the arts a kind of knowledge, or are they a means of expressing knowledge (p.24); what are the justifications for, and
implications of, claiming that there are absolute standards for morality, or that the standards of morality can be set only by a society, or that standards of morality can be set only by the individual (p. 27); among other questions. These questions tend to be peripheral to the main epistemological issue, but never the less led into this area.

The question of how knowledge is attained and the two sub issues are directly engaged with by the ToK course. Issue six concerning the relative contributions of sense data and mental activity to knowing are dealt with through the ways of knowing (p. 10–15) and knowledge claims. Epistemological responses to this question have varied where a view exists that verifiable propositions from observed phenomena could be called knowledge, to the other extreme that the world is understood and interpreted through different beliefs, cultures and language, where there is no independent criterion for deciding if one understanding is more compelling and legitimate than another (Fitzgerald & Cunningham, 2002, p. 214). The ToK course merely raises these issues without taking a specific stance.

The degree to which knowledge is discovered or created is examined extensively from a ToK ‘point of view’ in knower and sources of knowledge (p. 8) and methods of gaining knowledge. The possibility of subjectivity and cultural biases in the creation or discovery of knowledge is recognised with the question, ‘How is knowledge gained? What are the sources? To what extent might these vary according to age, education or cultural background?’ (IBO, 1999, p. 8). A series of questions exist for the methods of gaining knowledge in the differing IB group or domain areas which highlights these issues and those of subjectivity and objectivity.

The ToK moves beyond the above model in directly challenging the accepted subject divisions with definitional questions that require discussion on the kinds of knowledge included in the category for example, of human sciences and whether it matters that this Area of Knowledge is called a ‘human science’ or ‘social science’ (IBO, 1999, p. 20). The ToK course also considers the relationship of the domain areas with values, in some cases technology, and specific knowledge perspectives with domain areas, all in the
‘spirit of enquiry and exploration’, enabling learners to develop an understand of knowledge.

Knowledge as discussed in this analysis is examined as declarative knowledge, the internal, cognitive representation of the areas of knowledge and ways of knowing which have shared attributes or properties in the Anderson (1983) sense. It is these mental representations that are the concepts which eventually determines’ the mental behaviour through a process of assimilation and accommodation.

3.7.3 What knowledge of knowledge do students have?

Students are generally perceived as beginning with a view of knowledge that is certain, objective and passively received and moving towards a view of knowledge where ideas are less certain, characterised by greater complexity, beliefs are justified on a probabilistic basis, and knowledge is actively constructed and understood in the context in which it was generated. There is a presumption that these beliefs about knowledge affect one’s learning experience, with recent evidence suggesting that the stage a student is at plays a part in assisting conceptual change, and the organisation of scientific knowledge in cognitive structures (Bell & Linn, 2000; Elder 2002; Qian & Pan, 2002); and that prior knowledge is an influential factor on the construction of knowledge (Carey & Gelman, 1991; Shapiro, 1994).

Much of the research on epistemological development has presumed a common form of beliefs across domain areas, although present research is suggesting that students may hold different beliefs for different domain areas, such as the natural sciences and psychology (Hofer, 1997 as quoted by Hofer, 1999), and that beliefs in Mathematics can shape behaviour in strong and negative ways (Schoenfield, 1992). This suggests that student beliefs might be developed through classroom learning experiences.

To further examine what knowledge of knowledge students have, King and Kitchener (1994) allowed for the contextual dependencies of student’s beliefs about knowledge and developed the reflective judgement model. This model assesses two aspects of
learner epistemological beliefs, the view of knowledge held on a continuum from being absolute to contextual and subjective, and the justification of these knowledge beliefs.

3.7.4 The Reflective Judgement Model

The Reflective Judgement Model of Kitchener & King (1994) is a framework for studying beliefs about knowledge and the effects of these beliefs on behaviour. There are seven sequential stages of epistemological development, with the focus on epistemic cognition, or ‘the ways that people understand the process of knowing and the corresponding ways they justify their beliefs about ill-structured problems’ (King & Kitchener, 1994, p. 13). Each stage is characterised by its own assumptions with different approaches to the justification of knowledge (Appendix 3.3, Reflective Judgement Model). The model was developed in the context of ill-structured problems, examining the assumptions and reasoning styles of older adolescents and adults.

Ill defined problems are problems about which ‘reasonable people can disagree’ (Kitchener, 1983). This implies that any solution requires judgements to be made on the available evidence and adequacy of arguments (King & Kitchener, 2002, p. 37), which King and Kitchener argue is the outcome and developmental endpoint of their model. In the ToK course, the issues and discussion centre around problems of knowledge and ways of knowing where students can hold opposing and contradictory views. The purpose of ToK is to analyse, reason, evaluate and arrive at a ‘reflective judgement’ or justification of their view on such issues.

The reflective judgement model has seven qualitatively different reflective judgement stages, the focus in each stage being on the student’s view of the nature of knowledge, and the process of justification. Within these seven stages are three levels, the pre-reflective (stages 1, 2, 3), the quasi-reflective (stages 4 and 5), and the reflective (stages 6 and 7). Each stage has an underlying organisation that is different and forms a constant sequence, at odds with alternative views that cognitive development may be sudden and irregular, or that a learner can operate in only one structure at a time.
(Flavell, 1971). The assumption is made that knowledge develops through assimilation and accommodation as the student interacts with their environment.

Those who hold knowledge assumptions in the pre-reflective stage (stages 1, 2 and 3) have the belief that knowledge is gained through an authority figure or observation, is simple and absolute and requires no justification, or if there is uncertainty and answers do not exist, a temporary situation of uncertainty is present where only personal beliefs can be known and defended as personal opinion. This implies that the authorities may not have the truth.

The quasi-reflective thinking stage (stages 4 and 5), recognises that a learner cannot know with certainty and that justification of knowledge beliefs is characterised by reasoning. Stage four is characterised by the view that each person has the right to their own belief, and the justification of these beliefs, while depending on reason, may also be idiosyncratic. Thus knowledge claims have a degree of uncertainty which is explained as missing information or due to the means of acquiring evidence. In stage five, knowledge is perceived as being contextual and relative, as the justification of beliefs is balanced against alternative interpretations. Knowledge is sifted and accommodated, being ‘… limited by the perspective of the knower’ (King & Kitchener, 1994, p. 62).

Stages 6 and 7 are hypothesised as the emergence of reflective thinking. Knowledge is constructed and claims not made with certainty, but this does not restrict reasonable inquiry. At stage 6 the learner constructs knowledge into conclusions about ill-structured problems, drawing on a range of perspectives that are critically evaluated. Stage 7 is characterised by critical thinking and probabilistic justification which guides the process of ‘reasonable inquiry’. During this process students will determine that some evidence and the judgements made will have greater validity than others, and that conclusions represent the most reasonable but their adequacy may need to be re-evaluated.
This model links a students’ defence of their point of view in the context of an illstructured problem to their assumptions made about knowledge. Students whose beliefs are derived from authority figures also believe that knowledge exists with absolute certainty. At the other end of this continuum are students whose beliefs were based on their evaluation of the evidence, believed their own perceptions affected the evidence they considered significant and that absolute knowledge claims are dubious, requiring re-evaluation.

The most serious limitation to this model is that the collected evidence suggests that only a small number of those interviewed had reached stages 6 or 7, and this population consisted of advanced graduate students. This suggests that if this is the case, one has grounds for questioning current educational practices if it is deemed that these knowledge outcomes are important developmental issues.

The purpose of ToK is learning about knowledge, to help students clarify their own understanding about knowledge and to recognise and understand what problems of knowledge may exist or be implied in the essay attempted or the oral presentation on a contemporary issue. In recognising and understanding the problems of knowledge methods of verification and justification appropriate to the different domain areas are used, students critically reflecting and recognising the limitations, strengths and weaknesses of the knowledge issues under examination.

For high achievement in the ToK essay and oral presentation, students are required to meet assessment criteria that align closely to stages 6 and 7 of the reflective judgement model. Assessment is in terms of the extent to which students understand knowledge and justification of their view on the knowledge(s). What is less clear is whether the ToK course takes account of knowledge in culture and the extent to which this assessment by students, in a mother tongue other than English, reflects different cultural understandings and justifications of knowledge.
3.7.5 Student representations of knowledge

The integration of knowledge requires meta knowledge, knowledge about one’s own knowledge to enable the integration of knowledge. ToK introduces students to the processes associated with developing a knowledge of knowledge. The subject matter of ToK is conceptualised in terms of knowledge issues. Knowledge issues are examined in the areas of knowledge, a classification of knowledge into identified subject areas. This enables a discussion of knowledge issues or ‘ToK questions’ through the ways of knowing in the context of the academic subjects studied by students. In this manner students develop a knowledge of knowledge.

A student’s knowledge of knowledge may take several forms depending on their underlying epistemic beliefs. A student may assume an objective reality that is absolute and knowable, or alternatively that there is no objective knowledge in this sense. Another approach is to assume that knowledge is the outcome of ongoing critical inquiry (Kitchener & King, 1981). These different assumptions will lead students to examine the nature of the problem and possible solutions available in different ways.

With the ToK, students develop an understanding of knowledge as being the outcome of reasonable inquiry where an essay on generic questions about knowledge and cross disciplinary in nature is treated in terms of domain specific knowledge. Problems of knowledge are recognised and ‘... methods of verification and justification appropriate to the different areas of knowledge’, are required (IBO, 1999). Knowledge claims are argued logically and coherently, justified and evaluated with an effective conclusion. In the ToK oral, candidates must recognise an issue with an appropriate problem(s) of knowledge that demonstrates ‘... the application of ToK thinking skills to a contemporary issue’ (IBO, 1999).

This representation of knowledge assumes students construct a view of knowledge in the context of presented (ToK essay) or created (ToK oral) ill defined problem or issue. Information is sought from various sources, divergent points of view are considered,
values and biases in knowledge are considered and arguments evaluated and justified. Beliefs about knowledge are justified and evaluated on the basis of their implications and an identification of counter claims. This suggests a probabilistic judgement dependent on interpretation, weighing of evidence and a conclusion formed from the most credible and persuasive evidence. The representation of knowledge formed is the outcome of reasonable inquiry.

3.8 Schema and ToK

Understanding knowledge in the ToK is a change process requiring students to reflect on and demonstrate and understanding of the strengths and limitations of the Ways of knowing (W of K) and methodologies used in the different Areas of Knowledge (A of K) and making connections between and across the W of K and A of K. Knowledge is identified and classified in subjects areas according the Diploma Programme (ToK Guide, 1999, p. 6). Schema in the context of ToK is the storing of information in the student mind, how information in the domain areas and connections across domains are selected, perceived, interpreted and built on through class discussion and reflection, to form an understanding of knowledge. Schemas are formed from previously built cognitive structures in the domain area of study, the W of K which retrieve, interpret and react to the external stimuli.

As student’s knowledge of domain areas develops in the preceding years to the Diploma programme, schemas are used for information processing for the formation of subject area knowledge. The accumulation of information and knowledge experiences enables the development of more elaborate schema enabling easier and more effective schemas (Nishida, 2005) in the processing of information.

The ToK is the means to challenge and question the bases for knowledge, W of K and to make connections across domain areas. Conflict between existing schema and new information occurs, leading to assimilation and accommodation, with the new information unable to fit into the existing model of knowledge, requiring schema modification. Students learn to broaden their view to include more information.
variables, building on what they know and extending their schema to an understanding of the strengths and limitations of the W of K, and to the making of connections between and across W of K and A of K.

3.9 Enhancing knowledge

The ToK provides the opportunity for students to form an understanding of declarative knowledge, the meaning of ideas and their relationship to other ideas in the different subject domains. The extended essay provides the opportunity for students to develop a positive disposition to knowledge change and the processes involved in information – knowledge conversion. It enables students to develop a question of hypothesis that is researched and communicated. This process, or procedural knowledge, builds on the understanding of knowledge that students have developed during the ToK course.

3.10 Chapter summary

This chapter has examined the nature and purpose of ToK and the understanding of what is knowledge as developed through this course. Consideration is given to student understanding of knowledge through an examination of the conceptual change model and the Reflective Judgement model. The view of knowledge formed by students through ToK is based on judgement and dependent on interpretation, the weighing of evidence and a conclusion formed from the most credible and persuasive evidence. A cross disciplinary understanding of knowledge is developed and an ongoing focus of ToK is the integration of the AofK within the Diploma Course. The representation of knowledge formed is the outcome of reasonable inquiry.
Chapter 4
Learning factors that influence student enhancement of knowledge through research (EE)

4.1 Overview

The EE enables students to engage in academic discourse and develop intellectual autonomy. It provides the opportunity for students to research critically a specific topic or issue and to communicate the outcomes of this research in a coherent way. The EE has the capacity to help students learn generic strategies for self direction, motivation and management as knowledge generators. Students are encouraged to think creatively and innovatively and to display their change in knowledge in terms of specified parameters.

The EE is a learning environment, where from one of the subjects a student studies, individual knowledge and skills are developed within the structure of that discipline through enhancing knowledge. From that subject students develop a question or hypothesis that is researched. The EE may be expected to assist students to increase their knowledge of how to manage knowledge change and the processes of information-knowledge conversion. The quality of the problem and question/hypothesis is important in the subsequent learning process. A good question/hypothesis is one suitable for stimulating interest, providing opportunities for formulating learning goals and stimulating self-regulated learning.

Completion of the EE requires the coordinated use of a range of learner variables, attitudes to learning, beliefs about knowledge and information and a knowledge of how to convert information to knowledge. This learning activity requires students to have motives or intentions for learning, to frame questions or queries concerning the knowledge, to think through these questions or enquires, to operate as an information processor and to display the outcomes of these investigations.
This investigation examines the learner variables that influence achievement and creativity in extended research projects. It is expected that the relevant learner variables interact differently with understanding and the enhancement of knowledge.

4.2 Theories of creativity

Numerous theories for explaining the emergence of creative outcomes have been proposed (Lubart, 2000-2001). The componential model identifies the components of knowledge necessary for creative outcomes. One of the most influential is that of Amabile (1996, 2001) who comprises three components necessary for creativity:

1. domain relevant skills, ‘… competencies and talents applicable to the domain or domains in which the individual is working’ (Amabile, 2001) that is, relevant to the topic or issue (Baer, 1998);
2. intrinsic task motivation, ‘… an internally driven involvement in the task at hand’ (Amabile, 2001) or to be creative;
3. creativity relevant processes that include thinking strategies, personality characteristics and cognitive styles that promote creativity. These characteristics of Amabile’s theory have been extensively tested (Conti, Coon and Amabile 1996; Ruscio, Whitney and Amabile, 1998).

Other theories emphasize the processes needed for creative outcomes. The theory of creative cognition (Finke, Ward and Smith, 1992), proposes two central cognitive processes that contribute to creativity. First, there are generative processes in which an idea is initially created, and second, exploratory processes in which the idea is examined and evaluated in different ways. Each involves a range of component processes (Sternberg, 1999), with some investigators arguing the need to separate the different domains of creative performance (Baer, 1998; Plucker, 1998; Runco, 1987).

For creative outcomes to occur, these cognitive processes interact with personality and motivational variables and lead to a high level of self-direction and strong sense of autonomy (Deci and Ryan, 2000). Non-conformity, flexibility in thinking and a tolerance of ambiguity, a self initiated drive for closure, a capacity to balance, and to
integrate reality and fantasy, and high level of intuitive thinking, are also needed (Feldhusen, 1995; Csikszentmihalyi, 1985; Eysenck, 1997). It is argued that beyond a certain point, levels of ability become less important than the role played by personality and motivational factors (Amabile, 2001; Winner, 1996).

The models listed in the next section lead to a set of inferences about the instructional conditions most likely to lead to creativity.

4.3 Models of creativity

Necka (1986) strongly argued that the creative act and psychological qualities of creatively gifted people cannot be described or explained by means of a simple model. A more complex view of creativity has grown through the 1980’s and 1990’s (Urban, 1995), where the processes and components that contribute to creative solutions to problems have been developed (Amabile, 1983a, 1983b, 1996; Sternberg, 1988, 1999, 2000; Sternberg & Lubart, 2002; Cropley & Urban, 2000). These models develop the structures of interacting cognitive and personal components of the creative individual, as well as the mutual dependencies of personal and environment in the creative process (Urban, 1995).

Urban’s (1990) components model of creativity specifies the relationships between the characteristics of the learner and the learner environment (See Figure 1). There are six components, each with a set of subcomponents, ‘… that work together for and in the creative process, within a framework of environmental conditions’ (Cropley & Urban, 2000, p. 491). The first three components are cognitive and are:

1. Divergent thinking and acting;
2. General knowledge and a thinking base;
3. A specific knowledge base and area specific skills.

The other three components, representing personality components, are

4. Focusing and task commitment;
5. Motivation and motives;
6. Openness and tolerance of ambiguity.
No single component or subcomponent is sufficient for the whole creative process but works as a functioning system (Urban, 1995). The respective componential structures ‘... are dependent on such factors as the kind of problem, the stage or phase of the creative process, the kind of process in relation to the kind of problem and the respective conditions of micro- and macro environment’ (Urban, 1995).

Figure 4.1 Cropley and Urban Model of Creativity

These components are now developed:

1. Divergent thinking and acting.
   Thinking skills allow the development of creative outcomes (Feldhusen, 1995). These thinking skills require two characteristics,: the need to think in particular ways and knowing the value of thinking in these ways, and being discerning in the use of these ways of thinking. Metacognition is a central aspect of creativity (Davidson and
Steinberg, 1998; Jausovec, 1994), being a key characteristic of planning (Feldhusen, 1995). Creativity is not what one knows but how an individual decides to use what he or she knows (Sternberg, 2000). This view differs from the traditional understanding of creativity as a fixed ability (Guilford, 1968).

Divergent thinking, has been linked to creative thinking since Guilford (1950) and by others (Torrance, 1966, 1999; Urban & Jellen, 1996; Urban, 2002), with its subcomponents of fluency, flexibility, originality, restructuring and elaboration. The starting point for the creative process is ‘problem sensitivity’, the ability to form a problem, to ask questions that others may not ask (Urban, 2002).

2. General knowledge and a thinking base.
A body of knowledge is required for the creative outcome (Baer, 1998; Cropley and Urban, 2000; Amabile, 2001; Urban, 2002). This knowledge for the creative process or product needs to be sufficiently broad to be elaborated, differentiated, indexed and seen as expert (Simon, 2001).

Problem sensitivity and divergent thinking are dependent on ‘… broad perception and general deep knowledge and thinking base’ (Urban, 2002). This need for the processing of information and data and storage in a flexible memory network, are the presuppositions for fluent, flexible and associational thinking (Urban, 2002). Analysis, reasoning and logical thinking is necessary for reconstructing a problem at the beginning phase of the creative process, and ‘… together with critical and evaluative thinking in the final phase, when realisation and elaboration of the creative idea or product comes about’ (Urban, 2002).

3. A specific knowledge base and area specific skills.
Area specific knowledge as a pre-requisite for generating creative ideas and products has been given increasing attention in recent years, as divergent thinking alone will not lead to creative excellence (Urban, 2000). Relevant area knowledge and skills are seen as fundamental to creative ideas (Amabile, 1983a; Hayes, 1989; Urban 1995, 2002).
4. **Focusing and task commitment.**

Acquiring area specific knowledge and skills necessitates a disciplined commitment and persistence. The problem being examined and the connecting domain field is the focus of attention over a long period of time, which is required for ‘collecting, analysing, evaluating, and elaborating information and data’ (Urban, 2000).

5. **Motivation and motives.**

An appropriate motivation ‘… preferably intrinsic in nature’ (Urban, 2002) is a prerequisite (Amabile, 1983a; Hayes, 1989; Urban, 1995, 2002). According to Hayes (1989), motivation is essential in creative achievements, no cognitive variables having been shown to be capable of distinguishing between creative and non-creative individuals. Variations in creativity would appear to have their origins in differences in motivation which leads to cognitive diversity (Urban, 1995). Motivation and cognitive variables together would explain the differences between high and low creative individuals (Urban, 1995).

An additional aspect that interacts with these conditions is the preparedness of an individual to engage spontaneously with these areas of knowledge in a systematic and co-ordinated way. It is inferred that creativity is more likely when he or she has positive beliefs about their ability to be creative, that is, a positive self-efficacy about creativity (Munro, 2002).

6. **Openness and tolerance of ambiguity.**

Openness and tolerance of ambiguity is of importance in the dialectic relationship with focusing and task commitment (Urban, 1995, 2002), the ‘… importance of the change between focused and intense activity and the withdrawal, the taking back of this intensity’ (Urban, 2002). Another subcomponent is the ability to maintain nonconformist behaviour and autonomy in thinking. Playfulness and experimenting are associated with fluency and flexibility (Urban, 2002).

The model emphasizes the interacting and mutually dependent elements of creativity (Urban, 1995). An example of this is that ‘… divergent, associational thinking is linked
with deep domain-specific knowledge, broad open perception, …’ (Cropley & Urban, 2000), which are prerequisites for fluent and flexible thinking (Urban, 1995). Area specific knowledge or special field mastery is ‘… a precondition for generating creative ideas and products, especially for those of outstanding and original, … importance’ (Urban, 1995). A similar position has been adopted by Amabile (1983a, 1996), Feldhusen (1995, 2002), Murphy and Alexander (2002) where area relevant knowledge and skills are fundamental to the achievement of creative products.

Acquiring a comprehensive and thorough area specific knowledge and skills ‘requires disciplined topic commitment and persistence at a high level’ (Urban, 1995). Examining a problem and the associated subject field requires concentration and the ability to select, collect, analyse, evaluate and elaborate relevant information and data (Urban, 1995). Other related subcomponents are the resistance to group pressure which is necessary for non-conformist behaviour and autonomy of thinking, playfulness and the willingness to experiment go with fluency and flexibility (Cropley & Urban, 2000). Each (sub)component plays its role at certain points in the creative process with each component being a prerequisite for and a result of others (Cropley & Urban, 2000).

Bandura (1986), argued that individuals have a ‘self system’ that permits them to employ a measure of self control over their thoughts, feelings and actions. This self system accommodates ‘… one’s cognitive and affective structures and includes the abilities to symbolize, learn from others, plan alternative strategies, regulate one’s own behaviour, and engage in self-reflection’ (Pajares, 1996). Bandura’s representation of human behaviour and motivation in which the belief people have about themselves are key essentials in the use of control and personal organisation. Self-referent thought mediates between knowledge and action, and through self-reflection of one’s own experiences, thinking processes and behaviours are evaluated (Pajares, 1996). This self evaluation includes perceptions of self-efficacy, that is ‘… beliefs in one’s capabilities to organise and execute the courses of actions required to manage prospective situations’ (Bandura, 1997, p. 2).
Self-efficacy beliefs affect a range of features allied with learning. Among these are goal setting (Locke and Latham, 1990; Wood and Locke, 1987), problem solving (Bouffard-Bouchard, 1989; Larson, Piersel, Imao, and Allen, 1990) and academic performance (Bouffard and Vezeau, 1996; Malpass and O’Neil, 1996) across a range of domains (Locke and Latham, 1990; Pajares, 1996). These factors influence self-efficacy through the effective use of self-regulatory strategies, a motivation to achieve, effort, persistence, and perseverance (Bouffard-Bouchard, Parent, and Larivee, 1991; Zimmerman, Bandura, and Martines-Pons, 1992).

Self–determination theory maintains that an understanding of human motivation requires a consideration of innate psychological needs for competence, autonomy and relatedness (Deci & Ryan, 2000). This theory focuses on the extent to which human behaviours are volitional or self-determined, that is the degree to which individuals endorse their actions at the highest level of reflection with a full sense of choice. This becomes significant in the EE and EE where the learner needs to self-manage and direct their learning (Munro, 2001).

4.4 The academic essay

The academic essay requires a clear sense of purpose to persuade readers of an idea or claim based on evidence through argument (Kain, 1999; Rickets, 2001) and in so doing, develop intellectual autonomy (MacIellan, 2004). The focus of the academic essay is on the accessing of information and converting of this information to knowledge, with student interrogation and evaluation of their thinking and reasoning (MacIellan, 2004). The essay is the most common form of assessment in the social sciences, and an important tool for making judgements on student achievement and course progression (Brown, et al., 1997; Freeman & Lewis, 1998).

The writing of an academic essay is a powerful mechanism for knowledge transformation (MacIellan, 2004). It takes the form of drawing on relevant knowledge and experience in preparing for new activities, to consolidate and review new
information and experiences, and to reformulate and extend knowledge (Langer & Applebee, 1987, p. 41).

The context for an academic essay enables students to engage in academic discourse and develop intellectual autonomy (MacIellan, 2004), so equipping them with the conceptual tools required for independent thinking and preparation for participation in a future world that is largely unknown and unknowable (Bowden & Martin, 1998). To prepare students for the future by using current information or knowledge and enhancing this knowledge, thus extends students’ experiences of this world (Newmann & Archbald, 1992).

### 4.4.1 Reflection

A recognised means through which intentional and autonomous learning can occur is through the process of reflection (MacIellan, 2004; Barnett, 1990; Cowan, 1998), and particularly through the process of reflective or transformative writing (Bereiter & Scardamalia, 1987; Moon, 1999). Reflection can be described as a “… cognitive or affective response to some experience with the intention of coming to a revised or new understanding(s)” (MacIellan, 2004). Reflection as a tool for learning depends on it being not only purposeful, but conscious (Boud et. el., 1996; Marton & Booth, 1997), and applied to relatively complicated or formless ideas (King & Kitchener, 1994).

Where the purpose of reflection is revising existing understandings and constructing new understandings requires “… dealing with fuzzy ideas to reconcile ambiguity and inconsistency; to recognise the ways in which one’s current knowledge and understanding are confused, incomplete or misconceived; and to make meaningful (for oneself) that which is disparate” (MacIellan, 2004), reflection can be seen as useful for deep learning (Marton et. el., 1997), organising knowledge at an abstract level (Biggs & Collis, 1982), and activating the skills of self regulation (Ertmer & Newby, 1996).

Reflection in the process of writing is a means of thinking (Nickerson et. el., 1985), not only recording what one knows (Bereiter & Scardamalia, 1987), but also as a means of
learning what one thinks about an issue (Kellog, 1994; Richardson, 1994). This allows the generating, integrating and evaluation of ideas (Langer, 1986; Langer & Applebee, 1987), and the transforming (Bereiter & Scardamalia, 1987) or enhancing of knowledge.

4.4.2 The characteristics of an academic essay

An academic essay demonstrates a high level of understanding with reference to a particular subject (Ricketts, 2001), aims to persuade readers of an idea based on evidence (Kain, 1999) and displays knowledge in the subject area. It can be characterised as:

1. Having an argued position (MacIellan, 2004; Troth & Brunetto, 2002);
2. Use of literature to inform this position (MacIellan, 2004; Duffin, 1999);
3. Use, evaluation and justification of that use of evidence (Harvey, 2006; Troth & Brunetto, 2002);
4. Analysis and synthesis of material (MacIellan, 2004; Harvey, 2006; Troth & Brunetto, 2002; Silber, 2005);
5. Methodology and structure of essay (Kain, 1999; Duffin, 1999; Harvey 2006).

The task of writing reflectively encourages connections to be made between declarative knowledge and procedural knowledge (Yost et al., 2001), allowing further development between the domain knowledge and the processes in writing the essay and skill development. However, the writer must view the writing process as an intentional task that leads to knowledge transformation (Bereiter & Scardamalia, 1987).

The characteristics of the academic essay align closely to the nature and purpose of the EE. The formulation of a research question, the collection of relevant information, the use of literature to inform this position, analysis and argument that addresses the question and a conclusion that is consistent with this argument and evidence. Implicit to the writing process is the need for reflection in revising, organising and constructing new understandings in enhancing knowledge.
4.5 The Stage Model of Creativity

Attention was focused on the process of creativity by Cropley (1997a), taking Wallas’s (1926) phase model as a starting point. Cropley (1997) added to Wallas’s (1926) phases of ‘Information’, ‘Incubation’, ‘Illumination’, and ‘Verification’, the further stages of ‘Preparation’, ‘Communication’ and ‘Validation’ (see Table 1). The phase of Preparation makes the stage of problem finding more explicit, and ‘… Communication and Validation are necessary as without them novelty may be produced, but cannot receive ‘socio-cultural validation’ (Cropley & Urban, 2000).

<table>
<thead>
<tr>
<th>Stage</th>
<th>Process</th>
<th>Result</th>
<th>Motivation</th>
<th>Personality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation</td>
<td>identifying problem</td>
<td>Initial activity</td>
<td>problem-solving drive</td>
<td>critical attitude</td>
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<td></td>
<td>Setting goals</td>
<td>general knowledge</td>
<td>(intrinsic)</td>
<td>optimism</td>
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<td></td>
<td>Convergent thinking</td>
<td>special knowledge</td>
<td>hope of gain (extrinsic)</td>
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<tr>
<td>Information</td>
<td>perceiving</td>
<td>focused special</td>
<td>curiosity</td>
<td>Knowledgeability</td>
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<td></td>
<td>learning</td>
<td>knowledge</td>
<td>preference for</td>
<td>willingness to judge</td>
</tr>
<tr>
<td></td>
<td>remembering</td>
<td>rich supply of cognitive elements</td>
<td>complexity</td>
<td>and select</td>
</tr>
<tr>
<td></td>
<td>convergent thinking</td>
<td></td>
<td>willingness to work hard</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>hope of gain</td>
<td></td>
</tr>
<tr>
<td>Incubation</td>
<td>divergent thinking</td>
<td>configuration</td>
<td>freedom from constraints</td>
<td>relaxedness</td>
</tr>
<tr>
<td></td>
<td>making associations</td>
<td></td>
<td>tolerance for ambiguity</td>
<td>acceptance of fantasy</td>
</tr>
<tr>
<td></td>
<td>bisociating</td>
<td></td>
<td></td>
<td>nonconformity</td>
</tr>
<tr>
<td></td>
<td>building networks</td>
<td></td>
<td></td>
<td>adventournness</td>
</tr>
<tr>
<td>Illumination</td>
<td>recognizing a promising novel</td>
<td>novel configuration</td>
<td>intuition</td>
<td>sensitivity</td>
</tr>
<tr>
<td></td>
<td>configuration</td>
<td></td>
<td>reduction of tension</td>
<td>openness</td>
</tr>
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<td></td>
<td></td>
<td>flexibility</td>
</tr>
<tr>
<td>Verification</td>
<td>checking relevance and</td>
<td>appropriate solution</td>
<td>desire for closure</td>
<td>hardnosed sense of</td>
</tr>
<tr>
<td></td>
<td>effectiveness of novel</td>
<td>displaying relevance and effectiveness</td>
<td>desire to achieve quality</td>
<td>reality</td>
</tr>
<tr>
<td></td>
<td>configuration</td>
<td></td>
<td></td>
<td>self-criticism</td>
</tr>
<tr>
<td>Communication</td>
<td>achieving closure</td>
<td>workable product</td>
<td>desire for recognition</td>
<td>self-confidence</td>
</tr>
<tr>
<td></td>
<td>gaining feedback</td>
<td>capable of being made</td>
<td>(intrinsic)</td>
<td>autonomy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>known to others</td>
<td>desire for acclaim or</td>
<td>courage of one’s</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>reward (extrinsic)</td>
<td>convictions</td>
</tr>
<tr>
<td>Validation</td>
<td>judging relevance and</td>
<td>product acclaimed by</td>
<td>desire for acclaim</td>
<td>toughness</td>
</tr>
<tr>
<td></td>
<td>Effectiveness</td>
<td>relevant judge (e.g. teacher)</td>
<td>mastery drive</td>
<td>flexibility</td>
</tr>
</tbody>
</table>

Cropley & Urban 2000, p. 493
In each stage (column 1) psychological processes (column 2) produce a psychological ‘configuration’ (Simonton, 1988) shown in column 3 that forms the basis of the next stage. The psychological processes are facilitated by the motivational condition (column 4) and personality characteristics (column 5), finishing in a socially validated product (Cropley & Urban, 2000). The process can be finished earlier, if metacognitive processes indicate the current configuration will fail, while the creative process may begin part way through the stages if a student has learned more returns to a previously abandoned configuration, restarting the process (Cropley & Urban, 2000).

Cropley (1997b) emphasized the paradoxical nature of creativity, for example, in the stage of information, convergent thinking and intrinsic motivation may be of greatest significance, whereas in the stage of illumination, divergent thinking, general knowledge and openness might be of principal importance (Cropley & Urban, 2000). This means that pursing a vague notion of fostering creativity may be ineffective, as teachers need to be aware of the aspect of creativity they wish to promote and which particular activity will do this, while students need to understand more specifically the purpose of what they are learning (Cropley & Urban, 2000).

The EE and ToK in the International Baccalaureate are the task format used to study creativity is. Both these tasks allow students to display creativity in the domain area or topic of their choice. The focus of this study is on the processes that students use to produce creative outcomes in these tasks, the learning variables that influence creativity and the extent to which self-efficacy and self-determination are significant in the creative process. To minimise the constraints on student thinking, the domain or topic area would be chosen by the students and to reduce the extent to which creativity was restricted by technical and manual skills, the creative outcomes would be displayed in writing for the EE and orally and in writing for the ToK.

### 4.6 Creative Problem recognition and solving

The EE provides the opportunity for students to research critically a specific topic or issue and to communicate the outcomes of this research in a coherent way. It requires a
question or hypothesis to be created or discovered from one of the domain subject areas that the student is studying, this problem being researched and written up by the student. In the early stages of development the question or the problem is not necessarily stated clearly but is a problem that has been identified in this learning environment requiring mental representation.

4.6.1 Cognition and ‘epistemic cognition’

The cognitive processes underlying the understanding of knowledge in the ToK and the enhancing of knowledge through the EE, are supported by evidence and argument, that these processes play an important role in the reasoning capacity of students in the higher level of secondary school. Researchers (Basseches, 1980; Broughton, 1977; King et. el., 1983; Kitchener & King, 1981; Labouvie-Vief, 1982) argue that student assumptions about knowledge and changes in these assumptions, from an epistemic point of view, underlie their ability to manage conflicting ideas and opinions, issues of logic and reasoning and choice between alternatives. This is critical for achievement in the ToK and EE. This evidence suggests that while cognitive and metacognitive processes begin to form in children at an early age, epistemic cognition appears in late adolescence and may further change in later years.

Kitchener (1983) proposed a three level model of cognitive processing to monitor the epistemic nature of ill-structured problems and problems where opposing and contradictory evidence and opinion exist. Three distinct types of problem skills were identified. In this model well defined problems, those which have correct and knowable solutions, can be solved using ‘cognitive tasks such as computing, memorising, reading perceiving, acquiring language, etc., … on which the knowledge of the world is built’ (Kitchener, 1983). At level two, the metacognitive level, individuals monitor their cognitive progress when engaged in level one cognitive tasks. Metacognitive processes include knowledge about the cognitive tasks, the use of strategies to solve those tasks, when and how these strategies should be used and the success or failure of any of these processes (Kitchener, 1983).
Ill-defined problems require level three skills, and what Kitchener terms ‘epistemic cognition’, the ability of students to reflect on the epistemic nature of the problem, its truth value in terms of alternative solutions and the limits, certainty and criteria of knowing. This notion of ‘epistemic cognition’ is used to explain the student monitoring of problem solving when engaged with ill-structured problems that have no one clear solution. Kitchener clearly distinguishes between epistemic knowledge and the cognitive processes used in solving ill-defined problems and epistemic knowledge concerning the legitimacy of solutions while the latter concerns the processes used to reach these solutions.

Epistemic assumptions play a significant role in a student’s understanding of the nature of the problem, influencing the strategies used to solve the problem. As well-defined problems lead to a single unequivocal solution, arguably epistemic assumptions do not influence the outcome (Kitchener, 1983), but an ill-defined problem that has a number of possible solutions, that cannot be solved without making epistemic assumptions about the nature of knowledge.

Further, Kitchener (1983) proposed that epistemic assumptions differ from person to person, and in this view, different beliefs about knowledge lead to different solutions in ill-defined problems. Some students believe that knowledge is absolute and truth determined with certainty (Chandler et. el., 1990), Kitchener (1983), suggesting an inability by students to consider and distinguish between the possible types of solutions for ill-structured problems. Further, students will assume that their task is to apply the right procedures and ensure a valid and true solution (Kitchener, 1983).

Alternatively a student may understand that absolutely correct solutions do not exist, that some solutions may be better than others, and that more than one perspective on a problem can exist. The quality of the data and reasoning may all influence different available solutions, students assuming the interpretation of knowledge depends on the context in which it occurs (Perry, 1970). Others assume that knowledge and truth only exist in a consensual synthesis of differing world views (Benack & Basseches, 1989).
Solutions to ill defined problems can only be established with conditional certainty in a range of contexts.

The way a student approaches the EE is influenced by his or her beliefs on the nature of knowledge, which has also influenced the ToK tasks and outcomes. An appreciation that students have different belief assumptions about knowledge, which influences their ‘epistemic cognition’ is important in comprehending how students understand and define a problem in the EE, the choice of strategies to solve the problem and the divergent means of justification that students use. This forms part of the problem solving cycle.

4.6.2 Problem solving cycle

Problem solving requires the initiation and engagement of discretionary actions to produce a goal state or outcome (Scandura, 1977). The ‘problem solving cycle’ is a step by step description of problem solving, not proposed as a sequential order, as ‘… successful problem solvers are those who are flexible’ (Pretz et. al., 2003, p. 4).

The stages of the problem solving cycle are represented in Sternberg’s (1985) triarchic theory of human intelligence which proposes that the meta level executive processes or meta components guide the problem solving cycle by planning, monitoring and evaluating this problem-solving process. These meta components incorporate processes such as:

1. A recognition of the character of the problem or task;
2. Defining the nature of the problem or task;
3. Allocation of the mental resources required to finding a solution;
4. Determining how information about the problem should be represented;
5. Planning the approach to solve the problem;
6. Turning this approach into a strategy for a problem solution;
7. Monitoring the problem-solving process or task performance;
8. Evaluation of one’s task performance.

(Kolligian, et. al., 1987)
Problem definition or construction represents a cognitive process that plays a part in creativity and the enhancing of knowledge. The cognitive processes in the EE involve thinking (the ability to reason, explain, evaluate), problem creation, and problem solving that use existing information and to convert that information into knowledge. This process requires the selection from available information, relating new information to what is known and combining the selected aspects of the new and old information, evaluating the novel and emerging arrangements of knowledge, and to selecting and retaining the relevant arrangements which function as new information and creates new cognitions.

### 4.6.3 Problem finding and definition

Getzels (1982), classified the recognition or finding of a problem in the manner of how they were ‘found’. In Getzels (1982) framework, a presented problem is one that is clearly stated and given directly to the solver to be solved. A well defined problem is one ‘… for which there are absolutely correct and knowable solutions’ (Kitchener, 1983). This style of problem has its key features defined by others. There are two implications for well-defined problems. First, there can be only one solution which is established definitively, and second, there is an established procedure which arrives at the solution.

In contrast, ill defined problems, are those ‘… for which there are conflicting assumptions, evidence and opinion which may lead to different solutions’ (Kitchener, 1983). In this situation, there may be an unclear problem statement, leading to difficulty in problem definition and problem representation (Pretz et. el., p. 4). Multiple solutions may exist, or no solutions at all, with no guaranteed procedure to reach a solution. The EE falls into this broad category of ill-defined problems. Within this class of ill-defined problems exists two further types of problems, ‘discovered’ and ‘created’. The discovered problem is characterised by its already existence but has not as yet been clearly represented to the solver. This requires the problem solver to find the ‘hole’ in the current knowledge and to discover and identify the nature of the problem from the information presented. In contrast to the discovered problem is the
created problem, one that does not currently exist but which is invented by the problem solver. Here the nature of the problem and the relevant information generating the problem is defined by the individual (Mumford et. al., 1994, p. 8). In both Mumford et. al. (1994) and Getzels (1982) classifications of problem types, the construction of the problem becomes a more important determinant of performance, particularly as the formation of a hypothesis or question is derived from reasoning rather than observable facts. In this situation students are more likely to use a problem-construction process for discovered and created problems which potentially have a greater impact on achievement.

It is arguable that a created problem can produce a more creative solution as the identification of the problem diverges in thinking from the first two classes of problem types. In a study of artists, Getzels and Csikszentmihalyi (1976), found those artists who spent more time formulating the problem were judged to have produced the more creative art work and over the longer term remained creative.

Of relevance to this thesis is the formulation of a question or hypothesis in the EE. Students are required, with the help of a supervisor, to ‘define a suitable topic’ and ‘formulate a precise research question’ (IBO, 1998, p. 5). There is a clearly stated expectation that a student will not be presented with a problem or question (IBO, 1998, p. 6). The formulation of this question in the EE falls into the above second and third categories, a discovered or created problem.

4.6.4 Problem representation

The problem of construction process is dependent on the mental organisation of prior information known about the problem. The notion of problem representation first proposed by Holyoak (1984), suggests the way in which information known about a problem is mentally organised in ad hoc categories. These categories are constructed to capture four crucial types of information, essential to the problem solving efforts. These are: the goals and outcomes associated with the problem solving effort; the essential information required to define and solve the problem; the strategies to be
applied to this information to solve the problem, and fourth, the constraints placed on
the problem solution (Mumford et. el. 1994, p. 10). By containing this information in
the form of mental representations a student is ‘… able to remember more of the
problem by ‘chunking’ the information, in order to organise the conditions and rules of
a problem to determine which strategies are useful and to assess progress towards the
goal state’ (Pretz, et. el. 2003, p. 6). Solving an ill-defined problem may require several
representations of the problem before an effective or acceptable solution is discovered.

4.6.5 The problem construction process

The problem construction process encompasses the defining of goals, objectives, an
acknowledgement of the limitations of the problem solving process and ‘the context for
the application of other processes involved in creative problem solving’ (Mumford et.
el., 1994, p. 6). This can alternatively be seen as a plan to direct and structure the
creative problem solving effort. In Figure 4.2, Mumford et. el. (1991), present a
hypothesised relationship among core creative processes illustrating the significance of
problem construction. Clearly an effective problem solving process is dependent on the
structure and direction given at the problem construction stage in terms of the processes
and conditions for successful creative problem solving.

The uniqueness of the EE is in the assumption that students can recognise and define a
problem that is amenable to further analysis, research and a conclusion. The solution to
the defined problem is written to criteria with a judgement made on the quality of the
question or hypothesis and creativity. The key issue in the problem construction
process is the identification of a problem, an area where supervisors and students have
little training to search for problems, and where relevant background knowledge is
required with the necessary time to reflect on the problem and its solution.
Figure 4.2  Hypothesised relationships among core creative processes

The difficulty in solving an ill-defined problem is clarifying and being specific about the nature of the problem. As indicated earlier, in ill-defined domains problem construction becomes an important influence on the relevant goals, parameters, required information and appropriate strategies to be used in obtaining a solution, particularly if these are inadequately stated (Anderson, 1985).

Mumford, Reiter and Redmond (1994) present a Model of Problem Construction Operations (Figure 4.3), that proposes an outline of the cognitive processes associated with finding, defining, and representing ill-defined problems. This process would appear to occur in a selective fashion as students are engaged in multiple ongoing activities that require mental space and demands on their attentional resources (Kahnemann, 1972), and requires that students do not spend much of their time in defining problems (Mumford & Gustafson, 1988), or are taught to do so.
While the EE is a requirement of the Diploma, the problem solver or student must recognize a problem through attention to and perception of the cues in their learning environment, such as their interest in a preferred subject and an area within that subject which could lead to a question of interest. Many factors can operate to mobilize the attentional resources that include ‘… the presence of surprising or incongruent cues, the
presence of salient, personally meaningful cues, and a moderate, general level of arousal’ (Mumford et. el., 1994, p. 12). The exact type of perceived stimulus cue will depend on its distinctiveness, relevance, the possibility of a high achievement outcome, prior knowledge and accessible knowledge structures. The particular cues considered relevant and important by the student will significantly influence the nature of the problem constructed (Hogarth, 1986). Of special importance are two aspects to the process of allocating attention and perceiving the stimulus cues. First, the needs and learning situation relevant to the desired achievement outcomes and disparities with the student goals will allocate attentional resources to certain cues (Newell & Simon, 1972), and second, that students are more responsive to stimuli that can be encoded into the working memory because of the applicable knowledge structures (Siegler & Richards, 1982). Students are more likely to focus on this information if it is stimulated by these structures (Fiske et. el., 1983).

Second, the appropriate analogous representations are determined by the role of attention and perception and the stimulus signals or cues from past learning events. The activation of these representations depends on the strength of the association with past cues with the present situation (Holyoak, 1984). As the number of perceived cues increase, there will be an associated increase in the number of activated representations. The EE is a difficult task that requires both complex and diverse representations from prior learning situations, with the achievement outcome wanted, also influencing the activated representations and consequent problem construction (Howe, 1982). Greeno (1977) suggests that not only does prior learning influence problem construction but the structured nature of expert representation will build up associational networks that may activate further representations whose cues may be less directly related.

In the third instance, analogous representations must be evaluated as an ill-defined problem may activate a number of problem representations. This screening strategy may select the most robustly activated representation, which is likely to share many cues in common with the stimulus cue (Mumford et. el., 1994). This strategy is likely to be domain specific with representations analogous to the knowledge and procedures previously used. As the EE can be written in any one of the six subjects a student is
presenting for, he or she may consciously screen problem representations and select a representation for retention. This selection would depend on the decision strategies. Decision strategies may eliminate a representation with a number of constraints or representations with similar goals to the learning situation are retained. Likewise representations that require knowledge similar to an activated representation may be retained, while a representation connected with unreliable operations discarded (Voss et. el., 1980).

This suggests that when selecting a strategy for the EE, elements of the problem representation must be specified for the screening process, which will depend on the previous association of a strongly activated representation. This implies the idea of adequate similarity and dissimilarity with elements of the previous representation to guide rejection or acceptance decisions. What is adequate similarity and dissimilarity as the screening criteria must be defined, which could vary according to the novelty of the domain area and may also be influenced by variables such as values, learning goals, cognitive complexity, flexibility and risk taking (Mumford & Gustafson, 1988).

In the fourth aspect of problem construction, element selection strategy must be applied, which is dependent on the goals and constraints of the problem being defined. It is the elements of the problem representations that will be retained and in turn used to structure the problem and guide the problem solving efforts. The above screening process of representations will have limited the number of elements to choose from the existing problem representations. The nature and number of the retained elements will be affected by features of the student, such as their expertise, openness and tolerance for ambiguity (Mumford et. el., 1994), as well as features of the EE that require the creation of a question or hypothesis, planning and organising relevant to the domain area in which the essay is being written and to be creative (Lissitz & Willhoft, 1985; Owen & Baum, 1985). These retained elements will provide the foundation for information encoding, and information relating to the constraints, crucial knowledge and key procedures are most likely to be retained (Mumford et. el., 1994).
Fifth, the elements of the problem must be represented mentally, these retained features having a degree of coherence, particularly if a student has some domain relevant proficiency. If the question or hypothesis has resulted in a more complex problem solving circumstance and a variety of elements retained, these elements will need to be reorganised into a representational structure. Mumford et. al. (1994) suggest this element reorganisation, while important, is unclear as to how it occurs. It is postulated that the key elements are drawn from various representations that provide the central organisational framework which is extended to incorporate other elements leading to revision and further processing of element relationships. This will result in a plan for problem solving and provides a structure for an ill-defined domain, through the setting of goals, recognising constraints, developing strategies, key information and the procedures and processes needed to solve the problem. This plan may be further revised as a student seeks to develop and enhance their knowledge.

Most ‘real-world’ creative problem solving occurs in situations that are ill-defined or not defined at all. Problem construction can be expected to be of particular importance in these situations, and in the situation of the EE where student academic creativity plays a significant role in the formulation of a question or hypothesis in the EE and then solved. In essence students in this situation should examine a problem from different viewpoints, scrutinize the problem for constraints and search for alternative strategies and goals before problem solving begins (Mumford et. el., 1994).

### 4.7 The nature of the EE process

The nature of the EE process is such that students must be open to identifying the problem, have time to reflect on the problem (Getzels & Csikszentmihalyi, 1976; Moore, 1990), represent the problem (Anderson, 1985) and allow a solution to evolve. Experienced teachers will spend more time in planning and providing solutions to students (Moore, 1990). The ability to effectively represent and solve a problem comes from background knowledge and experience (Hardiman, Dufresne & Mestre, 1989), to plan in advance and coordinate problem solving sequences (Bereiter & Scardamalia, 1987). The implementation of an effective strategy is dependent on the clarity of
problem identification and representation and the use of procedural knowledge (Swanson, O’Connor & Cooney, 1990). The final facet in the process is in evaluating the solution, to self-regulate and reflect on the process and product.

Metacognition, the self-appraisal and self-management of cognition (Paris & Winograd, 1990, p. 17), enhances student performance through being aware of one’s thinking and problem solving abilities when reading and writing. Self-appraisal answers questions such as ‘... what you know, how you think, and when and why to apply knowledge or strategies’ while self management is ‘metacognition in action’, are the mental actions that help ‘... orchestrate aspects of problem solving’ (Paris & Winograd, 1990, p. 18).

Metacognition is a central element to the learning that occurs in enhancing knowledge in the EE. Students who are aware of their metacognitive processes are more strategic than less informed learners Self-management enables students to plan and monitor their learning when identifying and representing a problem, evaluating a plan of action, coordinating problem solving sequences, implementing an effective strategy and monitoring the progress of a solution (Garner & Alexander, 1989; Pressley & Ghatala, 1990). In this sense metacognition acts as a knowledge transformation mechanism in the enhancing of knowledge.

Another aspect to metacognition is transfer, ‘... when a person’s prior experience and knowledge affect learning or problem solving in a new situation’ (Mayer & Wittrock, 1996, p. 48). Here the difficulty is knowing what the prior knowledge and experience is, and its effect on the new learning in the EE process. Mayer and Wittrock (1996) suggest a view of transfer where effective supervision ensures the selection of relevant information, the building of new schema from task information and to the new context.

The role and difference between procedural and declarative knowledge is also acknowledged:

Metacognitive knowledge concerns the declarative knowledge one has about the interplay between personal characteristics; task characteristics and available strategies in a learning situation (Flavell, 1979). This knowledge does not lead automatically lead to an appropriate problem solving behaviour. ... Metacognitive skills, on the other hand, concern the procedural knowledge that
is required for the actual regulation over one’s learning activities. Task orientation, planning, monitoring, checking, and recapitulation are manifestations of such skills. Veenman & Elshout, 1999, p. 510.

This suggests a significant role for procedural knowledge in the problem solving processes for the EE. Procedural knowledge requires transfer of solutions from previous problems to the new situation and for this to be effective, self-appraisal and self-management of cognition is required. The effective use of procedural knowledge in the EE enables a required task to be solved more quickly. The limitation to transfer is the more task specific or dependent the situation, the less a problem can be practiced or the limitations of this approach understood.

The role of writing in learning is seen as a means of reflecting on and reviewing what has been written, functioning as a means of improvement and influencing the direction of ideas (Langer & Applebee, 1987, p. 3). There is growing acceptance of the notion of writing as a means of developing of thinking skills in a context that demands deep thinking (Applebee, 1977; Fulwiler & Young, 1982). This conception of the role of writing can be understood as the revision of ideas that are better executed because ideas are written in a lasting and examinable form; that writing is explicit and must last beyond the immediate context; that writing provides the means of organising and understanding connections between ideas; and that writing provides the means of examining the assumptions and associated issues (Langer & Applebee, 1987, p. 4, 5).

Writing also serves a broader instructional role that promotes learning. Writing provides the means of drawing on relevant prior knowledge (Langer & Applebee, 1987, p. 42); it is the method to appraise and review new information and in particular the learning of subject specific information (Langer & Applebee, 1987, p. 45); and third, enabling the reflection and reorganisation of knowledge being learnt (Langer & Applebee, 1987, p. 49). The evidence from these studies indicates clearly that ‘... writing leads to better learning, .... Writing assists learning’ (Langer & Applebee, 1987, p. 135). These findings also show that writing in focusing on different types of information, can lead to different knowledge being gained (Langer & Applebee, 1987, p. 135). Writing for the reorganisation and extension of knowledge leads to ‘... more complex reasoning’, and writing to enhance student knowledge was most effective
when emphasis was placed on the competency of student thinking (Langer & Applebee, 1987, p. 136, 137). The nature of the writing and the shaping of thinking suggests a progression toward deeper understanding and learning. This further suggests that writing to appraise, review and extend information and the use of prior knowledge in the development of thinking skills, all have a significant role in the writing of the EE.

### 4.8 Phases in the EE sequence

The conversion of information to knowledge can be described in terms of a number of phases or learner interactions (Munro, 2001), as shown in Table 4.2. The participating school in this preliminary study was School 10 (n = 31), with students who had completed the IBD in 2000. Students volunteered to participate in the study once their final examinations were completed. Cognitive task analysis identified a number of intermediate outcomes on the pathway to the completion of the EE.

#### Table 4.2 Phases of the EE

<table>
<thead>
<tr>
<th>Key interaction</th>
<th>Student activity</th>
</tr>
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<tbody>
<tr>
<td>Select, decide your topic</td>
<td>Skim/scan subjects studied, sources of information to see if you are likely to be interested in taking any ones further, challenged by it</td>
</tr>
<tr>
<td>Define, refine what is known re the topic</td>
<td>Unload/collate/assemble what you know about the topic</td>
</tr>
<tr>
<td>Develop action plan to move to goal</td>
<td>Identify the issue or key question</td>
</tr>
<tr>
<td>Imagine what the outcome might be like</td>
<td>Work backwards from the outcome to develop a set of steps</td>
</tr>
<tr>
<td>Access, search for information</td>
<td>Identify key subordinate questions the essay might answer</td>
</tr>
<tr>
<td>Revisit information sources to identify the questions they answer, key, subordinate ideas</td>
<td>Look at the information from different angles for unique perspective, for example, de Bono, analyse it in different ways</td>
</tr>
<tr>
<td>Look at how the topic has been researched/investigated earlier</td>
<td>Identify what they don’t know re the topic; map what they know is relevant and identify ‘holes in the plaster’</td>
</tr>
<tr>
<td>Decide the specific questions you will target</td>
<td>Select and decide the specific questions; ‘dry run’ possible guiding Questions</td>
</tr>
</tbody>
</table>
This study examined students’ perceptions of the comparative difficulty of each phase in the pathway to essay completion and how they dealt with phases judged to be difficult. Students were asked to rate each phase in the EE pathway as easy or hard. These student perceptions are acknowledged as subjective. Students are likely to differ in what they judge to be difficult and in their activity following this judgment. Some may follow a difficult judgment with a temporary cessation of construction activity while others may follow it with sustained activity to alleviate the difficulty (Munro, 2001).

The comparative difficulty of each phase is shown in Table 4.3.
Table 4.3 The comparative difficulty of each phase of the EE

<table>
<thead>
<tr>
<th>Phase</th>
<th>Rank order of difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defining and refining the issue</td>
<td>1</td>
</tr>
<tr>
<td>Deciding the specific questions</td>
<td>2</td>
</tr>
<tr>
<td>Identifying unanswered questions</td>
<td>3</td>
</tr>
<tr>
<td>Accessing, searching for information</td>
<td>4</td>
</tr>
<tr>
<td>Semi-final draft</td>
<td>5</td>
</tr>
<tr>
<td>Selecting a topic</td>
<td>5</td>
</tr>
<tr>
<td>Developing an action plan</td>
<td>7</td>
</tr>
<tr>
<td>Assembling, collating information</td>
<td>8</td>
</tr>
<tr>
<td>Final draft</td>
<td>8</td>
</tr>
<tr>
<td>Collecting data/ information</td>
<td>10</td>
</tr>
<tr>
<td>First draft</td>
<td>11</td>
</tr>
</tbody>
</table>

Munro, 2001

This data indicates that those phases identified as most difficult involved organizing and prioritizing the change in knowledge in terms of the questions asked and to examine and support the case that was being developed. Those phases identified as having medium difficulty involved students organizing themselves, for example, developing a pathway, locating and obtaining data and aligning the change in knowledge with task parameters. Those identified as easiest involved clarifying and questioning existing knowledge.

The types of difficulty students noted about each phase and the steps they took to resolve each difficulty were recorded and summarized in Appendix 4.1, (Difficulties encountered by students and the steps taken to resolve difficulties in the EE).

4.9 Schema in the EE

Enhancing knowledge in the EE can be viewed as a learning change process where the limits of the schemas are enlarged to incorporate more elements, the accretion of experiences that stimulate and accrue, so schemas are modified, transformed and
increased (Anderson, 1984). In completing the EE students learn new behaviours, the identification of a problem, representation and categorisation of the problem, selection of appropriate strategies, the implementation of these strategies and an evaluation of the solution. These new stimuli serve as the means for students to broaden their understanding of learning, to an understanding of what is required to enhance their knowledge. In this manner students learn new attributions for being creative (Chaney & Martin, 2007), developed the skills of interpretation (Mezirow, 2000; Taylor, 1994), and through the writing of the EE, a heightened understanding of communication (Beamer & Varner, 2003).

This adaption to a new set of learning behaviours helps transform a student to an understanding and belief in the creative process, the development of new skills and growth in their schemas.

4.10 Creativity and knowledge

As noted in Chapter 1.7, the EE values creativity as one of the outcomes. Creative thinking can be displayed in various ways in the EE, through the:

1. development of a novel research question;
2. transfer of an established concept;
3. creative operations or processes;
4. re-prioritisation of ideas (Munro, 2002).

It is argued in this thesis that creativity is influenced by, domain knowledge, creative thinking strategies, autonomous or self-regulation strategies, intrinsic and extrinsic motivations to learn, approach to learning, literacy, and self-efficacy.

The representation of knowledge built up by students through the EE is one of enhancing knowledge through a subject domain. A good research question of an ill defined problem lends itself to a systematic investigation through questioning, the use of multiple sources of information requiring analysis, interpretation and evaluation. The creation of knowledge is dependent on the strengths and weaknesses of the relevant
arguments appropriate to the question. Knowledge is viewed as being constructed by the student, the outcome of ‘reasonable inquiry’, with the essay investigation and conclusion justified on the basis of evidence and opinion in the context of the EE criteria (Appendix 4.2, EE General Criteria).

4.11 Chapter summary

This chapter has examined the EE as a self directed research project enabling students to develop intellectual autonomy. The cognitive processes associated with the EE are complex and require a range of learner variables, attitudes to learning, beliefs about knowledge and an understanding of how to convert information to knowledge.

It is argued that the EE provides the opportunity for students to research a specific question or issue, the creative processes being identified through a synthesis of Urban’s Componential Theory of Creativity and Cropley’s Stage Model of Creativity. The nature of the problem as proposed by the student is considered to be ill-defined, where conflicting assumptions may exist and different solutions investigated and proposed. The nature of the problem construction process is considered with cognitive task analysis identifying intermediate outcomes on the pathway to the completion of the EE. Knowledge is understood as being constructed by the student and is the outcome of reasonable inquiry.
Chapter 5  
The present study

5.1 Overview

In the present study, it is proposed that certain learner variables, including beliefs about knowledge and the influence of school and language, predict student understanding and enhancement of knowledge. This chapter investigates the extent of student understanding of knowledge and the extent of their ability to enhance knowledge. Little is known on the cognitive processes that influence these understandings in the context of the EE and ToK.

The cognitive processes required to generate new knowledge are assumed to require a higher level of skill than the cognitive processes needed to represent knowledge about existing knowledge. The present study compares the learning demands made on students in completing the EE and ToK. It is hypothesised that the cognitive processes to enhance knowledge call for a higher level of skill and make greater demands than the cognitive processes needed to represent knowledge about existing knowledge.

Models of learning suggest that an individual’s knowledge base influences the generation of new knowledge and that performance is predicted by student ability to recall and apply relevant domain specific knowledge. The domain specific knowledge in which the EE is written, is examined for the influence it has on achievement in the EE but not in the ToK.

An understanding and enhancement of knowledge in the ToK and EE is further investigated for the role that creativity and creative thinking strategies play in the conversion of information to knowledge. It is further hypothesized that a balanced ability to engage in verbal and imagery thinking strategies, a preference for autonomous or self-regulated learning strategies, a balanced use of deep, surface and achieving approach beliefs and strategies, an ability to comprehend the written text, and a degree of student self-efficacy is required for achievement and creativity. This study is also
expected to show insight into the influence of language in which the student learns on their learning outcomes.

5.2 Comparative difficulty of the EE and ToK

Little is known about student perceptions of the demands made on them and the thinking skills required for the EE and ToK. The extent to which the cognitive processes to enhance knowledge call for a higher level of skill and make greater demands than the cognitive processes needed to represent knowledge about existing knowledge requires further examination. If one task is shown to be more cognitively demanding then different learning strategies will be required. This will help in clarifying the results for the other hypotheses.

Cognitive definitions of learning complexity (Lohman, 1989; Snow, 1996) focus on the number of non-automated cognitive processes that learners must employ to achieve explicit learning goals. As achieving learning goals require more non-automated processes the level of cognitive complexity increases. Well defined tasks such as a presented mathematics problem, require fewer measurable cognitive stages than a less defined task. Student prior knowledge can enable quicker learning as not as much complexity is encountered compared to that of a student with less prior knowledge (Elen & Clark, 2006, p.28). The difficulty of assessing the degree of complexity for learners in any task situation is that, ‘… what is novel for one person may not be novel for another person or even the same person at a different time … [but] … inferences about how subjects solve items that require higher levels of processing must be probabilistic, since the novelty of each item varies for each person’ (Lohman, 1989, p. 348). In these terms complexity is characterized by reference to prior knowledge and the motivations that a student brings to the learning process. It is furthered argued that any learning goal can be unduly complex for students with varied cultural backgrounds and different levels of prior knowledge (Lohman, 1998).

To successfully complete the EE a student is required to ‘… define a suitable topic’ and from that ‘formulate a precise research question’ (EE, 1998). This requires a student to
recognise an issue and, having identified the existence of such a problem, to define its scope and goals. To solve such a problem creatively may require a redefinition and conceptualisation of the question. Problem solving does not usually begin with a clear statement of the problem but rather an identified issue within the student academic environment that must be defined and represented mentally (Pretz et al., 2003, p. 3).

This requires the co-ordinated use of a range of learning and information processing strategies, attitudes to learning, and beliefs about how the conversion of information to knowledge can be realized (Munro, 2003). Problem recognition occurs with respect to the knowledge a student has about a subject domain, with prior knowledge influencing the student’s ability to define and represent the problem (Pretz et al., 2003, p. 15). Further, the student requires a range of thinking skills and motives for learning, information literacy to align information with their existing knowledge and to enhance that information, to organise, prioritise and evaluate this knowledge from different perspectives. Academic self regulation is important for students to control their learning and manage their approach to learning and study, to be able to structure their response and use learning strategies to maximise their academic performance (Purdie & Hattie, 1996).

Achievement in the ToK requires students to complete an essay on any one of ten titles prescribed by the IBO for each examination session, and a ten minute oral presentation on a contemporary issue of student choice. Within this framework students use learning and information processing strategies to complete the required tasks. In selecting the essay topic, a choice is made between the titles, each being a generic question(s) about knowledge and cross disciplinary in nature. The choice of question can be answered with reference to any part of the ToK programme, to specific disciplines, with reference to opinions gained about knowledge from within and beyond the classroom. The essays are not meant to be treated in the abstract, with all claims made within the essay being justified and relevant with counter claims and original examples being used to illustrate the argument (ToK, 1999, p. 38).
The oral presentation may take a variety of forms, with the use of supporting material allowed. The presentation may be on any topic relevant to ToK, provided it can meet the assessment criteria. Central to the assessment criteria is recognition of the ‘problems of knowledge’, which refers to ‘… possible uncertainties, biases in approach to knowledge or limitation of knowledge’. This criterion also judges candidates on a presentation that ‘… is highly imaginative and reflects the candidate’s original thinking’ (ToK, 1999, p. 51). Other criteria require a treatment of divergent points of view that demonstrate critical reflection and insight into the problem(s) of knowledge, and the application of ToK thinking skills to a contemporary issue (ToK, 1999, p. 52, 53). The phrase ‘ToK thinking skills’ is the ability to ‘… identify problems of knowledge, to analyse and evaluate claims and counter-claims, to draw inter-disciplinary links, and be aware of differing underlying values’ (ToK, 1999, p. 53).

The present study compares the cognitive demands made on students in completing the EE and ToK on a number of learning criteria. These learning criteria include the range of thinking involved, the range of phases required to complete the EE and ToK, the structuring of student responses, the degree of self control, motivation, learning process and the need to be creative.

5.3 The role of subject area knowledge

The acquisition of a large knowledge base along with the mastery of skills in a domain area, due to the conversion of information to knowledge through the cognitive interaction with the subject matter, requires receiving information, sorting, grouping, reconceptualising and the ability to recall and apply relevant subject area knowledge. Achievement in the EE, but not ToK, is predicted by student ability to recall and apply this relevant subject area knowledge.

5.3.1 Subject area knowledge and achievement

Domain knowledge represents the information that a person holds related to a subject area such as biology or physics (Alexander & Jetton, 2000). This construct is generally
defined as comprising declarative knowledge and within this category, semantic and episodic knowledge, and procedural knowledge (Lawless & Kulikowich, 2006; Alexander & Judy, 1988).

The effect of domain knowledge on the learning process has been shown as a necessary condition in the learning process for student achievement (Perkins, 1990; Rabinowitz & Glaser, 1985) and in a number of subject areas including Biology, History, and Psychology (Alexander, 2003). A large knowledge base has been found to be a strong predictor of information acquisition from different instructional contexts (Alexander, 2003; Shen et al., 2003; Lawless et al., 2003), and provides the basis for the acquisition of new knowledge (Halford, 1993). Domain knowledge enables the making of inferences and can affect the perceived meaningfulness of new information (Gagne et al., 1993; Marshall, 1995). It has been shown that the more domain knowledge learners have the more effectively new information from a domain can be processed (Alexander, 1992; Alexander & Judy, 1988).

In determining the interaction between achievement and domain area knowledge our understanding will be facilitated by being more informed on the relationship between various subject domains and achievement. Certain domains have been selected such as Economics (Voss et al., 1986), Avionics (Gitomer, 1984), Physics disessa, 1982), among others, to explore this relationship.

While the hypothesis is plausible, a synthesis of the literature germane to student achievement in recalling and applying relevant subject knowledge is lacking to validate this statement. Demonstrations of learning occur in this achievement context of the EE and ToK, providing the opportunity to increase an understanding of the learning factors that affect high achievement in the EE and ToK as increasing an understanding of the enhancement of knowledge.
5.3.2 Subject area knowledge and creativity

A dimension of learning relates to the learner’s existing knowledge, its organisation and use during information processing. What and how learners know provides a base for use of thinking strategies, the questions they ask, their capacity to organise and integrate the information accessed, how they convert the knowledge and display the outcomes (Munro, 2003).

Sternberg (1988) stressed the role of the knowledge base in creative thinking, arguing that:

> In recent times, cognitive scientists have more and more emphasized the role of knowledge in intelligence … and knowledge would seem to play a role in creativity as well. In particular, it is impossible to have novel ideas about something if one knows nothing about it. One needs knowledge to extend from in order to see how to apply or extend it creatively.

Sternberg, 1988, p.137

Sternberg clearly proposed that creative thinking involves the management of ideas from the knowledge base, creative thinking occurring when ideas are extended, adapted or combined in ways that become useful or valuable (Feldhusen, 1995). In Amabile’s (1990) componential model, ‘knowledge about a domain’ is included under the heading of domain-relevant skills, factual knowledge, technical proficiency, and special talents in the domain being part of the conception of the knowledge base (Feldhusen, 1995). Likewise in Cropley & Urban (2000), a ‘Specific knowledge base and specific skills’ is one of the 6 components of the model.

In various discussions about creativity, the need for mastery of a domain or knowledge base, before the act of creation can occur by transforming the knowledge or elements of knowledge into ideas or solutions is recognised (Schank, 1988; Feldman, 1988; Walberg, 1988; Baer, 1998; Cropley & Cropley, 2000; Rubenstein, 2000; Feldhusen, 2002; Han, 2003). The creative process depends strongly on a knowledge base reflecting past learning and fluency or retrieval skills, flexibility manifested through
personal openness, and elaboration as a process of adding ideas to emerging processes and products (Feldhusen, 2002).

Evidence for the generality of creativity comes from report scales (Hocever, 1976, 1981), and Runco (1987), where the correlation of self-report indexes of creativity in various domains was ‘low to moderate’.

Within creativity theory and assessment, the area of divergent thinking has encouraged the idea of generality in creative thinking skills (Baer, 1998; Runco, 1991; Torrance & Presbury, 1984). Guilford’s conception included a large number of independent divergent thinking factors (Baer, 1998) but this view was replaced by ‘… a focus on ideational fluency as a general associative process, a sort of ‘g’ factor underlying virtually all types of creativity’ (Brown, 1989, p. 21). Thus divergent thinking has been viewed as a general process that would explain various creative activities although a case against divergent thinking as an all purpose creative thinking skill has been made (Baer, 1993; Brown, 1989).

Despite the shift in the general view of creativity towards the domain specific, the debate over the domain-specificity and domain-generality continues to be controversial and complex, with a range of results and conclusions (Han, 2003). Tardiff and Sternberg (1988) indicated ‘… it is generally acknowledged that people are creative within particular domains of endeavour … when the issue of domain-specificity occurs … much less agreement ensures’ (p. 433).

Learning in this context provides an opportunity to increase our understanding of the effect of subject knowledge on both academic achievement and creativity. The present study will examine the extent to which achievement in the EE, and not the ToK, is predicted by student ability to recall and apply relevant subject area knowledge.
5.4 Creative thinking strategies

The outcomes of creativity are identified in terms of a product that is novel, as discussed in Chapter 1. This product can be both tangible and intangible. Tangible products that are novel may include works of art, musical compositions, written documents and physical structures such as a building or bridge. Intangible products can be plans, strategies, essays, or sets of new ideas that provide a mean of conceptualisation in some discipline. The focus of the cognitive approach to creativity has given emphasis to the processes that produce a novel product, the control mechanisms that regulate production and the outcomes (Cropley, 1999).

Significant research has been devoted to examining the factors that influence creativity. In general models of creativity (Urban, 1990, as presented in Chapter 4), creative performance is affected by cognitive and personality factors and environment. In these models a critical component is the ability or skill to generate ideas. The general approach to assessing ideation is divergent thinking skills tests, where individuals are provided with some stimuli and respond with numerous ideas. It is assumed that a necessary component of creative performance is the generation of new ideas and, if divergent thinking skills tests are valid means of assessing ideation, then they can be used to predict achievement and creative performance.

5.4.1 Creative thinking strategies and achievement

Creativity, the ability to develop and realise ideas that are both original and useful (MacKinnon, 1962), is regarded as important for academic success. Much research has been devoted to exploring the factors that influence and predict creativity. The generally accepted model argues that creative performance is affected by several factors, including the cognitive and personal components of the creative individual, and the mutual dependency of student and environment in the creative process (as discussed in Chapter 4). Within this model a critical component is the use of creative thinking strategies to generate ideas. The TTCT is one measure of individuals generating these
ideas in response to verbal and figural stimuli. A key component of writing an EE is the ability to be creative, and use this creativity to enhance knowledge.

Studies have examined the relationship between creativity and academic performance (Niaz, 1987; Niaz & Saud de Nunez, 1991; Runco & Okuda, 1988; Schack, 1993; Torrance & Safter, 1986) and showed the importance of divergent thinking skills on student academic achievement. These studies provide evidence for the hypothesis that creativity variables as measured by the TTCT are important predictors of academic success.

Ideas are an important component of creative performance, and given the validity of these instruments for assessing creative thinking, the TTCT is useful for predicting academic achievement. The purpose of this study is to investigate creativity, as measured by the TTCT, as a model of creative functioning that predicts academic achievement in the EE and ToK. The hypothesis that creativity itself is a factor that contributes to achievement and that creative people are able to achieve highly through ease of use of creative thinking strategies.

5.4.2 Creative thinking strategies and creativity

Building on Guilford’s work, Torrance (1974) developed the Torrance Test of Creative Thinking (TTCT) that involved divergent thinking and other problem solving skills. These creative thinking abilities, as used in the TTCT, refer to the mental abilities that are presumed to be brought into play in creative achievements. The mental abilities include, fluency (total number of relevant responses), flexibility (number of different categories of relevant responses) originality (the statistical rarity of the responses), and elaboration (amount of detail in the responses). The Figural A and Verbal A Torrance tests were used as a measure of creative thinking imagery facilitating creative thinking, and verbal thinking facilitating the organisation of creative outcomes for communication. The Torrance Tests are applicable in cross-cultural situations (Torrance, Ball, & Safter, 1992).
Divergent thinking tests have been shown to predict creative performance, in both concurrent and longitudinal validity studies (Cropley, 1972; Cramond, 1974; Milgram & Hong, 1994; Plucker, 1999; Torrance, 1972; Torrance 1981; Yamada & Tam, 1996), and provide evidence that divergent thinking skills tests are domain specific (Baer, 1991, 1994, 1996, 1998; Han, 2003; Han & Marvin, 2002; Runco, 1989). The implication of domain specificity is that divergent thinking in one domain may not be evident in another. However it is not always clear what domain specificity refers to, whether it is broad subject matter or specific tasks within a content domain (Clapham et. at, 2005, Baer, 1998; Diakidoy & Spanoudis, 2002). Baer (1993) and Runco (1989) have ascertained that creative performance across content domains and across tasks within a content domain are not highly correlated. This suggests that divergent thinking may not be a general skill applicable to varied content domains or tasks (Clapham et. al, 2005).

Divergent thinking skills have been found to be predictive of performance and creative accomplishments. Divergent thinking tests were predictive of performance ratings of military leaders and business managers (Mumford et. al, 1998; Scratchley & Hakstain, 2001); 9th grader scores on the TTCT were found to affect divergent thinking scores (Daikidoy & Spanoudis, 2002); and scores from 4th, 5th and 6th grade students on ‘real world’ divergent thinking scores correlated with creative outcomes (Okuda et. al, 1991; Han & Marvin, 2002).

Such studies need to be conducted on student academic performance at the higher age level at secondary school. Creative thinking can be displayed in various ways in the EE: in (1) the development of a novel research question, (2) the transfer of an established concept, (3) creative operation or processes, and (4) the re-prioritisation of ideas (Munro, 2002). The use of the Torrance Tests is seen as a useful method for investigating both achievement and the use of creative thinking during completion of the EE and ToK, as it focuses on the mental abilities required for successful completion. The purpose of the present study will examine the extent to which learner variables associated with creativity have the potential to predict achievement and creativity.
5.5 **Self-determined behavioural regulation**

Motivation is the process by which activity is directed to achieving particular goals, the initiation and maintenance of this activity (Schunk, 1990). In this context motivation to learn is related to what learners believe about how well they can control and manage their ability to learn. This view implies a knowledge and understanding of how one learns, is motivated to regulate themselves in this way, and have the capacity for regulating their action and behaviours to achieve their goals. The contemporary view of motivation to learn is that a learner is motivated to learn an idea when there is a goal for learning. Students are motivated to learn when they are prepared to engage their existing knowledge with new information and activate learning strategies to understand and enhance that existing knowledge.

Within this view two types of generic motivation are identified, extrinsic and intrinsic motivation (Deci, 1975). Extrinsic motivation exists when a learner perceives to learn for purposes external to the change in knowledge, that learning is a means to an end. Engagement in the task occurs for task unrelated factors such as promise of rewards and punishments. Intrinsic motivation exists when learners learn because of a desire to know more about a set of ideas. Here the tendency is to engage in tasks for reasons of interest, satisfaction and challenge. The learner perceives that they are capable of learning the ideas and can manage their learning to achieve this end (Deci & Ryan, 1985).

Self determination theory (SDT) maintains that an understanding of human motivation requires a consideration of innate psychological needs for competence, autonomy and relatedness (Deci & Ryan, 2000a). Self-determination is ‘the process of utilizing one’s will’ (Deci, 1980, p. 26), requiring an acceptance of one’s abilities, both strengths and limitations, being aware of their environment, being able to make choices and determine how to achieve these choices. SDT distinguishes the goals and the regulatory processes through which the goals are pursued, making predictions for different contents and processes. It uses the notion of innate psychological needs as the foundation for integrating the differentiations of goal contents and regulatory processes and predictions.
that result from these differentiations (Deci & Ryan, 2000b). According to SDT, the
degree to which individuals are able to satisfy their essential psychological needs is
crucial to their pursuit and attainment of their outcomes or goals (Deci & Ryan, 2000a;

SDT maintains that to develop a full understanding of goal-directed behaviour,
psychological development and well-being, can only be achieved by examining the
needs that give goals their psychological effectiveness and the influence of regulatory
processes that direct the individual’s goal pursuits. Three psychological needs,
competence, relatedness and autonomy, ‘… are considered essential for understanding
the what (i.e., content) and why (i.e., process) of goal pursuits’ (Deci & Ryan, 2000a).

SDT assumes that individuals are naturally inclined ‘… toward the development of an
organised coherence among their psychological make up and between themselves and
the social world’ (Deci & Ryan, 2000a). However, these natural development
tendencies towards internal and social integration require supports from the social
environment to function effectively.

In recent research reviewed (Deci & Ryan, 2000a), it has been shown that social context
is supportive of the needs for competence, autonomy and relatedness, and:
1. Maintains or enhances intrinsic motivation;
2. Facilitates the internalisation and integration of extrinsic motivation leading to
   more autonomous orientations;
3. Promotes life goals that provide satisfaction of basic needs.

Intrinsic motivation, autonomous regulation of extrinsic regulation and intrinsic
aspirations were allied with positive affective experiences of quality performance,
healthy behaviour and better mental health. Conversely research showed the frustration
of basic needs was associated with less intrinsic motivation, more controlled regulation
and amotivation, and stronger extrinsic aspirations resulting in a falling performance,
experience and wellness (Deci & Ryan, 2000).
SDT argues that behaviour can be broadly categorised as intrinsically motivated, extrinsically motivated or amotivated. SDT differentiates these forms of behaviour on a continuum by the extent to which they denote autonomous or self-determination, to a controlled functioning of behaviour.

According to Deci and Ryan (1991), intrinsic motivation is the archetype of autonomous behaviour and by definition, self-determined. It is where behaviours occur without external reward and undertaken out of interest in the activity itself which is optimally challenging, rather than for the outcomes of the activity itself. Extrinsically motivated activity is the degree to which the motivation is more controlled or less autonomous, where the activity is carried out as a means to an end. Amotivated behaviour is when individuals are neither intrinsically or extrinsically motivated. These situations exist where individuals perceive no contingencies between outcomes and their actions, where experiences of uncontrollability and incompetence exist (Vallerand et al., 1992).

Within extrinsic motivation, SDT differentiates four further categories of motivation dependent on the extent to which the motivated activity has been internalised. External regulation represent behaviours that are regulated through external means, such as rewards and punishments. Introjected regulation is taking a behaviour that is not accepted as one’s own; it is beginning to be internalised but not fully self-determined. These behaviours can be performed to gain social recognition (Ntoumanis, 2001). Identified regulation is more autonomous, with the behaviour being highly valued and performed again with less pressure. As the internalisation process continues, integrated regulation represents the most autonomous form of the internalisation process. Deci and Ryan (1991) stressed that this behaviour is an extrinsically motivated behaviour because it is executed to achieve personal goals and not because of its intrinsic appeal. External regulation and introjected regulation are deemed controlling forms of motivation, while intrinsic, identified regulation and integrated regulation are pictured as self-determined (Ntoumanis, 2001). This model predicts that different types of motivation ‘… will lead to important cognitive, affective and behavioural consequences’ (Ntoumanis, 2001).
5.5.1 Self-determined behavioural regulation and achievement

Research into self-determined regulation theory has focused on a broad range of issues (Deci & Ryan, 2002). In an academic context self determination theory suggests that autonomously motivated students flourish when student autonomy is teacher supported (Reeve, 2004, p. 183). Further it has been shown that SDT predicts that intrinsic goal pursuit is closer to basic need satisfaction in learning while extrinsic goals undermine learning and performance (Vansteenkiste et al., 2006; Vansteenkiste et al., 2009). Vansteenkiste, Lens & Deci (2006) show that when learning is structured in terms of intrinsic goals, student ‘... enjoyment of learning, and graded performance’ is enhanced when ‘... compared with extrinsic goal framing’ (as quoted in Vansteenkiste et al., 2009 (Miserandino, 196; Flink et al., 1990; Flink et al., 1992; Boggiano et al., 1993). This research will examine the relationship between SDT and an understanding of knowledge and enhancement of knowledge.

5.5.2 Self-determined behavioural regulation and creativity

Creativity is an important aspect of human activity and while cognitive skills have been seen as an important part of the creative process (Sternberg & Lubart, 1995, Amabile, 1996), there has been a relatively small focus on the role of self regulation in creative thinking. It is assumed that people can be more creative by regulating their goal directed behaviour (Koestner, et al., 1984; Amabile, 1985; Lam & Chiu, 2002), and in this context creativity is a series of stages including task identification, idea generation, solution finding, transformation of ideas into products and evaluating the outcomes (Amabile, 1996; Isaken & Treffinger, 1985). This research will examine the characteristic of the creativity outcome, the H criteria that are accounted for in each goal orientation.

A self-regulated person will regulate their thinking and behaviours in such a manner as to achieve their outcomes, strategically flexible and resourceful in a particular context and the ability to assess and understand their actions in terms of its consequences and
implications. This study provides the opportunity to examine two aspects of self-regulation, learning and motivation which will be assessed in relation to achievement and creativity. It is the intention to examine the preference for autonomous or self-regulated behavioural regulation and the extent to which it predicts achievement in the EE and ToK. Furthermore, the relationship between learning self-regulation and motivation self regulation and creativity will be examined.

5.6 Intrinsic and extrinsic motivations to learn

Contemporary theories of motivation assume learners will initiate and persist with certain behaviours to achieve their desired outcome or goal. SDT has placed the emphasis in its approach by ‘differentiating the content of goals and the regulatory processes through which the outcomes are pursued’ (Deci & Ryan, 2000a). While students may be motivated to perform well on learning tasks there can be problems in initiating and maintaining the required task behaviour. SDT bridges the gap between academic performance and cognitive abilities and achievement motivation.

An alternative approach is to consider enhancing motivational patterns through setting achievement goals. Setting goals can be an important source of motivation (Bandura, 1977) as they determine an external standard for students to internally evaluate their performance. Student motivation to learn is determined by the interactions of a students’ motivational orientation and the goal. Goal orientation embodies the beliefs that lead to ‘different ways of approaching, engaging in, and responding to achievement situations’ (Ames, 1992, p. 261). Goal orientations are the reasons why students pursue achievement tasks, not just performance objectives (Urdan, 1997), and these are ways of judging their performances as successes or failures of in reaching those goals (Pintrich, 2000; Elliot, 1997). Thus goal orientation is best understood as the purpose and rationale for undertaking a task, assimilated with the standards to evaluate the task performance.

Two types of achievement goals have been identified. Intrinsic motivation that has been linked to achievement goals and variously called task involvement or mastery
goals and extrinsic motivation which has been linked to achievement goals and referred to as ego involvement or performance goals. Here the discussion centres on the extent of student motivation being determined by the interaction between the students’ motivational orientation and the teaching task. These two goal orientations reflect students’ reasoning for engaging in a task.

Intrinsic motivation is the performance of an activity for its own sake, where the enjoyment, challenge, interest, and satisfaction is inherent in the task itself (Deci, 1975; Deci & Ryan, 1985; Eccles, Wigfield, & Schiefele, 1998; Moneta, 2002). Extrinsic motivation is the performance of an activity to meet some goal external to the task itself, for unrelated factors such as the promise of rewards and punishments, competition, and commands from managers (Deci & Ryan, 1985; Collins & Amabile, 2002). While different researchers have conceived intrinsic motivation in slightly different ways (Murphy & Alexander, 2000) these definitions provide a shared commonality (Gottfried, Fleming & Gottfried, 2001). Gottfried (1985), first proposed the construct of academic intrinsic motivation and in this context refers specifically to school learning. This construct is characterised ‘by a mastery orientation, curiosity; persistence; task endogeny and the learning of challenging, difficult and novel tasks’ (Gottfried et al., 2001).

Research has demonstrated a positive relationship between academic achievement and intrinsic motivation for secondary level students (Deci & Ryan, 1985; A.E. Gottfried, 1985; Lloyd & Barenblatt, 1984). Students with higher motivation show task persistence and a mastery orientation, striving to learn more (A. E. Gottfried, 1985; Dweck, 1986; Meece, 1994), intrinsic motivation being associated with student learning goals emphasising the mastery of challenging tasks (Dweck & Leggett, 1988). Elliott and Dweck (1988) established that students who assumed a learning goal used more effective strategies to solve learning tasks. In comparison, when learners set performance goals they ‘seek to gain favourable judgements of their competence, or avoid negative judgements of their competence (Dweck, 1986). Students who are faced with a performance goal and have little confidence in their capabilities display helplessness (Driscoll, 2000, p. 309). Pintrich and Schrauben (1992) argue that many
tasks in classrooms may be low level and focus on recall of information, which encourages students to adopt an extrinsic orientation and more surface type strategies.

While intrinsic and extrinsic goal orientations are often thought of as extremes, it is more likely that students can adopt both as goals (Wentworth, 1991). Students may want to understand and master subject content due to intrinsic goal orientations, but also be concerned about subject performance (Pintrich & Garcia, 1991). It is not unreasonable to expect students to adopt intrinsic goal orientations that result in deeper levels of cognitive engagement, but where there is an interaction with an extrinsic orientation (Pintrich & Schrauben, 1992, p. 157).

### 5.6.1 Intrinsic and extrinsic motivations to learn creativity

Much research evidence has accumulated over the past 25 years that intrinsic motivation encourages creativity (Amabile, 1979, 1985; Amabile & Gitomer, 1984; Amabile, Goldfarb, & Brackfield, 1990; Amabile, Hill, Hennessey, & Tighe, 1994; Ruscio, Whitney & Amabile, 1998; Mumford, 2003).

Intrinsically motivated individuals should show deeper levels of involvement in the problem because of an interest in, and enjoyment of searching for a solution to the problem (Ruscio, Whitney & Amabile, 1998). Csikszentmihalyi has suggested that identifying problems with potentially creative solutions is focused by an intense interest, and curiosity in the subject matter, and by perseverance due to the intrinsic rewards offered (Csikszentmihalyi & Robinson, 1986; Getzels & Csikszentmihalyi, 1976). It is also argued that such individuals would engage in more exploratory behaviours (Condry, 1978) and greater persistence (Deci & Porac, 1978).

Passionate involvement in challenging and risky problems and the opportunity to use their talents excite creative people (Albert, 1990; Perkins, 1988) particularly when individuals are engaged in challenges that match their skills (Csikszentmihalyi & Csikszentmihalyi, 1988); will search for more challenging problems, as they become more skilled in a domain (Csikszentmihalyi, 1990); and that intrinsic motivation is so
strong that thinking about a task may be sufficient reason to increase creativity in that endeavour (Greer & Levine, 1991, Hennessey & Zbikowski, 1993; Amabile, 1996).

The suggestion that extrinsic motivation undermines creativity has been the focus of significant research. Studies have confirmed the undermining effect of expected performance evaluation (extrinsic motivator), and the receipt of positive evaluation prior to performance (extrinsic motivator), produces negative effects on creativity (Amabile, Goldfarb, & Brackfield, 1990; Hennessey, 1989; Szymanski & Harkins, 1992). Individuals are less creative when being watched by others (Amabile, Goldfarb, & Brackfield, 1990; Barron, 1988); when autonomy is reduced in completing a task (Amabile, et al. 1996; Greenberg, 1992; Hennessey, 1989); competing for prizes to construct the best product (Amabile, 1987; Hennessey, 1989; McGraw & McCullers, 1979). The most likely reason for this undermining effect of extrinsic motivation on creativity is attentional, that individuals could divide their attention between the extrinsic goal and the task at hand (Amabile, 1983; Lepper & Greene, 1978).

There is an increasing number of studies that have evidence to suggest that extrinsic motivation may not be harmful to creativity in certain circumstances (Esienberger & Selbst, 1994; Eisenberger & Cameron, 1995; Amabile, 1996). Participants in these studies were told to be creative on a particular type of task and were rewarded for these behaviours (See Collins & Amabile, 2002 for a review; Amabile, 1996).

Ruscio, Whitney and Amabile (1998) found empirically, that involvement in a task mediated some of the effect of intrinsic motivation on creativity, leaving open the question of what else mediates motivational effects on creativity.

Intrinsic and extrinsic motivation are often viewed as opposite extremes of the one dimension, an individual being unable to enjoy a task for its own sake and be motivated by reward simultaneously (Eisenberger & Shanock, 2003). Empirical studies have failed to agree on the relationship between extrinsic motivation and the creative process (Eisenberger & Shanock, 2003). However extrinsic motivation can play an important
part in creativity with intrinsic motivation coexisting with extrinsic motivation (Ruscio, Whitney & Amabile, 1998).

Extrinsic motivation or reward requiring a high level of performance increased perceived self-determination and perceived competence, both of which enhanced intrinsic task motivation (Eisenberger, Rhodes et al., 1999), this conclusion being supported by Eisenberger, Pierce et al. (1999). These findings question the generality of decremental effects of reward on creativity (Amabile, 1983a, 1996; Condry, 1977).

It is hypothesised that the EE and ToK require a balanced use of intrinsic and extrinsic motivations. The present study will examine the extent to which achievement in the EE and Theory of Knowledge is predicted by a balanced use of intrinsic and extrinsic motivations.

5.7 Approaches to learning

To develop a fuller picture of student learning, research has focused on how students conceive of their learning in the learning process. This ‘approach to learning’ consists of an intention and strategy and can be considered the ‘something’ between the student and the task (Ramsden, 1988, p, 20; Biggs, 1993). A learning approach describes the way in which students go about a learning task. This relationship encapsulates their intentions and the activities by which they address the task (Entwistle, 1987). A surface and deep approach to learning is where learning as an increase in knowledge is identified with a surface approach, while learning as understanding or insight is considered as a deep approach (Entwistle, 1981; Biggs, 1987). This conceptualisation of surface and depth is consistently identified in both different methodological procedures and in different cultures (Biggs, 1987; Marton & Saljo, 1984; Ramsden & Entwistle, 1981). An achieving approach has also been identified (Entwistle, 1981) where students may move between a surface and deep approach, dependent on what the student finds to their advantage in the situation.
A deep approach to learning is characterised as the situation of students having the intention of seeking meaning and an understanding of the material through questioning the ideas, linking them to what is known, examining the material from different perspectives and applying and transforming this material to unfamiliar situations. Here the motive is intrinsic and students complete a task to actualise their interest and competence (Biggs, 1987; Marton & Saljo, 1984). This deep approach is associated with constructivist teaching whereby students actively construct their own knowledge (Dart, 1997). A surface approach to learning is the action to memorise the information and learn by rote, to link ideas in an unquestioning way, with the student limiting their goal to the essential or minimum effort (Biggs, 1987). This approach is linked to the teaching model where information is transferred from teacher to learner, and the learner assumes a passive role (Dart, 1997). The achieving approach is to achieve understanding relative to others, for ego enhancement. This approach can be linked to either the deep or surface approach.

Biggs’ (1978, 1979) conception of the learning process was based on the assumption that students react in a way typical of them across situations, but specific to a particular situation or context. Biggs’ understanding of ‘approach’ is the learning process that arises from student perceptions of an academic task and the personal characteristics that influence it. This contains both situational and personal elements (Biggs, 1988, p. 185). The Learning Process Questionnaire (LPQ) designed by Biggs measures the extent to which individuals support common approaches to learning tasks. It conceptualises the learning process as students’ learning motives and strategies, with each combination identifying a distinct approach to learning.

The three main approaches to learning each have two dimensions: a motive for learning and an appropriate strategy for learning (Biggs, 1987). The three types of motives for learning are: (1) a ‘surface’ motive, where the requirement is to retain knowledge to meet an external criteria with minimum of effort; (2) a ‘deep’ motive where there is an personal interest in what is being learnt, a desire to increase one’s knowledge of a topic; and (3) to achieve an understanding relative to others, ‘…to enhance ego and self-esteem through competition’ (Biggs, 1987).
Each motive has a linked set of learning strategies that describes how the learner acts on the knowledge. The ‘surface’ approach involves learners focusing on the superficial aspects of a topic, learning and memorising in an unthinking way. The ‘deep’ approach leads to an understanding of the topic, a search for meaning through questioning and linking back to previous relevant knowledge (Biggs, 1987); while the ‘achieving’ approach ‘focuses on learners organising or structuring knowledge of a topic in the most efficient way (managing time commitments, working space) with the purpose of optimizing assessment grades or meeting other external criteria’ (Munro, 2003).

5.7.1 Approaches to learning and achievement

An approach to learning is a critical element of the quality of learning outcomes achieved. Marton and Saljo (1976), in a naturalistic study of how Scandinavian students approached the task of reading academic articles and texts, established that students who used a deep approach to learning achieved a high level of understanding. In contrast, students who adopted a surface approach had a poor level of understanding. This research also suggested that the intention to adopt a deep approach depended on having adequate prior knowledge of the subject involved. Additional research confirmed these findings (Dahlgren, 1984; Prosser & Millar, 1989, Van Rossum & Schenk, 1984; Wong and Atkins, 1998), and where quantitative analysis has been used these studies have further corroborated the relationships between student learning approaches and the higher the quality of their learning outcomes (Biggs, 1979; Trigwell & Prosser, 1991; Watkins & Hattie, 1981; Sadler-Smith, 1996; Booth et al., 1999; Byrne, 2002). Studies of student learning in tertiary education reveal that surface learning is not conducive to academic success (Biggs, 1994; Ashton, 1997; McAlpine, 1998), and deep learning is more effective (McManus et al., 1999).

There is clear evidence to conclude that teaching presage factors lead to students’ adopting deep approaches to their learning (Dart et al., 1999; Entwistle & Ramsden, 1983), and student presage factors on the other (such as low level of anxiety, conception
of learning as searching for meaning) (Dart et al., 2000; Saljo, 1982; Selmes, 1987; Van Rossum & Schenk, 1984).

In investigating student approaches to learning, Entwistle and Biggs have focused on the motivations and strategies adopted by students in their every day courses. Showing how students adopt to greater or lesser degree these learning strategies and motivations in their course work, raises the question to explain the role played in high achievement in the EE and ToK.

5.7.2 Approaches to learning and creativity

When considering creativity in the curriculum as a key outcome of learning, knowledge enhancement processes can be examined from a range of perspectives. The relevance of approaches to learning and its relationship to creativity is the recognition that differences between learners exist, and these differences are explainable in terms of the combination of motivational approaches and strategies that a student can take to their learning, and enhancement of knowledge.

Little has been explored or written in this area, with deep, surface and achieving approaches to learning having not been previously identified as factors influencing an enhancement of knowledge. The degree to which students can demonstrate academic creativity in their studies, and be encouraged to do so, will vary significantly, and to examine their motivational approaches and use of strategies will help understand how students conceive of these cognitive processes. The EE recognises the importance of this aspect of learning development according to the assessment criteria, where an assessment of academic creativity is made through the ‘H’ criteria or Holistic judgement. This provides an appropriate framework for exploring the effect of student approaches to learning on knowledge enhancement. This exploratory investigation examines the effects that an approach to learning has on academic creativity.

The present study will examine the extent to which achievement in the EE and ToK are predicted by a balanced use of deep, surface and achieving learning approach strategies.
It offers the opportunity to enhance an understanding of the factors underpinning the learning processes that affect an understanding and enhancement of knowledge. For successful completion of the EE and ToK, students require the use of all three approaches at various times (Munro, 2003): the deep approach giving high order outcomes, exhaustive analysis, synthesis of material, creativity, efficiency in organising and aligning bodies of knowledge; the achieving approach to create action plans, use information effectively, monitor progress, and align existing knowledge with external criteria; and the surface approach to assist with short term retention of information and application of conventions.

5.8 The conversion of written information to knowledge

The notion of literacy has been extended over recent years through new information and communication technologies, contributing to a redefinition of literacy. Broadly speaking, a literate person is one who is capable of reading, writing, speaking, listening, viewing, and evaluating print and non-print texts (Gee, 1996; Luke & Freebody, 1997; Moje, Dillion, & O’Brien, 2000). At the heart of this definition is the notion that defines literacy as engagement with print, to be literate is to be able to read and write.

Student literacy is an increasing challenge in many schools with students required to learn by reading in different subject domains. The challenge has been increased in recent years with greater emphasis on self managed and directed student learning (Munro, 2002b); the spread of information and communication technologies and the need to access an increased range of information sources (Nichols & Cormack, 2002; Munro, 2002b); and the concept of ‘lifelong learning’ which encourages larger numbers of the population to see themselves as ‘learners’, not only in schools, but at university and in the workplace (Nichols & Cormack, 2002).

The ‘new worker’ or ‘knowledge worker’ is described by Gee et al. (1996) as flexible, creative, able to pick up new skills, prioritise, have various forms of literate competence, including oral and written skills. This representation of a ‘knowledge worker’ is consistent with the above definition of literacy.
Munro (2002b) emphasizes the importance of student ability to convert information to knowledge in terms of literacy:

… are at a severe disadvantage in world of the twenty first century. Not only are they less able to access information, but they have less opportunity to display what they know in written ways. As well, they have less opportunity to have their existing knowledge of a topic ‘programmed’ in verbal linguistic ways. As a consequence, they are less able to align the knowledge they have of a topic with related written text on subsequent occasions.

Munro, 2002b, p. 23

Studies have indicated the significance of language impairment in preschool children, and the difficulties that continue with problems in learning to read (Bird et al. 1995; Catts et al., 1999; Snowling et al. 2000), and that these reading difficulties can impair academic achievement in a range of subjects (Tallal et al., 1997). Further studies assessing problems of language disorder affecting comprehension and the impact on achievement confirm the widespread nature of this problem (Aram et al., 1984; Stothard et al., 1998; Rutter & Mawhood, 1991). Snowling et al. (2001), examined children whose literacy skills based on Basic Reading, a test of Word Recognition, Spelling and Reading Comprehension (Wechsler Objective Reading Dimension test), while largely resolved at the age of 5 or 6, still performed below average at the GCSE examinations when compared to students with no prior language issues. What is clear from this discussion is that children who experience significant literacy problems will be compromised in their academic achievement. What is less clear is the impact that literacy has on the completion of the EE and ToK.

Knowledge of vocabulary is a gauge of domain knowledge that influences procedural knowledge and impacts on the learning process (Bruning, et al., 1999, p. 270). Vocabulary knowledge facilitates cognitive processing, enabling more rapid reading, efficient listening, expression of ideas and reading comprehension. To a large extent vocabulary knowledge is automatized and procedural in nature. The correlation between vocabulary knowledge and achievement outcomes have long been shown to be strong (Conroy & Plant, 1965), while vocabulary and reading comprehension (Stahl & Fairbanks, 1986; Sternberg, 1987) possess a robust association.
When discussing vocabulary knowledge, a distinction between definitional word knowledge and contextual word knowledge can be made. Definitional word knowledge encompasses the notion that words exist in a semantic network of words, these words having a relationship to other words of which learners may already have a knowledge. Contextual word knowledge provides an understanding of the use of these words in writing and speaking (Bruning, et al., 1999, p. 273). The notion of contextual word knowledge suggests vocabulary knowledge can be viewed as schema like arrangements that give meaning to the word (Nagy, 1988; Powell, 1988; Sternberg, 1987, as quoted in Bruning, et al., 1999, p. 273).

Reading comprehension ‘... is the process of simultaneously extracting and constructing meaning through interaction and involvement with written language’ (Sweet & Snow, 2003, p. 1). The act of reading is engaged in for externally imposed reasons or for internal intentions that are influenced by cognitive factors such as motivations. The elements of comprehension involve ‘... the reader, the text and the purpose for reading’ (Sweet & Snow, 2003, p. 2). For this thesis, the context for reading is the research requirements for the ToK and the EE. Reading can be engaged in for a variety of purposes, to obtain a cursory understanding and overview of the text through to engagement with the text for the purpose of retaining information. As reading is engaged in, fresh questions arise as new information is discovered that may lead to a re-evaluation of the purpose. Imperfect comprehension can arise if the student does not accept the external purpose for reading.

Schemata play an important role in learning though reading comprehension (Andre, 1987). For each reading comprehension experience past reading knowledge forms the basis for the assimilation of new text information. The learner’s knowledge structure activates the creation of an understanding, selectively allocating the learner’s attention during reading (Glover, Dinnel, et al., 1988) to different sections of the text. The location of important ideas allows for the learner to infer and construct meaning from the text, the quality of these inferences being determined by the complexity of the activated schemata. The memory searches for relevant bits of knowledge to make these
inferences, the memory search facilitated by schemata (Anderson & Pearson, 1984). The assimilation of new information, summarising (Hidi & Anderson, 1986), editing, enhancing and integrating this information into reconstructed knowledge is made possible in the memory through schemata. The role of schemata in reading comprehension highlights the importance of appropriate comprehension strategies.

Logical relationships are a measure of student ability to recognise connections between concepts, to draw analogies and to recognise the principles of organisation in a text. This permits the communication of ideas in a particular sequence, enabling the writer to organise and emphasise the relative importance of these ideas or concepts. These ideas can be expressed both within and between sentences. While students may be able to identify definitional word knowledge, logical relationships will be inadequate unless a contextual word knowledge exists. This argument is highlighted from the view of bilingual students where

... native speakers of English express ideas ... derived from the oral rhetoric of their Greek and Roman cultural forebears. They are sure to be different from the ways in which Chinese students of English think and reason and order their ideas in written form. These differences in logical relationships are very likely to cause interference with the students’ own language conventions or habits.

(Ding Xin-shan, 1994).

This suggests the cultural implications of literacy play an important role in developing a student understanding and enhancement of knowledge.

Writing can be viewed as a problem solving activity (Flower & Hayes, 1980), facilitating learning. Bereiter and Scardamalia’s (1987) distinction between ‘knowledge transforming’ and ‘knowledge telling’, is a useful approach to understanding the role of writing in the EE and ToK. ‘Knowledge telling’ is the retrieval of information from memory with minimal planning and goal setting, and the writing down of these ideas. In contrast, ‘knowledge transforming’ is a problem solving process where information retrieval is mediated by goal setting and the research question. This requires the active reworking of thoughts, student thinking being shaped by the EE writing process that alters and develops student knowledge. This consideration of writing is aligned closely
with higher level cognitive processes such as problem creating, elaboration of ideas, analysis, evaluation, and meta-cognitive thought (Bruning et al., 1999, p. 313; Langer & Applebee, 1987, p. 41, 42).

While little research has been completed on the relationship between writing and the enhancement of knowledge, parallels exist between the ‘knowledge transforming’ approach and creativity as defined in Chapter 1, that academic creativity is the development of a novel research question, the transfer of an established concept, creative processes and the re-prioritisation of ideas. This requires cognitive development in thinking skills as suggested above. Creativity arises when a student engages in inferential thinking about ideas, as argued above. The capacity to manipulate ideas through writing accessed from stored information, reading or both, makes possible the enhancement of knowledge.

Achievement and creativity in the EE and ToK are inferred from performance on the literary tests. To successfully complete these tasks, students are required to read and write; more specifically, to be able to distinguish essential information from supporting information, to identify ideas when stated in a language different from the original, to have a wide vocabulary and to see relationships between words, sentences and ideas. The present study provides the opportunity to examine the extent to which achievement in the EE and ToK is predicted by student ability to convert written information to knowledge.

5.9 **Student self-efficacy**

The notion of self-efficacy and its effects on the cognitive processes take various forms. Where personal goals are set, these are influenced by a self – appraisal of ability. The stronger the perception of one’s self-efficacy, the more likely high goals will be set and the greater the commitment to them (Bandura, 1991).

Most courses of action are initially shaped in thought. People’s beliefs in their efficacy influence the types of anticipatory scenarios they construct and rehearse. Those who have a high sense of efficacy visualize success scenarios that provide positive guides and supports for performance. Those
who doubt their efficacy visualize failure scenarios and dwell on the many things that can go wrong. It is difficult to achieve much while fighting self-doubt.

Bandura, 1993

Our understanding of human ability as a general capability in which cognitive, motivational and behavioural skills must be organised for different purposes, involves handling emotional reactions that can harm or positively influence our thinking. To achieve not only requires skill, but also self-beliefs of efficacy to manage these skills in adverse or agreeable circumstances. Depending on the situation a student may perform poorly, satisfactorily or excellently depending on their self-efficacy thinking.

Self-efficacy is ‘the belief in one’s capabilities to organize and execute courses of action required to produce given attainments’ (Bandura, 1997, p. 3). It is the belief about one’s competence to learn or perform a task effectively. Academic self-efficacy refers to students’ beliefs concerning their capability to perform given academic tasks at designated levels (Schunk, 1991; Bong, 2001b).

Self-efficacy is distinguished from self-regulation in that self-efficacy for learning concerns beliefs about the self-regulatory processes such as goal setting, self-monitoring, strategy use, self-evaluation and self-reactions to learn. Academic self-regulation is the extent to which students are metacognitively, motivationally and behaviourally pro-active regulators of their own learning processes. Self-efficacy items are phrased in terms of what a student ‘can do’, as opposed to self-regulation where questions are phrased in terms of what they ‘will do’ or ‘usually do’ in a particular domain (Bandura, 2001).

5.9.1 Student self-efficacy and achievement

Evidence clearly reveals the crucial role of self-efficacy perceptions in determining one’s achievement-related cognition, affect and action (Bouffard-Bouchard, Parent, & Larivee, 1991; Pajares, 1996). Students with a strong sense of self-efficacy freely engage in challenging tasks such as problem creation and problem solution, devote greater effort and determination and show superior academic performance to those who
lack such confidence (Bandura & Schunk, 1981; Pajares & Miller, 1994; Pintrich & De Groot, 1990; Schunk, 1981; Zimmerman, Bandura, & Martinez-Pons, 1992). Student self-efficacy is also connected to achievement in academic fields such as reading and writing (Shell, Colvin & Bruning, 1995), Mathematics (Hackett & Betz, 1989; Pajares & Miller, 1994), Science (Britner & Pajares, 2001), and associated with motivation constructs such as self-regulation (Zimmerman, 2000), achievement goal orientation (Urdan, 1997), self concept (Bong & Skaalvik, 2003) and causal attributions (Stajkovic & Sommer, 2000).

Self-efficacy beliefs play a central role in academic achievement. Students who show greater interest and believe they can succeed in their academic work tend to set higher goals, demonstrating greater effort and resilience when difficulties are encountered. These students tend to set themselves more challenging tasks, leading to greater proficiency (Bandura, 1977; Pajares, 1996). Students who believe they are competent at performing academic tasks use more cognitive and meta-cognitive strategies and persist longer than those who do not (Pintrich and Garcia, 1991). Improving self-efficacy might lead to increased use of cognitive strategies and therefore higher performance, as ‘… students need to have both the ‘will’ and the ‘skill’ to be successful in classrooms’ (Pintrich and DeGroot, 1990, p. 38). There is reason to believe that ‘… self-efficacy is a powerful motivation construct that works well to predict academic self beliefs and performance at varying levels but works best when theoretical guidelines and procedures regarding specificity and correspondence are adhered to’ (Pajares, 1996).

According to Bong (2001a), student self-efficacy holds strong subject specific components. Evidence is provided by Bandura (1997), that ‘… individuals are likely to generalise their self-efficacy when different activities share similar sub-skills, when skills in dissimilar domains are developed concurrently, when generic self-regulatory capabilities are acquired, … . Skills taught in different school subjects often share similar sub-skills, especially when they are dependent on strong linguistic or quantitative competencies’ (Bandura as quoted in Bong, 2001a). Skill development in schools tends to take place concurrently, and is based on common self-regulatory capabilities.
There is strong evidence that self-efficacy is able to improve performance in specific cognitive areas and is much more than the reflection of content specific ability (Chemers, Hu, & Garcia, 2001); mathematics students with high self-efficacy will persist longer at problem solving (Bouffard-Bouchard, Parent, & Larivee, 1991), set high aspirations, show greater strategic flexibility in the search for solutions, achieve higher performance, and be more accurate in evaluating the level of their performance than students of equal ability with lower self-efficacy (Bouffard-Bouchard, 1990; Cervone & Peake, 1986).

The present study provides the opportunity to examine the extent to which achievement in the EE and ToK is predicted by the degree of student self-efficacy in the learning process.

5.9.2 Student self-efficacy and creativity

It is reasonable to propose that self-efficacy can affect student perception of their creative ability. In the field of creative cognition, creative capacity is seen as a characteristic of normative human cognition. Not only is creative cognition recognised in scientific, technological and artistic innovation and progress, but in the generative processes associated with everyday thinking. The adaptability of language and development of new constructions from a small set of rules (Chomsky, 1972; Pinker, 1984); the structuring of concrete and abstract concepts from ongoing and discrete experiences suggests a generative capacity (Ward et al., 2002). The ability to create goals for immediate situations, the restructuring of concepts through considering other perspectives, the combining of concepts to create more complex ones (Barsalou, 1987, 1991), and the comprehension and creation of figurative language (Ward et al., 2002), all point towards an enhancing of information.

These cognitive processes and the enhancing of information are normative of the human mind, and produce novel outcomes that satisfy the criteria of a creative product, novelty and utility. To understand creativity, the creative processes must be understood. In
Bandura’s (1986) social cognitive theory, he wrote that students possess a self system that allows a measure of control over their thoughts, feelings and actions. Within this self system are the cognitive structures that enable the ability to learn from others, to plan, self-regulate and evaluate one’s behaviour, engage in self-reflection and create. When a student has positive beliefs about their ability to process and enhance information their self-system, a self-efficacy to be creative is enhanced. This also provides a means of perceiving, regulating and evaluating behaviour between the self system and external environmental source of influence. These mechanisms of behaviour are key elements in the exercise of control and personal agency of student self-efficacy in enhancing knowledge or creativity.

It is reasonable to propose a ‘self-efficacy about creativity’, that creativity is more likely when one has positive beliefs in one’s ability to be creative. Characteristics of a more positive creativity would be demonstrated by spontaneous behaviours that suggest self-confidence in one’s ability to be creative. A less positive self-efficacy would be characterised by a greater dependence (Munro, 2002).

5.10 The role of language

Language learning is fundamental to academic cognitive development and the construction of knowledge (IBO, 2008, p. 4). For successful academic achievement a student must be able to use the language of academic discourse for learning subject matter, the language and subject content being closely interconnected (IBO, 2008, p. 4). A necessary competence is required for an understanding of complex vocabulary, grammatical structures and the required context specific language to perform the tasks needed in academic subjects (Short & Spanos, 1989), with greater demands made on memory and other cognitive processes (Ezra, 2003). A basic proficiency of language is inadequate as students are dealing with a complicated set of language forms. As explained by Cummins (2009), “... non-native speakers might be able to pick up enough English to interact with their peers and teachers relatively quickly, understanding and utilizing the more complex language of textbooks and curricula is much more difficult. It can take longer for a non-native speaker to catch up academically”. Cummins (2000)
argues that at least five years are required for students to reach academic language fluency, or cognitive academic language proficiency (CALP) (Cummins, 2000).

Academic proficiency understood in this sense is the transfer of cognitive skills and conceptual knowledge from the native language to English. This transfer can be expressed as the “... pre-existing knowledge base for making inferences and predictions” Saville-Troike (1988, p. 5). Hakuta (1990, p. 7) describes this process with “... child learning about velocity in Spanish should be able to transfer this knowledge to English without having to relearn the concepts as long as the relevant vocabulary (in English) is available”.

5.10.1 Language and achievement

Research on the relationship between language proficiency and achievement has led to some divergence in findings. Berman and Cheng (2001) found that undergraduate non-native English speakers (NNES) while reporting difficulties with language skills were as successful as native English speakers (NES) when GPA (Grade Point Average) scores were compared while graduate non-native English students with similar language skill difficulties had significantly lower GPA’s than native English speakers. Wicks (1996) found NNES had similar results to Australian students for academic achievement at an Australian University.

Other findings suggest that moderate associations exist between international undergraduate TOEFL (Test of English as a Foreign Language) scores and academic achievement as measured by GPA, number of subjects completed, withdrawals and passing the course (Stoynoff, 1997); TOEFL has been shown to predict GPAs for a number of proficiency levels (Johnson, 1988); writing skills associate with a range of academic results for NNES and NES (Ramburuth, 2001); that mother tongue proficiency influences student poor performance in English in West Nigeria (Oluwole, 2008); that English language proficiency is an indicator and predictor of academic achievement in Nigeria (Fakeye, and Ogunsiji, 2009); and that language learning
correlates with higher academic achievement on standardized test measures (Armstrong and Rogers, 1997; Johnson, Flores and Eillson, 1963; Barik and Swain, 1978).

Language proficiency has also been shown to have a direct affect on the progress of competence in the second language. The failure to progress in first language development has in some cases restricted progress in second language proficiency and cognitive academic growth (Saville-Troike, 1984), while Hakuta (1990) considers mother tongue language proficiency as a robust gauge of second language development. The older a student is the higher the level of cognitive maturity which translates to greater second language proficiency (Snow & Hoefnagel-Hohle, 1977). Maturational constraints on language development, and the level of attainment are dependent on the age at which learning begins (Long, 1990), while Collier (1987) suggests that immigrant and refugee learners are behind academically between the ages of 12 and 18 due to limited English skills.

5.10.2 Language and creativity

Whorf (1956) argued that language shapes thought while Lakoff and Johnson (1956) suggested that language structures convey a culture’s awareness and understanding of the world. Studies have assessed the influence of language on creativity and language can be expected to inform creativity (Lubart, 2002, p. 344). Ricciardelli (1992) in a review of 24 studies assessing the effect of language on creativity found that a positive association existed between bilingualism and creativity in the majority of these cases. The measure of creativity in most investigations was the TTCT, with bilinguals speaking English and a range of languages including French, Spanish, Italian, Greek and Chinese. Ricciardelli (1992) also suggested that a threshold for bilingual proficiency exists before a benefit for creativity can be established.

Lubart (2002, p. 344) suggests that “... language as an integral part of culture may restrict the ways that people can creatively conceive of a problem”. Probable reasons for the benefits of bilingualism include greater flexibility owing to a twofold linguistic perspective (Lambert, 1977; Ben-Zeev, 1977; Mohanty & Babu, 1983). Greater
tolerance for ambiguity which is compatible with the ill defined aspects of problem solving and different linguistic nuances associated with an idea (Ricciardelli, 1992), and a variety of associations to the same idea due to different linguistic networks (Lubart, 2002, p. 344), combine to provide benefits to bilingual students.

A western perspective of creativity usually has in its definition, the production of novel ideas that are useful and appropriate to the situation (Amabile, 1983b; Mumford & Gusstafson, 1988; Lubart, 1994). These novel ideas emphasise a product such as a work of art, a process, solution method or new ways of symbolising an area of knowledge. These ideas are novel in that they are not predicted and distinct from previous work, and satisfy the constraints of being useful and appropriate to the situation (Lubart, 2002). This notion of creativity stresses the importance of an observable product (Hugh & Drew, 1984) that can be assessed by experts or peers, and is to a large extent, a social judgement (Amabile, 1983). This is evidenced with tests used to assess creativity, such as the Torrance Tests of Creative Thinking, which is a product orientated and requires originality based thinking (Torrance, 1974).

In contrast, an eastern conception of creativity is less centred on innovative products, but rather engaged in a state of personal fulfilment, an inner essence or ultimate reality (Chu, 1970; Kuo, 1996). Within this understanding there are culturally divergent views of the importance of creativity (Lubart, 2002), but generally creativity is viewed as a positive construct (Chu, 1970; Joncich, 1964). In Hinduism creativity is viewed as a spiritual expression, rather than a solution to a problem (Aron & Aron, 1982), with less emphasis on originality (Hallman, 1970), while Indian scientists perceive creativity as being the ability to make a new contribution, alongside the ability to synthesize and integrate (Kapur, et. al, 1997). In West Africa, the Hausa and Benin cultures worship their gods of originality and creative individuals praised (Saad, 1985; Ben-Amos, 1986). This view of creativity centres on the poetic, artistic and everyday life domains of creative activity, allowing individuals to represent their own experiences in these life spheres (Wonder & Blake, 1992).
Studies examining the Chinese conception of creativity have found a shared core view with a western understanding, although there is some variation (Rudowicz & Hui, 1997), suggesting the concept of creativity is at least to some degree culture specific. One component in the Chinese construct, missing in a western conception is that of a moral component to creativity (Yang & Sternberg, 1997); while ‘aesthetic appreciation’ is recognised in the western view but not in the Chinese understanding (Rudowicz & Yue, 2000).

The present study takes the mother or native tongue of the learner as the definition of the language variable. It seeks to examine academic achievement in the context of the IB Diploma which is taught in the English medium in this sample of schools, but to students whose native tongue is English, Chinese, Indonesian, Japanese and Korean. More specifically, the ToK and EE are examined from two different language perspectives, as a means of understanding and enhancing knowledge. The H or Holistic criteria, is the measure of creativity. Results on final IBD examinations designed to meet IBO curriculum objectives are taken as the measure of academic achievement.

5.11 Hypotheses

In summary, this study will examine the extent to which learner variables, including beliefs about knowledge, predict achievement and creativity in the EE and ToK. More specifically, its purpose is indicated in the hypotheses examined. These purposes are as follows:

**Hypothesis 1** The EE is perceived by students to be more cognitively demanding than the ToK.

**Hypothesis 2** Achievement in the EE, but not in the Theory of Knowledge, is predicted by student ability to recall and apply relevant subject area knowledge.

**Hypothesis 3** Achievement in the EE and Theory of Knowledge is predicted by:
3a Ease of use of creative thinking strategies (fluency, flexibility, originality, elaboration, abstractness of title and resistance to premature closure);

3b A preference for autonomous or self–determined behavioural regulation;

3c A balanced use of intrinsic and extrinsic motivations to learn;

3d A balanced use of deep, surface and achieving learning approach beliefs and strategies;

3e Student ability to convert written information to knowledge;

3f The degree of student self-efficacy to learn.

**Hypothesis 4:** The association between the above learning influences on achievement outcomes is influenced by the student mother tongue.

This study aims to contribute to the debate about knowledge enhancement and innovation by examining the variables that influence these processes. Hypothesis 1 examines student perception of the comparative difficulty between the EE and ToK, while Hypotheses 2, 3 and 4 will identify the relationship between the named learner variables and beliefs about knowledge and the achievement outcomes in the EE and ToK.

5.12 Chapter summary

Little is known about the degree of student understanding of knowledge and the extent of their ability to enhance knowledge. There is little empirical evidence to support the teaching strategies used in the context of student knowledge about knowledge and knowledge enhancement. The experimental research reviewed in this chapter indicates that the information to knowledge conversion process is essential for creative thinking
and achievement. The multi faceted nature of the learning process makes it impossible to focus on all aspects of the learning process. In order to understand more about the cognitive processes and other factors associated with a student understanding of knowledge, and enhancement of knowledge, a number of hypotheses are presented. These hypotheses will be tested against a number of instruments in conjunction with student perception of the relative difficulty of the cognitive processes affecting the EE and ToK, the extent to which subject area knowledge predicts achievement and the influence of the culture of a student as indicated by their mother tongue.
Chapter 6
Research methodology

6.1 Overview

The theoretical framework of a research activity directs researchers in their efforts to clarify the relationships between the relevant variables. The methodological framework guides the researcher in testing the hypotheses and answering the research questions. The present research has strong theoretical underpinnings with a sound methodology. This is essential as this study uses the International Baccalaureate Diploma as a context for examining the influence of learning factors on student understanding and enhancement of knowledge.

The theoretical orientation of this study is grounded in the behavioural tradition of cognitive psychology where learners are seen as active participants in the processing of information and where the role of knowledge and the student perspective is brought to the learning process, which is critical to the level of understanding achieved.

6.2 Project description

The EE and ToK are essential subjects in the International Baccalaureate Diploma. Taken together they have the potential to develop an explicit awareness of an understanding of knowledge and knowledge enhancement or innovation. The proposed research project examines the extent to which learner variables associated with high achievement are correlated with success in both the EE and ToK. It also investigates the extent to which the EE assesses creativity and innovation. This provides an opportunity to examine the extent to which formal curriculum and pedagogy assists students to become self managing and self directed learners.
6.3 Aim of the research project

The aim of this study is to examine the extent to which learner variables, including beliefs about knowledge predict achievement and creativity in the EE as a way of enhancing knowledge and ToK as a means of understanding knowledge.

6.4 Study design

Principals of schools that offer the International Baccalaureate Diploma were approached with an explanation of the project, and a request to allow the questionnaires to be completed by the students twelve months before they present for final examinations in the November or May sessions. Completion of the questionnaires was voluntary.

The questionnaires are comprised of items that are used to assess student perception of the relative difficulty of the EE and ToK, motivational orientation, cognitive style, verbal and non-verbal reasoning, self-efficacy and approach to learning. The score grades of the EE and ToK were used to investigate the learning characteristics of each student.

By using the achievement level score for Criteria H, Holistic judgement, the EE grades, the subject mark in which the EE was written, and the ToK score, the extent to which learner variables that are associated with high achievement, influence success in the EE and ToK can be examined.

Permission was also requested to approach IBCA (International Baccalaureate Curriculum and Assessment) to release the:

1. Scores for the general assessment Criteria H (Holistic judgement);
2. EE general criteria and subject specific criteria marks;
3. Subjects mark for the subject in which the EE was written;
4. Marks for the ToK oral presentation and essay;

for students who present for their Diploma examinations in the May or November examination sessions.
6.5 Study population

The participants in this study totalled 777 Year 11 International Baccalaureate students who are completing the EE and the ToK. The number of student participants involved in examining each hypothesis differed. The study did not draw on the same cohort when examining each of the hypotheses, but differed by location and source. Of the cohort, approximately 470 students are from schools in Melbourne, while the remaining 300 students study the IB diploma in schools in China, Europe, North America and New Zealand.

Schools were selected on the basis of willingness to be involved. While some 20 schools offered to participate data used in this study came from 12 schools. Of the remaining 8 schools data was either incorrectly collected when considered against the questionnaire instruction sheet or failed to administer the questionnaires. Students at each school volunteered to participate.

The participants submitted their EEs and the ToK assessments in June and November over the period 2001 to 2008. These tasks are assessed by external assessors appointed by International Baccalaureate Curriculum and Assessment in Cardiff, Wales. Their recall and application of relevant subject area knowledge is indicated by the relevant subject score.

As well, participants completed the questionnaire tasks that are intended to examine other aspects of their learning in various relevant areas. The abilities examined and tasks used with the number of participants and schools are shown in the following Table 6.1. The measure for the influence of culture on the learning variables that have an effect on creative academic outcomes is determined by the native or mother language (Language A1) taken by the student. The abilities of the students in China, Europe, North America and New Zealand will be assessed, using same task. Given the dangers inherent in translating tasks developed in the English language into other languages, translation would be done only in concert with teachers in the participating schools in these countries and experts in language translation. It was decided not to attempt to
translate these tasks into Chinese given that this study is an exploratory examination of these learning issues and all students were being taught in English.

Principals were approached with a background statement and overview of the research project, with a Plain Language Statement (Appendix 6.1) and Consent Form (Appendix 6.2) provided to all participants. On the whole schools were cooperative in allowing student participation. Data was collected at the end of the first year of the IB Diploma.

In all cases data was collected in pencil and paper contexts, with the set of tasks being completed by a group of students. No student had access to another student's responses. The actual total time commitment involved did not exceed 150 minutes for any one group of students and the administered task. The tasks were administered at times that did not overlap with regular timetabled teaching sessions.

Student scores on the EE, the ToK and the relevant subject were obtained from the International Baccalaureate Curriculum and Assessment centre in Cardiff, with the written permission from the participating schools and students involved.

Table 6.1  Number of participants and questionnaires

<table>
<thead>
<tr>
<th>Test</th>
<th>Number of participants</th>
<th>Number of schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived difficulty of EE and ToK</td>
<td>77</td>
<td>2</td>
</tr>
<tr>
<td>Creativity test</td>
<td>191</td>
<td>6</td>
</tr>
<tr>
<td>Self – regulation Learning</td>
<td>248</td>
<td>5</td>
</tr>
<tr>
<td>Self – regulation Motivation</td>
<td>248</td>
<td>5</td>
</tr>
<tr>
<td>Beliefs about how to learn (HTL)</td>
<td>302</td>
<td>5</td>
</tr>
<tr>
<td>Learning process Questionnaire (LPQ)</td>
<td>264</td>
<td>5</td>
</tr>
<tr>
<td>Literacy test</td>
<td>191</td>
<td>4</td>
</tr>
<tr>
<td>Self – efficacy EE</td>
<td>225</td>
<td>5</td>
</tr>
<tr>
<td>Self – efficacy ToK</td>
<td>217</td>
<td>4</td>
</tr>
</tbody>
</table>

In all, 12 schools participated in the study. The number of participants and language grouping will be specified for each hypothesis.

In Table 6.2 below details are provided on the participating schools.
Table 6.2  Participating schools data

<table>
<thead>
<tr>
<th>School number</th>
<th>School Location</th>
<th>Private or Public (Government funded)</th>
<th>Language of instruction for Diploma</th>
<th>Date of commencement as IB World school</th>
<th>Gender</th>
<th>May or November examination session</th>
<th>Student numbers</th>
<th>Language A1 taught for 2009 May/November examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Australia</td>
<td>Private</td>
<td>English</td>
<td>1997</td>
<td>Coeducational</td>
<td>May</td>
<td>2284 (K-12) 110 Diploma students</td>
<td>Chinese A1, English A1</td>
</tr>
<tr>
<td>20</td>
<td>Australia</td>
<td>Private</td>
<td>English</td>
<td>1998</td>
<td>Female</td>
<td>May</td>
<td>2241 (K-12) 120 Diploma</td>
<td>English A1, Korean A1</td>
</tr>
<tr>
<td>25</td>
<td>Australia</td>
<td>Private</td>
<td>English</td>
<td>1991</td>
<td>Coeducational</td>
<td>November</td>
<td>3000 (K-12) 239 Diploma</td>
<td>Chinese A1, English A1, German A1, Indonesian A1, Korean A1</td>
</tr>
<tr>
<td>30</td>
<td>Hong Kong</td>
<td>Private</td>
<td>English</td>
<td>1991</td>
<td>Coeducational</td>
<td>November</td>
<td>1400 (K-12) 225 Diploma</td>
<td>Chinese A1, English A1</td>
</tr>
<tr>
<td>35</td>
<td>Australia</td>
<td>Private</td>
<td>English</td>
<td>2004</td>
<td>Coeducational</td>
<td>November</td>
<td>1712 (K-12) 75 Diploma</td>
<td>English A1</td>
</tr>
<tr>
<td>40</td>
<td>Australia</td>
<td>Private</td>
<td>English</td>
<td>1992</td>
<td>Coeducational</td>
<td>November</td>
<td>756 (K-12) 70 Diploma</td>
<td>English A1</td>
</tr>
<tr>
<td>No.</td>
<td>Country</td>
<td>Type funded</td>
<td>Language</td>
<td>Year</td>
<td>Type</td>
<td>Month</td>
<td>IB Code</td>
<td>Diploma</td>
</tr>
<tr>
<td>-----</td>
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</tr>
<tr>
<td>50</td>
<td>USA</td>
<td>State funded</td>
<td>English</td>
<td>1983</td>
<td>Coeducational</td>
<td>May</td>
<td>2250 (Yr 9 – 12)</td>
<td>English A1</td>
</tr>
<tr>
<td>*60</td>
<td>Hong Kong</td>
<td>Private</td>
<td>English</td>
<td>1991</td>
<td>Coeducational</td>
<td>May</td>
<td>250 Diploma</td>
<td>Chinese A1 English A1</td>
</tr>
<tr>
<td>*70</td>
<td>Italy</td>
<td>Private</td>
<td>English</td>
<td>1981</td>
<td>Coeducational</td>
<td>May</td>
<td>200 Diploma</td>
<td>Chinese A1 English A1</td>
</tr>
<tr>
<td>80</td>
<td>Australia</td>
<td>Private</td>
<td>English</td>
<td>1997</td>
<td>Coeducational</td>
<td>November</td>
<td>1560 (K-12) 150 Diploma</td>
<td>English A1</td>
</tr>
</tbody>
</table>


Data for all schools accessed at [http://ibo.org/school/](http://ibo.org/school/) on 19/08/2010 and email with IB Coordinators in August 2010. These data indicate country location and educational/IBO implementation and language data for participating schools.
6.6 Evaluation instruments

The multifaceted nature of the learning process in understanding and enhancing knowledge requires a series of questionnaires to explore all aspects of achievement. Rather than focusing on one aspect, this study examines the extent to which 7 learner variables, including beliefs about knowledge predict high achievement in the EE and ToK.

6.6.1 Comparative cognitive difficulty of the EE and ToK

The present study compares the demands made (on students) in completing the EE and ToK on a number of learning criteria. These learning criteria included the range of thinking involved, the range of phases to complete the EE and ToK, the structuring of student responses, the degree of self control, motivation, the need to be creative and learning processes.

The evaluation of student beliefs about the comparative difficulty of which was more or less demanding to complete, the EE or ToK, was examined by designing a questionnaire on the learning factors that affected the student perceptions of, and the thinking required for both tasks. No instrument of this type was available and one was designed, trialled and administered, to evaluate these student beliefs. A past student was interviewed on her perceptions of the comparative difficulty of the two tasks and which task was more demanding. This interview indicated that student beliefs about the comparative difficulty of the EE and ToK could be rated using a Likert scale. This led to the development of the questionnaire. It was expected that student perceptions of, and the thinking required for these tasks, would confirm that the EE is the more demanding task and poses the greater challenges for the student.

The content of the test sought first to establish which task, the EE or ToK was perceived as the more demanding, with room for the student to explain why they believed this to be the case. Students were able to list as many reasons as possible in the space provided. Second, an initial draft of 31 questions covering the range of thinking involved, the range of phases involved in both tasks, the structuring of student
responses, the degree of self control, motivation, the need to be creative and the learning processes. The questionnaire was trialled with a small group of year 12 students who had completed the EE and ToK. The results of this trial indicated that further modifications had to be made to a number of questions and their structure.

A panel of two experts in Psychology rated the extent to which each question achieved unambiguously its intended purpose and recommended minor modifications. The final questionnaire (Appendix 6.3, Comparative difficulty of the EE and ToK questionnaire) is reproduced in the form it was presented to participants. The test was administered in the students’ regular classrooms, and participants were permitted to use pencil or pen. In all cases students had submitted their EE and ToK essay and completed the ToK presentation.

Due to the complex nature of the second part of the questionnaire arising from the need to compare the EE and ToK on the criteria associated with learning, a clear explanation on how to complete the questionnaire was given. For each criterion the EE and ToK was required to be rated on a scale of 1 to 5, 5 being the most demanding, with no difference in the demands between the EE and ToK requiring a rating of 0.

This test was devised to evaluate which task was perceived by students as being the more demanding. The intention was to establish first, which task was perceived as the more demanding and why students thought this to be the case, and second, how students on a number of learning criteria rated each task as being more demanding. Seventy seven students from schools 10 and 25 completed this test. While teachers administered this survey, the author collated the information to maintain consistency.

6.6.2 Relevant subject area knowledge

The ability to achieve in the EE, but not in the ToK, is predicted by student ability to recall and apply relevant subject area knowledge and was assessed by evaluating the relationship between these variables. The design to test this relationship was to examine the subject score the student achieved and the correlation to EE results for the general and subject specific criteria and total score for the EE. A similar procedure was
used by examining the relationship of the subject score to the ToK essay, oral presentation and total result.

The International Baccalaureate Curriculum and Assessment at Cardiff, Wales in the United Kingdom, assisted in the collection of the relevant data. The total sample size for this investigation was 777 students from 12 schools over 8 examination sessions. The schools were from Europe, U.S.A., China, New Zealand and Australia. Of the 777 students, 555 (71.4%) were English native speakers, 139 (17.9%) were Chinese native speakers, 23 (3.0%) Indonesian native speakers and the remaining 60 (7.7%) of students were from other language groupings or the data was missing. Of the relevant subject area or domain in which the EE was written 603 (82.8%) students were studying the subject at Higher Level, while 169 (23.2%) were presenting at Standard Level. The subject score achieved ranged from a two to a seven, with an average of 5.74 and standard deviation of 1.008.

The subject area in which the EE was written was taken as being representative of the information a student holds along with the mastery of skills in that domain area. This construct includes both declarative and procedural knowledge and provides the base for the use of thinking strategies in the understanding and enhancement knowledge. Data was sifted and collated from each of the data bases established for the other hypotheses, assembling student details, school, mother tongue, higher or standard level, subject area in which the EE was written and achievement outcomes for the EE and ToK. Seven hundred and twenty eight students from schools 10, 20, 25, 30, 40, 50, 60, 70, 80 and 90 had the above details included.

6.6.3 Creative thinking strategies

The Torrance Tests of Creative Thinking (TTCT) is a standardised instrument and was used for this thesis to evaluate creative thinking skills, however it was designed and normed in the United States of America. The TTCT consists of 2 parallel parts, Verbal Form A (1992) (Appendix 6.4) and Figural Form A (1993), (Appendix 6.5).
Verbal Booklet A, ‘Thinking Creatively with Words’ has 6 verbal activities, Asking, Guessing Causes, Guessing Consequences, Product Improvement, Unusual Uses and Just Suppose, yielding scores on each activity for Fluency, Originality and Flexibility. Figural Booklet A, ‘Thinking Creatively with Pictures’, has 3 figural activities, Picture Construction, Picture Completion and Lines that yield scores for 5 mental characteristics, Fluency, Originality, Elaboration, Abstractness of Titles, and Resistance to Premature Closure. In addition the figural test can be scored for 13 creative strengths such as Emotional Expressiveness, Unusual Visualisation, Synthesis of Incomplete Figures, and Fantasy.

The TTCT was chosen as it is based on a general theory of creativity and encompasses both imagery facilitating creative thinking and verbal thinking facilitating the organisation of creative outcomes. It draws on Guilford’s original Structure of the Intellect (SOI) model focusing on the four markers of creative intelligence; Fluency, the production of many ideas; Originality, the uniqueness or novelty of ideas; Flexibility, the willingness to modify ideas; and Elaboration, the extension of ideas.

It is argued that evaluations of the TTCT is ‘… the most extensively researched … and provides adequate updated norms. In addition, both the TTCT and the Wallach-Kogan tests have shown evidence of long-term predictive validity with measures of adult productivity as much as 18 to 22 years later’ (Torrance and Salter, 1989, in Fishkin & Johnson, 1987, p. 7).

McCabe (1991) asserts that the TTCT is ‘… the most widely validated test of creative thinking’, and that the TTCT still has the best tests of creativity and remain ‘… the most popular creativity tests of any kind’ (Colangelo & Davis, 2003, p. 316). Cropley (2001, p. 106), cites the TTCT as ‘… the best known and most widely used of the tests based on divergent thinking … it has established itself on a worldwide basis among practitioners as well as researchers and its role in defining creativity … can scarcely be overestimated’, while Plucker & Runco (1998, p. 36) name the TTCT as the ‘most popular’ of all the divergent measures of creative thinking. Reliability estimates of scores obtained in the TTCT have typically exceeded 0.85 (Kim & Michael, 1995).
Torrance originally claimed that the TTCT are more reliable indicators of giftedness than IQ tests and is supported as

The TTCT have been the most validated of any other tests of creativity, including a 22 year longitudinal validation by Torrance (1981). Plucker’s (1999) reanalysis of Torrance’s longitudinal data indicated that the TTCT predicted adult creativeness three times better than IQ scores.

(in Colangelo & Davis, 2003, p. 317)

The TTCT is suitable for administration to people over a wide age range, readily accepted by respondents and easy to administer and score. In this study 191 students from 6 schools in Australia and New Zealand participated, having completed one year of the Diploma.

Verbal Form A test is appropriate for subjects who have completed year 11, and each test situation was administered to students in groups of between 6 and 20 participants. In administering the series of verbal activities, students took the tests in their normal classroom environment, were instructed that these activities would be enjoyable and invited to have fun (Torrance, 1990, p. 3). The administration instructions were read to all participants. Students were supplied with the test booklets and pencils.

The administrator was supplied with administration instructions, test booklets, and pencils. There are six activities and for each activity. The administrator read the introductory paragraph and ensured the associated questions were understood by the participating students. It was also clearly indicated to students that each activity would be timed.

There are six activities to be completed. Activities 1-3, Ask and Guess, has 3 activities based on a line drawing to which students can refer back. These activities are designed to enable students to ‘… show how good they are at asking questions to find out things they don’t know, and making guesses about possible causes and consequences of the happenings’ (Torrance, 1990, p. 5). In Activity 1, Asking, subjects are given 5 minutes to ask all the questions they would need to ask to know what is happening. Activity 2, Guessing Causes, requires subjects to list as many possible causes of the action shown in the picture and Activity 3, Guessing Consequences, requires a list of as many
possibilities as you can of what might happen as a result of what is taking place in the picture. Both activities are allowed 5 minutes each. Activity 4, Product Improvement, requires students to observe a sketch of a stuffed toy elephant (and display to the group the small stuffed elephant supplied in the examiner’s kit) and to list down the cleverest, most interesting and unusual ways you can think of for changing this toy elephant so that children will have more fun playing with it’ (Torrance, 1990, p. 6). Activity 5, Unusual Uses, asks subjects to think of all the empty cardboard boxes that are thrown away and to think of all the interesting and unusual uses to which these could be put. Activities 4 and 5 are allowed ten minutes each. Activity 7, Just Suppose, provides students with an improbable situation which they need to imagine, for example, that clouds had strings attached to them which hang down to earth, and invites students to list their ideas and guesses as to what would happen (Torrance, 1990, p. 8), with a time limit of 5 minutes.

Performance in all activities are scored on three scales: Fluency, Flexibility and Originality. Originality is defined as ‘… the subjects ability to produce ideas that are away from the obvious, commonplace, banal, or established’. Flexibility is defined as ‘… a person’s ability to produce a variety of kinds of ideas, to shift from one approach to another, or to use a variety of strategies’, while Fluency ‘… reflects the subject’s ability to produce a large number of ideas with words’ (Torrance, 1990).

Figural Form A tests were administered to participants after a break from completing the Verbal Form A activities under similar conditions to those used in the Verbal Form A. Participants were encouraged to see the activities as enjoyable and invited to ‘have fun’. Each test situation was administered to students in groups of between 6 and 20, and overseen in their normal classroom environment. The administration instructions were read to all participants and students were supplied with the test booklets and pencils.

The administrator was supplied with administration instructions for the Figural Form A activities, test booklets, and pencils. Thinking creatively with pictures has 3 activities. The administrator in the introduction to the participants indicates to students that in the
first booklet they had to express their ideas in words. In this booklet they need to express their ideas in other ways. For each test the administrator reads the introductory paragraph and ensured the associated questions were understood by the participants. It was also clearly indicated to students that each activity would be timed.

Activity 1, Picture Construction. Students are shown a curved shape and asked to think of a picture or object that can be drawn with this shape as a part ‘that no one else would think of’. Students are encouraged in the written introduction to ‘Keep adding new ideas to the first idea and to make it tell as interesting and exciting story as you can’. When the picture is completed, a title or name must be written to help tell the story. Five minutes are allocated to this activity. For Activity 2, Picture Completion and Activity 3, Lines, ten minutes are allowed for each activity. In Picture Completion students are shown a series of 10 boxes with incomplete figures and are asked to ‘… sketch interesting objects or pictures that no one else will think of’, and ‘… to keep adding to and building up your first idea’. At the bottom of each box is room for an ‘interesting title’. Activity 3, Lines, consists of 3 pages of parallel lines. These pairs of straight lines should be the main part of whatever object or picture is drawn, with students encouraged to ‘… place marks between the lines, on the lines and outside the lines – wherever you want to in order to make your picture’. Students need to add names or titles in the spaces provided (Torrance, 1992).

Scoring the Figural Form A results in five norm referenced measures that include fluency, originality, abstractness of titles, elaboration and resistance to premature closure. The fluency score is a measure of the subjects’ ability to produce a large number of relevant figural images; originality still ‘… represents the ability to produce uncommon or unique responses the require creative strength’ and elaboration is defined as ‘… the subject’s ability to develop, embroider, embellish, carry out, or otherwise elaborate ideas, …’. Abstractness of title reflects the idea that one must sense the essence of the problem, that in creativity one must ‘know what is truly essential’. Creative behaviour requires the processing of information and a variety of information must be considered and the processing of this information must be kept ‘open’, reflecting the notion of resistance to premature closure (Torrance, 1992).
One hundred and sixty five students from schools 10, 20, 35 and 55 completed the TTCT. The author had a team of two people who were trained to mark the tests, one for the Figural Form and the other for the Verbal Form. Their marking was regularly checked for consistency and reliability.

6.6.4 Self-determined behavioural regulation

Self-regulation questionnaires assess individual differences in terms of behavioural regulation, and the extent to which they represent self-determined functioning. The format of these questionnaires were developed by Ryan and Connell (1989), with each questionnaire asking why the student does a particular behaviour, then providing several possible pre-selected reasons, representing the different type of learning and motivation self-regulation. The central concern is the perceived locus of causality for a learner’s action, to focus on how learners describe their own purposes for acting and the relation of these purposes to a continuum of autonomy (Ryan & Connell, 1989).

In developing new research questionnaires, some slight adaptation of existing questionnaires was needed for new behaviours (http://www.psych.rochester.edu/SDT/). As no directly relevant instrument was available for this study, two self-regulation questionnaires based on Ryan & Connell (1989) were designed to assess individual differences in learning and motivation self-regulation in the context of the EE.

To examine the structure of the reasons in relation to each another, answers were constructed for the why question in relation to the significant behaviours of learning and motivation for participation in the EE. The external reasons were behaviours that could be explained by reference to external authorities such as maximising results, other teachers or friends and the role of the supervisor. Introjected reasons were captured in terms of internal pressures to act by shame or guilt or other approval behaviours. Identifications were developed as reasons for one’s own values, and intrinsic reasons where particular learning and motivation behaviours were done for the inherent enjoyment (Ryan & Connell, 1989).
The learning self-regulation questionnaire (Appendix 6.6) is a structured self-report of reasons as to why students learn in the context of the EE. It asks three questions about why students engage in learning related behaviours followed by a series pre-selected responses that students rank from 1, ‘not at all true’ to 7, ‘very true’. The questions relate to the student reasons for participation in the EE. The questionnaire was formed with two subscales, autonomous regulation and controlled regulation. The responses presented fall into the category of controlled (external or introjected regulation) or autonomous (identified regulation or intrinsic motivation). The validation for this questionnaire was at the level of these two overall categories (Ryan & Connell, 1989).

This questionnaire was based on Learning Self Regulation Questionnaire (SRQ-L), which has two learning questionnaires: one on the reason for participating in the interviewing class (referred to as the Organ Systems within the medical school) and the second on the reasons for participating actively in the organic chemistry class (http://www.psych.rochester.edu/SDT/). Both questionnaires were structured in a similar way, with three questions and between 3 and 5 pre-selected responses for each question. The first question was ‘I will participate actively in the organ system classes/organic chemistry’; second, ‘I am likely to follow my instructor’s suggestions for interviewing/studying Chemistry’; and third ‘The reason why I will continue to broaden my interviewing skills/expand my knowledge of Chemistry is’. These were adapted to:

1. I will participate actively in the EE because:
2. I am likely to follow my supervisor’s suggestion for researching because, and
3. The reason I will continue to broaden my researching skills is because:

The pre-selected responses were then reworked to be consistent with the above three questions on the EE and the introduction read: ‘The following questions relate to your reasons for participating in the EE. Different people have different reasons for participating in such an activity and we want to know how true each of the reasons is for you. There are three groups of items and those in each group pertain to the sentence that begins that group. Indicate how true each reason is for you using the scale:’
These questions and the pre-selected responses were then reviewed by an independent panel of two teachers who had acted as supervisors of students in the EE. The review was to examine the structure and clarity of the questions, the pre-selected responses, and the terminology used. Minor modifications were made.

The content of the motivation self-regulation questionnaire (Appendix 6.7, Motivation self-regulation questionnaire) a self-report designed to examine the reasons why a person learns by researching a topic and asking questions in the context of the EE. It is structured by asking this one question and provides responses that represent external regulation, introjected regulation, identified regulation, intrinsic motivation and amotivation. In responding to this question, twenty pre-selected responses are ranked from 1, ‘not at all true’ to 7, ‘very true’. The basic issue being examined is the degree to which a student feels autonomous with respect to how they learn through researching and asking questions. The questionnaire was based on three versions of a motivation questionnaire, developed by different researchers that have ‘wholly comparable scales’ (http://www.psych.rochester.edu/SDT/).

The questionnaire was based on previously constructed questionnaires for examining the reasons a person exercises regularly. The ‘Motivation for Working Out,’ and ‘Motivation for Gymnastics,’ (http://www.psych.rochester.edu/SDT/), examine the degree to which a person feels autonomous with respect to engaging in regular exercise and gymnastic activity. The one question for the two questionnaires, ‘Why you work out?’ and ‘Why do you practise gymnastics?’ was adapted to ‘This questionnaire concerns the reason why a person learns by researching a topic and asking questions. Please indicate on the answer sheet how true each of these reasons is for you, and why you are involved in the EE.’

The pre-selected responses for ‘The motivation for working out’, and ‘The motivation for gymnastics questionnaires, were placed in a grid (Appendix 6.8, Motivation Exercise self-regulation) and the aspect of motivation listed beside the relevant response. A fourth column was added with the adapted question relevant for the EE. These questions were then reviewed by an independent panel of two teachers who had
acted as supervisors of students in the EE. The review was to examine the intent of the question responses, and the terminology used. Minor modifications were made and the number of questions reduced to 20, the number in the final questionnaire.

In administering the tests, self-regulation learning and motivation questionnaires, the instructions were read to all participants. Students were supplied with the test questions and pencils and the administrator read the introductory paragraph ensuring that the participating students understood the task. It was stated to students that the questionnaire was not timed. Participants then selected a response for each question by circling the relevant number, which ranged over a continuum from one extreme point, ‘not at all true’, to ‘very true’. The mid-point alternative was ‘somewhat true’. Schools 10, 40, 50, 60 and 70 participated in administering the questionnaires with two hundred and forty eight students completing the questions.

6.6.5 Intrinsic and extrinsic motivations to learn

Student preference for a balanced use of intrinsic and extrinsic motivations to learn was examined by using a questionnaire designed by Munro (1996), and based on Pintrich and Schrauben (1992). The questionnaire comprises a set of fifty items examining preferences in motivation to learn (Appendix 6.9, Beliefs about how to learn). Motivational constructs provide insight into student choice as to why they become cognitively engaged in academic classroom tasks. There is an element of choice in students’ use of cognitive strategies and the application of preferred motivation to learn strategies (Munro, 2001; Pintrich & Schrauben, 1992, p. 150), with this approach assuming that student motivation is ‘situation specific’.

The content of the test sought to establish what learners believed about learning and themselves as learners while studying for the IB Diploma. Fifty questions covered the preferences for motivation and the two related intrinsic and extrinsic goal orientations, reflecting student predilection for the task. These preferences indicate reasons for involvement, leading to different patterns of cognitive engagement.
In administering the test, Beliefs, about how to learn, the instructions were read to all participants. Students were supplied with the test questions and pencils and the administrator read the introductory paragraph ensuring that the participating students understood the task. It was stated to students that the questionnaire was not timed. Participants then selected a response for each question by ticking the relevant box, which ranged over a continuum from one extreme point, ‘never applied to you’, to ‘always applied to you’. The midpoint alternative was ‘applied to you about half of the time’. Three hundred and two students from schools 10, 20, 30, 40, and 50, completed this test.

6.6.6 Approaches to learning

The Learning Process Questionnaire (Biggs, 1987) was used to evaluate a students’ approach to learning. It is a standardized instrument designed, normed in Australia and used to assess the extent to which high school level students have different approaches to their learning, and the associated motives and strategies that accompany these approaches.

The Learning Process Questionnaire (LPQ) is a self-report questionnaire is comprised of three scales, surface approach, deep approach and achieving approach, each having a motive and strategy subscale. The questionnaire comprises of thirty-six items, twelve for each approach, divided equally into the two subscales for each approach, each subscale designed to measure the motive or the strategy associated with the student approach to learning (Appendix 6.10, Learning Process questionnaire). Each item is a statement of a motive or a strategy. Scores are yielded on three basic motives for learning and three learning strategies, and on the approaches to learning formed by a composite of these motives and strategies. The three approaches to learning are deep, achieving and surface, and these ‘… profiles represent an individual’s general orientation to learning: that is, a composite of motivational states and strategy deployment that is relatively consistent over situations’ (Biggs, 1987, p. 3).

Surface and deep strategies explain the ways in which learners connect in the task, while the achieving strategy describes the ways learners ‘… organise the temporal and
spatial contexts in which the task is carried out’ (Biggs, p. 3). It is possible for learners to combine an achieving approach with either a surface or deep approach. These three approaches describe ‘fairly consistent orientations, or learning styles’…, that persist ‘over reasonable periods of time’ (Biggs, p. 4) which lead to different kinds of learning outcomes and result in poor or good performances in the assessed tasks.

The instructions for the administration of the test are printed on the questionnaire and were read or explained to the students prior to answering the items. Emphasis was placed on the questions examining the students’ attitude towards their studies and their usual way of learning in school. It was also clearly stated that there is no right or wrong way about the approach a student took to their learning. The administration time allowed was 10 minutes.

For each item students rated themselves and recorded their answers on an answer sheet with a row of boxes for a five-point scale, marking the selected response. The respondents could rate the item statement as ‘Always or almost always true of me’ to ‘Never or only rarely true of me’. The LPQ is designed for use with a separate answer sheet with clear labelling about how these responses should be shown. The sample consisted of two hundred and fifty eight students who had completed a year of the International Baccalaureate Diploma. The 5 schools were from Australia, Hong Kong and the U.S.A..

A number of studies in different countries and cultures have investigated the factor structure of the LPQ and generally supported its validity. Studies in Australia (Ramsden et al., 1989; Watkins & Hattie, 1990; Bochner, 1996), Canada (Andrews et al., 1994) and Nigeria, (Watkins & Akande, 1994), have all generally confirmed the internal structure of the LPQ. This suggests that there some cross – cultural validity to the broad distinctions between the surface approach and deep approach, although the pattern is not always consistent. Evidence suggests that students in Hong Kong construe the subscales in a different manner from students in Britain and Australia, where an Asian learner adopting the deep approach to learning seeks to memorise and understand at the same time (Wen & Marton, 1993; Marton et al., 1995). This indicates
further work is needed if the surface dimension is to be unambiguously interpreted when applied to non-Western students (Eklund-Myrskog & Wenestam, 1999). Two hundred and sixty four students were involved in this study from schools 10, 20, 40 and 50.

6.6.7 The conversion of written information to knowledge

The procedures used to investigate the extent to which literacy skills are associated with the EE and ToK achievement scores was to examine the relationship of these variables with student ability to distinguish essential information from supporting information, to identify ideas when stated in a language different from the original, the effect of a wide vocabulary and to see relationships between words, sentences and ideas.

The English Skills Assessment (ESA) (1982) is a battery of tests designed for use with secondary students at Year 11 and Year 12. The essential purpose of this instrument is to assist in ‘… identifying individual strengths and weaknesses in areas of English and reading skills. By studying the pattern of student responses’, … teachers will be able to pinpoint gaps and misconceptions in student knowledge’. These tests provide the means of examining student ability to convert written information to knowledge. The three components used are, Comprehension 1, Vocabulary, and Logical relationships (Appendix 6.11, Literacy skills test).

The Comprehension Test is designed to measure ‘… a student’s ability to read and understand passages written in a variety of styles, about a variety of subjects’ (English Skills Assessment, 1982). Students need to read three passages, each of about 400 to 500 words in length, and accompanied by five questions. The articles allow an investigation of the following characteristics of comprehension skills:

1. The skills of understanding the main ideas and direct statements enable students to discriminate necessary information from supporting information and the ability to restate a paragraph or section of work in their own words. In comprehending written material there is an implication of a knowledge of
sentence structure, vocabulary, word relationships and the recall of sequences of ideas and information.

2. Translation and inference questions test a student’s ability to identify ideas when stated in a language different from that originally presented. This aspect is to test the ability to construe the meaning of unusual or difficult words, phrases or sentences, and the ability to apply ideas to new situations.

3. An ability to analysis a passage involves being able to evaluate its logical structure, and identify and evaluate a piece of writing in terms of the influences on the creator, such as the purpose of writing the work, attitudes and beliefs.

The vocabulary test is a measure of the extent of a student’s word knowledge. Participants are asked to choose a synonym for a given word, with twenty word questions to complete. As the words are not tested in context, it is worth noting that some students may not recognise words in isolation, but can provide a meaning when sighted in context (Goodman, 1995).

Logical Relationships test whether students recognise relationships between words, sentences and ideas. There are three sections to this item. In the first item participants are required to chose a word or phrase that best joins the sentence logically from a choice of four possibilities; second, chose a word or phrase that has the same relationship as a given pair of words; and third, determine the relationship between two sentences. The skills are classified into the following groups (English Skills Assessment, Manual, 1982):

1. Using appropriate connectives;
2. Drawing analogies;
3. Recognising principles of organisation.

While it is difficult to separate and isolate comprehension skills, (Spearritt, 1977), the aspects of comprehension tested in ESA measure a fairly general ability (English Skills Assessment, Manual, 1982).
The total sample size for this investigation was 191 students from 4 schools over 2 examination sessions, all schools being in Australia. Of these students, 85 (45%) were English native speakers, 91 (48%) were Chinese native speakers with the remaining languages including Indonesian, Japanese and Korean native speakers.

In the administration of the Literacy Test, a classroom environment that was familiar to the students was used. Students were supplied with the test questions, answer sheets and pencils, and for each section of the test, the administrator read the introductory paragraph ensuring that the participating students understood the task. Forty five minutes was allowed to complete the tasks, twenty two minutes for the comprehension, ten minutes for the vocabulary and ten minutes for the logical relationships. For the comprehension test, students circled their selected response from four alternatives on a multiple choice style answer sheet and did similarly for the vocabulary and logical relationships. All test booklets and answer sheets were collected at the conclusion of the testing. The administrator was encouraged to maintain as ‘normal a classroom as possible’.

Students from schools 10, 40, 80 and 90 participated in the Comprehension, Vocabulary and Logical Relationships tests that formed the literacy assessment. Overall one hundred and ninety one students participated with eighty five students from Group 1 (presenting in English A1) and ninety one students from Group 3 (Chinese A1).

6.6.8 Student self-efficacy

The present study examines the extent to which self-efficacy scores are associated with achievement scores in the EE and ToK. The role of self-efficacy in displaying academic creativity will also be examined. The evaluation of self-efficacy in the context of the EE and ToK was examined by designing two questionnaires on student perception of how confident they felt in being able to think about their EE in various ways and their feeling of confidence about writing the essay and making the oral presentation task in ToK.
While the measuring of self-efficacy is task specific, it is also recognized that ‘… that one can face a wide range of tasks situations with comparable self-efficacy’ (Bong, 2001a), and that self-efficacy developed in a particular context, can generalise to other tasks (Bandura, 1997; Pajares, 1996, Schunk & Swartz, 1993).

Self-efficacy has been assessed in a range of ways. One of the most effective procedures assess the particularised self-perceptions of competence by ‘… asking individuals to report the level, generality, and strength of their confidence to accomplish a task or succeed in a certain situation’ (Pajares, 1996). This can be accomplished in two ways. First, by asking students to provide judgements of confidence to complete particular tasks (Konstantopolous, 1996). In educational settings, ‘self-efficacy instruments may ask students to rate their confidence to solve specific mathematical problems’ (Hackett and Betz, 1989 as quoted in Pajares, 1996), perform particular reading or writing tasks, or taking part in certain self-regulatory strategies (Bandura, 1989). Second, by monitoring student spontaneous use of a range of thinking behaviours that indicate a positive belief in their capacity to be creative or an expectation when approaching tasks that they will be creative (Munro, 2002). Assessment of these expectancy beliefs includes requesting students to detail or respond to how well they expected to achieve in an academic subject (Meece, Wigfield, & Eccles, 1990), did they understand what they read, that is their perceptions of competence (Harter, 1982), their academic domain specific self-concept (Marsh, 1992) and ability perceptions (Meece et al, 1990).

No instrument was available to examine the degree of self-efficacy on student confidence in approaching the EE and ToK. A questionnaire designed by Munro (2003) was used for assessing the degree of self-efficacy in students who were currently presenting for the EE. The questionnaire was constructed to examine student confidence in their capacity to be creative and an expectation when approaching tasks that they will be creative. A second questionnaire was designed by Hamer (2003) for determining the degree of self-confidence when writing the essay and oral presentation
task in the ToK. Both questionnaires were designed in terms of the criteria that are used to assess these tasks.

The test on self-efficacy and the EE (Munro, 2003), ‘Ways of thinking about the EE’ (Appendix 6.12, Self-efficacy EE) presented students with seventeen sentences and asked them ‘… to comment on how well you can think about the EE in various ways’. Students had to read each sentence and then decide ‘how confident they felt about being able to’, responding to each statement by indicating how often it was true for them, on a scale of (1), ‘it is never true’, through to (5), ‘always true for you’.

The test on ‘Ways of Thinking about the ToK’, (Appendix 6.13, Self-efficacy ToK) presented students with twenty sentences with students required to ‘… comment on how confident you feel about the written essay and oral presentation tasks in the ToK’. The generic question, ‘How confident do you feel about being able to’: followed by the sentence question to which students responded on a scale of (1), ‘it is never true’, through to (5), ‘always true for you’.

The test was administered to students in their Year 12 or second year of the IB Diploma, when the EE and ToK tasks were near completion, or in some cases, had been completed and submitted. The test was administered to students in regular classrooms, with participants instructed that there was no time limit. In administering the test, students were instructed that there were no correct answers but to decide how true these questions were for them.

Two hundred and twenty five students sat the ‘Ways of thinking about the EE’ from schools 10, 40, 50, 60 and 70, while two hundred and seventeen students questionnaire responses from schools 10, 50, 60 and 70 were included in the data analysis foe the ToK.

6.6.9 The role of language

To test the association between the above learning influences of language on achievement outcomes, the ‘native language’ or ‘mother tongue’ of the student groups
were taken and used to separate students into 2 groups. Those whose native tongue was the English language formed Group 1 and students whose native language was Chinese formed Group 3. The mean score for EE results for the general and subject specific criteria and the overall score for the EE was examined on the basis of the language groupings. A similar procedure was used to examine the association between the ‘native language’ and the ToK results. To examine the association between the role of language and creativity, the ‘native language’ groupings were taken and the mean scores for the H criteria for each of these groups in the EE was examined.

The International Baccalaureate Curriculum and Assessment at Cardiff, Wales in the United Kingdom assisted in the collection of the relevant data. The total sample size for this investigation was 776 students from 12 schools over 4 examination sessions. The schools were from Europe, U.S.A., China, New Zealand and Australia. Of the 776 students, 555 (73.5%) were English native speakers, 23 (3.0%) Indonesian native speakers, 139 (18.4%) Chinese native speakers and the remaining 38 (5%) students were from 15 other language groups.

6.7 Data analysis

Data will be analysed to examine the extent to which learner variables predict creativity and achievement outcomes in the EE. The ToK scores will be used to investigate the effect of existing beliefs about knowledge on these achievement outcomes. The Statistical Package for Social Sciences (SPSS 16.0 Graduate Student Version) was used to carry out the statistical analysis (descriptive statistics, factor analysis, correlations, regression, post hoc and Chi Square tests and ANOVA). Factor analysis will use Varimax with Kaiser Normalisation, values below 0.40 to be suppressed. Incomplete data sets are excluded in the analysis. A detailed explanation of the approach to data analysis will be outlined at the start of each hypothesis in Chapter 7 Reporting of results.

6.8 Measures of achievement in the EE and ToK

In summary this study will examine the role that learner variables, including beliefs about knowledge, predict achievement, and creativity in the EE as a way of enhancing
knowledge and ToK as a means of understanding knowledge. More specifically the purpose is indicated in the hypotheses examined and the achievement measures used as outlined in Table 6.1, ‘Measures of Achievement in the EE and ToK’. The hypotheses outlined in the Table 6.1 will identify the association between the learner variables and the achievement outcomes. If an association exists then this relationship should be displayed in the correlation between the learner variables and achievement outcomes. The extent of this relationship will be determined by the levels of significance that will be judged to be influenced by cognitive factors. The Pearson correlation coefficient will be used to determine the levels of correlation.

Further evidence of the association between subject area and achievement outcomes will be observed in the predictive characteristics of the tests used in this study. The predictive characteristics will be determined using beta coefficients and the square of the multiple correlation coefficient, R². This will identify the predictive nature of the subject domain, and enable a comparison between the instruments when more than one shows predictability for the same subject domain.
### Table 6.3 Measures of Achievement in the EE and ToK.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Independent Variables</th>
<th>Measure</th>
<th>Analysis</th>
</tr>
</thead>
</table>
| **Hypothesis 1**  
The EE is perceived by students to be more cognitively demanding than ToK | Student perception of relative difficulty of cognitive processes affecting the EE and ToK | A questionnaire comprising a set of items based on examining the relative difficulty of the EE and ToK | Mean differences in students’ ratings of comparative difficulty between the EE and ToK are analysed using paired sample t tests |
| **Hypothesis 2**  
That achievement in the EE, but not in ToK, is predicted by student ability to recall and apply relevant knowledge | Relevant subject area knowledge | Subject score given in final IB examination | The extent to which subject achievement scores predict EE and ToK scores are examined using multiple regression procedures. |
| **Achievement in the EE and ToK is predicted by:** | | | |
| **Hypothesis 3a**  
Ease of use of creative thinking strategies (fluency, flexibility, originality, elaboration, abstractness of title, and resistance to premature closure). | Relevant verbal and figural dimensions of creativity. | Verbal and Figural scores given for the different dimensions of creativity on the Torrance Test of Creative Thinking, Torrance, E.P. (1999). Beaconville, IL: Scholastic Testing Services | The extent to which the verbal and figural creativity scores predict achievement scores and creativity (H criteria) in the EE and ToK scores are examined using multiple regression procedures. |
| **Hypothesis 3b**  
A preference for autonomous or self-determined behavioral regulation. | Relevant self-regulation strategies for achievement | Intrinsic (or mastery) belief score and performance (or extrinsic) motivation belief score. 2 sets of questionnaires based on Deci and Ryan (2000). | The extent to which self-regulation scores predict achievement scores in the EE and ToK scores are examined using multiple regression procedures. |
| **Hypothesis 3c**  
A balanced use of intrinsic and extrinsic motivations to learn | Relevant intrinsic or mastery motivation belief and performance or extrinsic motivation belief score of creativity. | A questionnaire comprising a set of items examining motivation to learn based on Pintrich, P. R., and Schrauben, B. (1992) | The extent to which intrinsic (or mastery) belief scores predict achievement scores in the EE and ToK scores are examined using multiple regression procedures. |
| Hypothesis 3e | Relevant comprehension, vocabulary, and logical relationship variables of creativity. | Comprehension, vocabulary, and logical relationship variable scores based on the English Skills Assessment (ESA) Australian Adaptation (1982). Hawthorn, ACER. | The extent to which literacy skills are associated with EE and ToK scores are examined using linear correlation procedures. |
| Hypothesis 3f | Relevant self-efficacy variable of creativity. | Self-efficacy score. A questionnaire comprising a set of items based on examining the role of self-efficacy in displaying creativity | The extent to which self-efficacy scores are associated with achievement scores in the EE and ToK are examined using multiple regression and linear correlation procedures. |
| Hypothesis 4 | Relevant learning variable scores of creativity. | Influence of above learning variable scores of creativity based on mother language of student. | The extent to which students’ first language influenced EE and ToK scores was examined using multivariate analysis of variance procedures. |
6.9 Chapter summary

Nine tests were utilised for this study to assess the learning factors that affect achievement in the EE and ToK and creativity in the EE. Three of these instruments were commercially available and provided standardised data in the form of percentile ranks. These instruments were the Torrance Test of Creative Thinking; How I Approach Learning, Pintrich and Schrauben, 1992; and the Learning Process Questionnaire (Biggs, 1987). Two of the sets of questionnaires on self – determined behaviour are based on Deci and Ryan (2000), while the third on literacy is based on the English Skills Assessment (ESA) Australian Adaptation (1982). Two other instruments were specifically designed to measure self efficacy and were titled ‘Ways of thinking about the ToK’ and ‘Ways of thinking about the EE’. The design of these questions was based on the criteria for assessing the ToK and EE. The final instrument used was to measure the perception of students on whether the ToK or EE was cognitively more demanding. This test was titled ‘The EE and ToK’, which underwent an extensive process of development to reach its final form. This test was trialled before being used in the project.

All questionnaires were administered in the class rooms of the students by the class teacher at the end of the students first year of the Diploma. Sets of teacher instructions were provided for test administrators and email and phone conversations were also used for clarification where necessary with interstate of overseas test administrators.

Student data was by arrangement provided by the International Baccalaureate Organisation in Cardiff, Wales. This data included the students General Criteria score, the Subject Specific score, H score and Total score for the EE; the ToK essay, ToK presentation and ToK total score; and the students subject area that the EE was written in, along with the subject grade.

Hypothesis 1 examines student perception of the comparative difficulty between the EE and ToK, displayed by the mean differences on student rating of the cognitive demands of each task. Hypotheses 2, 3 and 4 will identify the relationship between the named learner variables and beliefs about knowledge and the achievement outcomes in the EE.
and ToK. The extent of these relationships will be shown by the level of association using Pearson’s correlation coefficient and the levels of significance (p value) will be influenced by these learning variables. The influence of school and language on the explanatory variables will be examined using an ANOVA model.

The predictive nature of subject area knowledge will be further analysed using regression techniques. The regression method will be used to analyse the predictive strength of subject area knowledge on the EE and ToK achievement outcomes, including creativity. The relationship between subject area knowledge and creativity will be further analysed using parson Chi-square independence test to examine whether the subject score affects the H criteria.
Chapter 7
Reporting of results

7.1 Overview

The present study examines the learning influence of various knowledge and cognitive factors on the achievement outcomes in the EE and ToK. The influence of these variables on the achievement outcomes are examined in this chapter.

7.2 Comparative difficulty of the EE and ToK

Hypothesis 1: The EE is perceived by students as being more cognitively demanding than ToK.

The student beliefs on which task they found more demanding is examined in two parts. In part (1) students indicated which task they believed was more or less demanding and were able to give reasons as to why they thought this the case. In part (2) students rated their beliefs as to which task, the EE or ToK, was the more or less demanding on the basis of 33 paired questions covering seven learning categories.

7.2.1 Student beliefs as to which task was more or less demanding

The rating by the sample of 77 students on their perception of which task they believed to be more or less demanding is documented below. These perceptions are acknowledged as subjective. Fifty five students (71.4 %) perceived that the EE was more demanding than the ToK, while 15 (19.5 %) rated the ToK as the more demanding. Seven students (9.1 %) indicated that they found the EE and ToK made equal demands.

Participants were then asked to explain the factors that affected their perception as to why they believed their choice to be the more or less demanding. Each student response was categorised and listed in Table 7.1. Students are likely to differ in what
they judge as more or less demanding and in their understanding as to why this would be, with some students elaborating their responses.

These data indicate that the reason identified by students as the most significant in making the EE more demanding involved the amount and depth of research required. Following closely was the amount of time required for this task. Those reasons identified as having medium demand involved students creating their own topic or hypothesis, the requirement to organise themselves along the EE pathway and their ability to analyse and understand the information and its conversion to knowledge. Those areas identified as being least important in making the EE more demanding involved the use of greater outside knowledge, the independence required and no specific time for the completion of the process.

Table 7.1 Reasons given for the EE being more demanding

<table>
<thead>
<tr>
<th>Reason</th>
<th>% of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount and depth of research required</td>
<td>26</td>
</tr>
<tr>
<td>Time required for researching, drafting, refining</td>
<td>21</td>
</tr>
<tr>
<td>Ability to write a long essay</td>
<td>15</td>
</tr>
<tr>
<td>Creating own topic/hypothesis</td>
<td>9</td>
</tr>
<tr>
<td>Good planning and management</td>
<td>8</td>
</tr>
<tr>
<td>Analysis and understanding required</td>
<td>5</td>
</tr>
<tr>
<td>Preparation and discussion</td>
<td>4</td>
</tr>
<tr>
<td>Independence</td>
<td>4</td>
</tr>
<tr>
<td>Greater outside knowledge</td>
<td>4</td>
</tr>
<tr>
<td>No specific time</td>
<td>4</td>
</tr>
</tbody>
</table>

Students who found the EE less demanding suggested choice of topic, greater enjoyment, increased motivation, ease of researching and writing and greater interest in the task influenced this judgement.

The reasons given for ToK being the more demanding task are listed in Table 7.2. These data indicate a smaller range of reasons given as to why students took this view. ToK was perceived as being the more demanding due to the greater
abstractness in the concepts and the higher level of thinking, the ‘ToK thinking skills’ required. Students perceived the criteria as being restrictive, while reasons of least importance were the interlinking of ideas from the different areas of knowledge, originality and limited teacher support.

Students who judged the ToK as being less demanding perceived that more information and resources were available, the assessment requirements (ToK oral and ToK essay) were ‘shorter’ and required less time to meet the criteria, greater teacher support was given and the opportunity to choose from a prescribed list of questions lead to the student perception that the ToK assessments was less challenging.

Table 7.2 Reasons given for the ToK being more demanding

<table>
<thead>
<tr>
<th>Reason</th>
<th>% of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required higher level of thinking</td>
<td>20</td>
</tr>
<tr>
<td>Concepts more abstract</td>
<td>20</td>
</tr>
<tr>
<td>Questions prescribed</td>
<td>17</td>
</tr>
<tr>
<td>Criteria more restrictive</td>
<td>10</td>
</tr>
<tr>
<td>Time</td>
<td>10</td>
</tr>
<tr>
<td>Broader knowledge</td>
<td>7</td>
</tr>
<tr>
<td>ToK style and language</td>
<td>7</td>
</tr>
<tr>
<td>Interlinking of ideas</td>
<td>3</td>
</tr>
<tr>
<td>Originality</td>
<td>3</td>
</tr>
<tr>
<td>Support limited</td>
<td>3</td>
</tr>
</tbody>
</table>

7.2.2 Student rating of learning criteria on the extent to which they found the EE or ToK more demanding

Fifty nine students from two schools completed the questionnaire comparing the relative cognitive complexity of the EE to the ToK on a number of learning criteria. Questions were developed in terms of these seven learning categories:

1. Ways of thinking needed for successful completion;
2. Range of phases required to successfully conclude the ToK and EE;
3. Structuring of responses;
4. Degree of self control;
5. Motivation;
6. Need to be creative;
7. Learning processes.

Students were asked to compare and rate each question on a Likert type scale of 1 to 5 for the EE and 1 to 5 for the ToK, as to which task was the more demanding. The higher the score measured the greater demands made by the task for each paired learning question. Each student response indicated which of the two tasks was judged to be more demanding. An overall mean was calculated for the EE and ToK, and for each question a mean was calculated for the EE and the ToK. These means were then used to calculate the mean differences which were then ranked.

The overall mean for the paired EE total and paired ToK total was calculated and then compared to establish whether the difference between the two means was statistically significant (Appendix 7.1). The student rating for the task was perceived as the more demanding suggests that students found the EE as being the more cognitively complex. The overall mean for the EE was 97.74 (SD = 27.45) compared to 83.88 (SD = 28.43) for the ToK. This suggests that the EE was perceived as more difficult than the ToK with a mean difference of 13.86 and standard deviation of 27.44 (t = 3.81, p < .001). The Pearson Chi-Square Test Goodness of Fit Measure, $\chi^2 (1) = 51.55$, p < .001, supports the contention that student rating of the EE as the more difficult is statistically significant. Of note is the variability (SD) about the mean which is similar for both the EE and ToK.

These results are now examined in terms of the learning categories involved in completing the EE and ToK. The learning categories and questions with mean differences and levels of statistical significance (p < .05) between the EE and ToK are listed in Table 7.3, below (Appendix 7.2, Paired sample t test for the comparative difficulty of the EE and ToK).

These data indicate that categories A, F and G had questions where higher mean differences exist for both the EE and ToK. For categories B, C, D and E student responses indicated the EE only had the higher mean differences, statistically significant
at the p < .05. The mean differences and confidence intervals for all questions are now graphed in Figure 7.1, below.

Table 7.3  Mean differences between means significant at the .05 level

<table>
<thead>
<tr>
<th>Category</th>
<th>Question</th>
<th>Learning factor</th>
<th>Questions where ToK has the higher mean difference significant at .05 level</th>
<th>Questions where the EE has the higher mean difference significant at .05 level</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Question 1 – 5</td>
<td>Ways of thinking</td>
<td>2</td>
<td>3, 5</td>
</tr>
<tr>
<td>B</td>
<td>Question 6 – 10</td>
<td>Range of phases</td>
<td>Nil</td>
<td>6, 7, 8, 9, 10</td>
</tr>
<tr>
<td>C</td>
<td>Question 11 – 15</td>
<td>Structuring of response</td>
<td>Nil</td>
<td>11, 12</td>
</tr>
<tr>
<td>D</td>
<td>Question 16 – 19</td>
<td>Self control</td>
<td>Nil</td>
<td>17, 18, 19</td>
</tr>
<tr>
<td>E</td>
<td>Question 20, 21</td>
<td>Motivation</td>
<td>Nil</td>
<td>21</td>
</tr>
<tr>
<td>F</td>
<td>Question 22 – 25</td>
<td>Need to be creative</td>
<td>24</td>
<td>22</td>
</tr>
<tr>
<td>G</td>
<td>Question 26 – 33</td>
<td>Learning processes</td>
<td>Nil Equal rating to the EE</td>
<td>28, 30</td>
</tr>
</tbody>
</table>

In four of the learning categories, range of phases, structuring of response, self-control and motivation, all student responses to these questions rated the EE with a higher mean difference (Figure 7.1). The category, ways of thinking, had the greatest range of responses.

The category, structuring of responses, with a higher mean difference (p < .01) for questions 11 and 12, suggests that students have difficulty establishing the focus and direction of their EE, with the collection of relevant information to sustain their argument and arrive at consistent conclusions.
Figure 7.1  Graph of mean differences between EE and ToK and confidence limits
The category self-control, is a measure of student self-perception of the extent to which they work independently of their teachers or supervisors, trying new ways of working and researching. The EE is rated by students as being the more difficult, with questions 17, 18 and 19 having higher means, the mean difference being significant for 17 and 18 (p < .05) and 19 (p < .001). Student responses to Question 16 has the EE with a higher mean, but the mean difference is not significant (p = .05). This is again suggestive of the difficulty with the independent nature of the EE task.

Both questions in the motivation category have the EE with a higher mean difference, but only question 21 on asking questions and doing research is significant (p = .004). These data suggest that the EE, in terms of this learning category, is perceived by students to be a more demanding task reflecting the complexity of the learning process and the non-automatism of skills needed to enhance knowledge.

In the learning category, ways of thinking, the greatest range of responses occurred with, a higher mean difference for questions 3, the analysis to be completed, and 5 constructing the guiding question (p < .001) in the EE. Question 2 has a higher mean difference for the ToK (p < .001), with students suggesting greater depth of thought is required and question 1 had a higher mean for ToK, but not significant (p > .05).

These findings suggest that students have most difficulty in creating the question or issue, and the time taken to research, collect the relevant information and to write this up in a coherent manner. Implications of this exist for the EE, including:

- the nature of problem creating and problem representation; and
- development of research skills.

### 7.2.3 Ranking of mean paired differences

Table 7.4, Ranking of mean paired differences, orders student responses from to highest to lowest on their beliefs as to the relative cognitive complexity of the EE and ToK.
These data suggest that the group of questions that students found most demanding were the range of phases. Individual rankings indicate that pair 8 with the largest mean difference (p < .001), was believed to be the most demanding in the EE because students ‘... had to write up...’ the question or topic, followed by pair 6 (p < .001) where students also found the EE more demanding due to its continuous nature and the length of time over which it is written.

It has been argued in this thesis that the issue of creative problem recognition and the construction of a clear problem statement is a question of importance in the initial stages of an EE. These data suggests a recognition of this by students through the rating of pair 5, (Ways of thinking), where the EE was found to be more demanding because students ‘... had to work out the guiding the issue/question’ (p < .001). This finding is further reinforced with the result from pair 9 (p < .001), with students believing that it was more demanding to ‘... develop a plan of action and decide on the step to take’; pair 12 and 7 which recognizes the demands ‘... of collecting relevant information to answer the question (or topic)’ (p < .001), when compared to the ToK; and pair 11 with students needing to develop their ‘... own focus/direction’ (p < .001).
Table 7.4  Ranking of mean paired differences

<table>
<thead>
<tr>
<th>Question: I found the extended essay/Tok more demanding because:</th>
<th>Paired Differences</th>
<th>95% Confidence Interval of the difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean difference</td>
<td>Lower</td>
</tr>
<tr>
<td>Pair 8 ee8-tok8</td>
<td>2.06</td>
<td>1.52</td>
</tr>
<tr>
<td>I had to write up my question (topic)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 6 ee6-tok6</td>
<td>1.11</td>
<td>.67</td>
</tr>
<tr>
<td>It was continuous and completed over a long period of time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 5 ee5-tok5</td>
<td>1.09</td>
<td>.45</td>
</tr>
<tr>
<td>I had to work out the guiding issue/question</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 9 ee9-tok9</td>
<td>1.02</td>
<td>.62</td>
</tr>
<tr>
<td>I had to develop a plan of action and decide on the steps to take</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 12 ee12-tok12</td>
<td>.98</td>
<td>.53</td>
</tr>
<tr>
<td>I needed to collect relevant information to answer the question</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 7 ee7-tok7</td>
<td>.87</td>
<td>.37</td>
</tr>
<tr>
<td>I need to collect relevant information to answer the question (or topic)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 11 ee11-tok11</td>
<td>.85</td>
<td>.38</td>
</tr>
<tr>
<td>I needed to develop my own focus/direction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 3 ee3-tok3</td>
<td>.83</td>
<td>.44</td>
</tr>
<tr>
<td>Of the analysis I need to complete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 28 ee28-tok28</td>
<td>.80</td>
<td>.38</td>
</tr>
<tr>
<td>I have to work on questions outside my set course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 30 ee30-tok30</td>
<td>.79</td>
<td>.33</td>
</tr>
<tr>
<td>I have to read new material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 19 ee19-tok19</td>
<td>.69</td>
<td>.35</td>
</tr>
<tr>
<td>I can learn new ways of researching</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 21 ee21-tok21</td>
<td>.61</td>
<td>.20</td>
</tr>
<tr>
<td>I have to ask questions and do research</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 17 ee17-tok17</td>
<td>.57</td>
<td>.21</td>
</tr>
<tr>
<td>I have to rely on my teachers or supervisor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 10 ee10-tok10</td>
<td>.56</td>
<td>.20</td>
</tr>
<tr>
<td>I needed to monitor and revise my action plan as I progressed through the task</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 18 ee18-tok18</td>
<td>.33</td>
<td>.07</td>
</tr>
<tr>
<td>I can try new ways of working by myself</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 22 ee22-tok22</td>
<td>.33</td>
<td>.02</td>
</tr>
<tr>
<td>I can explore ideas as I want to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 13 ee13-tok13</td>
<td>.34</td>
<td>-.05</td>
</tr>
<tr>
<td>I needed to make a convincing argument relevant to the issue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 26 ee26-tok26</td>
<td>.29</td>
<td>-.15</td>
</tr>
<tr>
<td>It is difficult to do enough work on the topic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 14 ee14-tok14</td>
<td>.29</td>
<td>-.02</td>
</tr>
<tr>
<td>I needed to make a conclusion consistent with the argument</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 15 ee15-tok15</td>
<td>.18</td>
<td>-.25</td>
</tr>
<tr>
<td>I had to structure and develop a response for the issue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 4 ee4-tok4</td>
<td>.16</td>
<td>-.29</td>
</tr>
<tr>
<td>Of the interpretation(s) I needed to make</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 16 ee16-tok16</td>
<td>I had to work on my own</td>
<td>.05</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>Pair 20 ee20-tok20</td>
<td>It is difficult to stay motivated</td>
<td>.05</td>
</tr>
<tr>
<td>Pair 23 ee23-tok23</td>
<td>I can be creative in answering the question</td>
<td>.03</td>
</tr>
<tr>
<td>Pair 27 ee27-tok27</td>
<td>It is hard to relate my research to the subject I am studying</td>
<td>.00</td>
</tr>
<tr>
<td>Pair 32 ee32-tok32</td>
<td>I was able to transfer ideas from my subject to the essay</td>
<td>-.09</td>
</tr>
<tr>
<td>Pair 33 ee33-tok33</td>
<td>I had to link ideas within the essay itself</td>
<td>-.11</td>
</tr>
<tr>
<td>Pair 31 ee31-tok31</td>
<td>I was reminded of material I already knew and would understand in a new way</td>
<td>-.12</td>
</tr>
<tr>
<td>Pair 29 ee29-tok29</td>
<td>I needed to understand the topic/question I am researching</td>
<td>-.18</td>
</tr>
<tr>
<td>Pair 25 ee25-tok25</td>
<td>I have to think in possibilities about the issue/question</td>
<td>-.21</td>
</tr>
<tr>
<td>Pair 1 ee1-tok1</td>
<td>Of the ideas and concepts I needed to explore</td>
<td>-.35</td>
</tr>
<tr>
<td>Pair 24 ee24-tok24</td>
<td>I needed to look at ideas from different perspectives</td>
<td>-.59</td>
</tr>
<tr>
<td>Pair 2 ee2-tok2</td>
<td>I had to think more deeply</td>
<td>-.76</td>
</tr>
</tbody>
</table>

* Correlation is significant at the .05 level (2-tailed)
** Correlation is significant at the .01 level (2-tailed)
The EE was rated as more demanding in pair 3, the analysis needed to be completed (p < .001), and pair 28, where students indicated the need to ‘... work on questions outside my set course’ (p < .001). Rated after pair 28 is pair 30, ‘... the need to read new material’ followed by pair 19 where students found the EE more demanding, believing they need to learn ‘... new ways of researching’ (p < .001).

Pair 17 (self control) indicates that students believe a higher degree of reliance on the teacher or supervisor is required for the EE (p = .003), contrasting to responses with pair 10 that suggests an awareness of the need ‘... to monitor and revise my actions’ during the phases of the EE is more demanding than the ToK (p = .003).

Motivation describes how learners will initiate and persist with certain behaviours to achieve their desired outcome(s). Pair 20 suggests that students have difficulty staying motivated in the EE because of the questions to be asked and the research required (p = .004).

Students rate the need ‘... to make a convincing argument relevant to the issue’ as more demanding for the EE than for the ToK (p = .09) as suggested in pair 13. Pair 18 (p = .015) suggests students have a greater degree of self control finding ‘... new ways of working ...’ by themselves, and pair 22 (p = .038), the opportunity to be more creative exploring ‘... ideas as I want to’.

The mean score for pair 26 is higher for the EE than the ToK (p = .2) indicating students find it difficult ‘... to do enough work on the topic’. Pairs 14 and 15 relate to student structuring of responses where the means for the EE is higher than for ToK, the mean differences being .29 (p = .07) and .18 (p = .4) respectively. Pair 14 requires students to compare how demanding it is ‘... to make a convincing argument relevant to the issue’, while pair 15 required a judgement on the structuring and development of a response to the issue being discussed.

While students found the EE more demanding than ToK because of the ‘interpretations’ needed to be made (pair 4, p = .5), and the need to ‘... work on my own’ (pair 16, p =
the mean difference for student responses to both questions were not significant (p < .05).

There was little difference in the mean student responses to pair 20, suggesting that students found it neither easy nor difficult to stay motivated in either task (p = .8), and pair 23 student belief that either task allowed them to ‘... be creative in answering the question (p = .9). Pair 27, suggests that students have difficulty with either task in relating the research to the subject they are studying.

In the remaining student responses, the ToK has a higher mean than the EE. Students ratings suggest that they were able ‘... to transfer ideas from my subject to the essay’ (pair 32) with greater ease in the ToK, but not significant (p = .7).

Questions 33, 31, and 29 examine the learning process with ToK being rated as more demanding in terms of linking ideas within the essay (p = .5), that students were ‘... reminded of material already known and would understood it in a new way’ (p = .5), with the data suggesting that the ToK requires greater understanding of the topic/question (p = .5). Pair 25 suggests that ToK is more demanding as students ‘...think in possibilities about the issue/question’ (p = .2), and pair 1, ‘... of the questions and concepts I need to explore’ (p = .16).

Pair 24 (p < .001) and pair 2 (p < .001) have mean differences that are significant, the data suggesting in pair 24 that ToK is more demanding as ideas need to be looked at from different perspectives, and pair 2, that ToK required greater depth of thinking.

7.3 The role of relevant subject area knowledge in achievement and creativity

The ability to recall and apply relevant knowledge is examined to determine the extent to which domain area knowledge predicts achievement in the EE and ToK. It is hypothesised that the EE outcome is dependent on the subject area the EE is written in, while ToK reflects the interdisciplinary nature of knowledge and the concurrent study of Language, Humanities, Science, Mathematics and the Arts within the IB Diploma. To
facilitate the examination of this relationship the degree of association between the various subject domains and achievement in the EE, and ToK was calculated using the Pearson correlation coefficient (Appendix 7.3).

These data were used to examine the role of subject area and achievement and was compiled from data provided by IBCA. These data included Schools 10, 20, 30, 40, 50, 60, 70, 80, 90 and 25. Not all student EE and ToK achievement outcome data was available from IBCA, resulting in different student numbers for the correlation estimates between the subject score and achievement outcomes.

These data suggest that the subject area in which the EE was written, as measured by its subject score, associates with both the EE and ToK achievement outcomes. Further, these data suggest that subject area score correlates most strongly with the subject specific criteria of the EE, $r = .43$ ($p < .01$) and with the general criteria $r = .41$ ($p < .01$) of the EE.

Subject area knowledge associates with the creativity achievement score, $r = .35$ ($p < .01$) suggesting that a deep knowledge and thinking base is a requirement for problem sensitivity and divergent thinking. This domain specific knowledge and skills associated with that domain is viewed as a pre-requisite for generating creative ideas and products.

While subject specific knowledge (SSEE) has a numerically lower level of association with the ToKT achievement outcome, $r = .38$ ($p < .01$), subject knowledge acts to inform ToK as a unifying element in the IB Diploma, the ToK encouraging an understanding between the different subjects and developing in students a wider range of the ‘ways of thinking’. 
Table 7.5  Correlation estimates between subject score the EE was written in and achievement in the EE, ToK and creativity aspect of achievement

<table>
<thead>
<tr>
<th></th>
<th>GCEE</th>
<th>SpEE</th>
<th>H score</th>
<th>TEE</th>
<th>ToKE</th>
<th>ToKD</th>
<th>ToKT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation coefficient</td>
<td>0.41</td>
<td>0.43</td>
<td>0.35</td>
<td>0.31</td>
<td>0.31</td>
<td>0.33</td>
<td>0.38</td>
</tr>
<tr>
<td>p value</td>
<td>&lt; .001**</td>
<td>&lt; .001**</td>
<td>&lt; .001**</td>
<td>&lt; .001**</td>
<td>&lt; .001**</td>
<td>&lt; .001**</td>
<td>&lt; .001**</td>
</tr>
<tr>
<td>N</td>
<td>685</td>
<td>685</td>
<td>670</td>
<td>712</td>
<td>688</td>
<td>688</td>
<td>713</td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

7.3.1 Subject area knowledge and achievement

The ability to recall and apply relevant subject area knowledge was assessed by evaluating the relationship between achievement in the subject area and achievement in the EE and ToK.

In this study the extent of the association between the subject score the EE was written in and the achievement levels for the EE and ToK was first examined for subjects (N > 10) using the Pearson Correlation Coefficient. Further analysis of the data was made by examining subject areas where N > 30. The subject area domains are English A1 (N = 74), Chinese A1 (N = 78), Economics (N = 52), History (N = 116), ITGS (N = 30), Psychology (N = 109), Biology (N = 31) and Visual Arts (N = 43) (Appendix 7.4, Subject knowledge as a predictor of achievement). These cases were examined, firstly, for the level of association using the Pearson correlation coefficient, and secondly, using regression procedures to analyse the extent to which achievement in the EE and ToK were predicted by various subject domain scores and the degree to which these subject areas may influence to a greater or lesser extent, achievement in the EE and ToK.

7.3.2 English A1 as subject predictor of achievement

The extent to which the achievement level in the EE and ToK was predicted by English A1 was examined using regression modelling. The results are shown in Table .

177
Table 7.6  English A1 as a subject predictor of achievement levels in the EE and ToK (N = 74)

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>Adjusted R Square</th>
<th>Unstandardised Coefficient</th>
<th>df</th>
<th>F</th>
<th>p value</th>
<th>95% Confidence Interval for B</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCEE</td>
<td>.36</td>
<td>.12</td>
<td>1.93</td>
<td>1, 70</td>
<td>10.7</td>
<td>.002**</td>
<td>0.76</td>
<td>3.11</td>
<td></td>
</tr>
<tr>
<td>SpEE</td>
<td>.4</td>
<td>.15</td>
<td>1.05</td>
<td>1, 70</td>
<td>13.29</td>
<td>.001**</td>
<td>0.47</td>
<td>1.62</td>
<td></td>
</tr>
<tr>
<td>H Criteria</td>
<td>.28</td>
<td>.07</td>
<td>0.34</td>
<td>1, 71</td>
<td>6.09</td>
<td>.02*</td>
<td>0.07</td>
<td>0.61</td>
<td></td>
</tr>
<tr>
<td>TEE</td>
<td>.37</td>
<td>.12</td>
<td>2.87</td>
<td>1, 73</td>
<td>11.50</td>
<td>.001**</td>
<td>1.18</td>
<td>4.55</td>
<td></td>
</tr>
<tr>
<td>ToK E</td>
<td>.32</td>
<td>.09</td>
<td>2.26</td>
<td>1, 71</td>
<td>7.94</td>
<td>.006**</td>
<td>0.66</td>
<td>3.86</td>
<td></td>
</tr>
<tr>
<td>ToK O</td>
<td>.31</td>
<td>.08</td>
<td>1.00</td>
<td>1, 71</td>
<td>7.45</td>
<td>.008**</td>
<td>0.27</td>
<td>1.72</td>
<td></td>
</tr>
<tr>
<td>ToK T</td>
<td>.40</td>
<td>.15</td>
<td>3.30</td>
<td>1, 73</td>
<td>14.21</td>
<td>&lt;.001**</td>
<td>1.56</td>
<td>5.05</td>
<td></td>
</tr>
</tbody>
</table>

* Correlation is significant at the .05 level (2-tailed)
** Correlation is significant at the .01 level (2-tailed)

These data suggest that student use of English knowledge and skills learnt, help achieve in the EE and ToK. The level of association between English A1 and achievement outcomes varies between \( r = .31 \) (p = .008) and \( r = .4 \) (p < .001). The adjusted R Square, adjusted for the number of explanatory terms in the model, varies between 7% and 15%, suggesting other factors play a role in the EE and ToK outcomes.

English influences all outcomes as per the regression equation (p < .05). Overall English A1 accounts for 12% of the variance in the TEE (p = .001). A one part increase in English gives a 2.87 increase in the TEE, while a one part increase in English suggests on average a 3.30 increase in the ToKT (p < .001).

7.3.3  Chinese A1 as subject predictor of achievement

The extent to which the achievement level in the EE and ToK was predicted by Chinese A1 are shown in Table 7.7

The level of association between Chinese A1 and the TEE is \( r = .38 \) (p < .001) while the association with the other EE outcomes are less clear and not significant (p > .05). The association with ToKT is \( r = .40 \) (p < .01) and significant for ToKE and ToKO (p <
These data suggest students use their Chinese knowledge and skills to help achieve in the ToK (p < .05).

Table 7.7 Chinese A1 as a subject predictor of achievement levels in the EE and ToK (N = 78)

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>Adjusted R Square</th>
<th>Unstandardised Coefficient B</th>
<th>df</th>
<th>F</th>
<th>p value</th>
<th>95% Confidence Interval for B Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCEE</td>
<td>.10</td>
<td>.00</td>
<td>0.42</td>
<td>1, 77</td>
<td>.85</td>
<td>.4</td>
<td>-0.49</td>
<td>1.34</td>
</tr>
<tr>
<td>SpEE</td>
<td>.05</td>
<td>.00</td>
<td>0.10</td>
<td>1, 77</td>
<td>.18</td>
<td>.7</td>
<td>-0.37</td>
<td>0.57</td>
</tr>
<tr>
<td>H Criteria</td>
<td>.10</td>
<td>.00</td>
<td>0.10</td>
<td>1, 77</td>
<td>.71</td>
<td>.4</td>
<td>-0.14</td>
<td>0.35</td>
</tr>
<tr>
<td>TEE</td>
<td>.38</td>
<td>.14</td>
<td>2.27</td>
<td>1, 118</td>
<td>20.02</td>
<td>&lt;.001**</td>
<td>1.27</td>
<td>3.27</td>
</tr>
<tr>
<td>ToK E</td>
<td>.38</td>
<td>.13</td>
<td>2.55</td>
<td>1, 86</td>
<td>14.46</td>
<td>&lt;.001**</td>
<td>1.22</td>
<td>3.88</td>
</tr>
<tr>
<td>ToK O</td>
<td>.27</td>
<td>.06</td>
<td>1.22</td>
<td>1, 86</td>
<td>6.66</td>
<td>.012*</td>
<td>0.28</td>
<td>2.15</td>
</tr>
<tr>
<td>ToK T</td>
<td>.40</td>
<td>.15</td>
<td>3.76</td>
<td>1, 86</td>
<td>16.38</td>
<td>&lt;.001**</td>
<td>1.91</td>
<td>5.61</td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

The adjusted R Square for achievement levels, adjusted for the number of explanatory terms in the model, varies between -.2% and 16%, suggesting other factors play a role in the EE and ToK achievement levels.

Chinese influences all ToK outcomes as per the regression equation (p < .05), and the TEE achievement outcome, accounting for 15% of the variance in the TEE (p < .001).
A 1 part increase in Chinese A1 suggests on average a 2.27 increase in the TEE, while a 1 part increase in Chinese gives a 3.76 increase in the ToKT (p < .001).

This result is of note as it suggests that Chinese A1 is a poor predictor of an EE written in Chinese, while Chinese A1 is a better predictor of the ToK outcomes which are spoken (ToKO) and written (ToKE) in English.

7.3.4 Economics as subject predictor of achievement
The results are shown in Table 7.8 of the extent to which the achievement level in the EE and ToK was predicted by Economics.
Table 7.8  Economics as a subject predictor of achievement levels in the EE and ToK (N = 52)

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>Adjusted R Square</th>
<th>Unstandardised Coefficient B</th>
<th>df</th>
<th>F</th>
<th>p value</th>
<th>95% Confidence Interval for B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
</tr>
<tr>
<td>GCEE</td>
<td>.38</td>
<td>.13</td>
<td>1.31</td>
<td>1, 50</td>
<td>8.52</td>
<td>.005**</td>
<td>0.41</td>
</tr>
<tr>
<td>SpEE</td>
<td>.46</td>
<td>.19</td>
<td>0.84</td>
<td>1, 50</td>
<td>13.21</td>
<td>.001**</td>
<td>0.38</td>
</tr>
<tr>
<td>H Criteria</td>
<td>.27</td>
<td>.05</td>
<td>0.22</td>
<td>1, 46</td>
<td>3.49</td>
<td>.07</td>
<td>-0.02</td>
</tr>
<tr>
<td>TEE</td>
<td>.15</td>
<td>.00</td>
<td>1.04</td>
<td>1, 52</td>
<td>1.18</td>
<td>.3</td>
<td>-0.89</td>
</tr>
<tr>
<td>ToK E</td>
<td>.28</td>
<td>.06</td>
<td>1.72</td>
<td>1, 48</td>
<td>4.06</td>
<td>.05*</td>
<td>0.00</td>
</tr>
<tr>
<td>ToK O</td>
<td>.29</td>
<td>.07</td>
<td>0.83</td>
<td>1, 48</td>
<td>4.50</td>
<td>.04*</td>
<td>0.04</td>
</tr>
<tr>
<td>ToK T</td>
<td>.31</td>
<td>.08</td>
<td>2.18</td>
<td>1, 52</td>
<td>5.58</td>
<td>.02*</td>
<td>0.33</td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

These data suggests that student use of Economic knowledge and skills learnt, help achieve in the EE and ToK. The level of association between Economics and TEE is \( r = .15 \) and the level of association between Economics and ToKT is higher with \( r = .31 \). The adjusted R Square for the achievement levels, adjusted for the number of explanatory terms in the model, suggests other factors play a role in the EE and ToK.

Economics influences the outcomes as per the regression equation \( (p < .05) \) with the exception of the H criteria \( (p = .07) \) and TEE \( (p = .3) \). Overall Economics does not account for the variance in the TEE \( (p = .3) \), with a 1 part increase in Economics giving on average a 1.04 increase in the TEE, while a 1 part increase in Economics gives a 2.18 increase in the ToKT \( (p = .02) \), accounting for 8% of the variance.

7.3.5 History as subject predictor of achievement

The extent to which the achievement level in the EE and ToK was predicted by History are shown in Table 7.9
Table 7.9  History as a subject predictor of achievement levels in the EE and ToK (N = 116)

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>Adjusted R Square</th>
<th>Unstandardised Coefficient B</th>
<th>df</th>
<th>F</th>
<th>p value</th>
<th>95% Confidence Interval for B</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCEE</td>
<td>.43</td>
<td>.18</td>
<td>1.52</td>
<td>1,115</td>
<td>26.08</td>
<td>&lt;.001**</td>
<td>0.93 - 2.10</td>
</tr>
<tr>
<td>SpEE</td>
<td>.38</td>
<td>.14</td>
<td>0.85</td>
<td>1,115</td>
<td>19.68</td>
<td>&lt;.001**</td>
<td>0.47 - 1.23</td>
</tr>
<tr>
<td>H Criteria</td>
<td>.26</td>
<td>.06</td>
<td>0.19</td>
<td>1,115</td>
<td>8.17</td>
<td>.005**</td>
<td>0.06 - 0.32</td>
</tr>
<tr>
<td>TEE</td>
<td>.38</td>
<td>.14</td>
<td>2.27</td>
<td>1,118</td>
<td>20.02</td>
<td>&lt;.001**</td>
<td>1.27 - 3.27</td>
</tr>
<tr>
<td>ToK E</td>
<td>.56</td>
<td>.30</td>
<td>3.04</td>
<td>1,117</td>
<td>52.64</td>
<td>&lt;.001**</td>
<td>2.21 - 3.87</td>
</tr>
<tr>
<td>ToK O</td>
<td>.38</td>
<td>.14</td>
<td>1.09</td>
<td>1,117</td>
<td>19.48</td>
<td>&lt;.001**</td>
<td>0.60 - 1.57</td>
</tr>
<tr>
<td>ToK T</td>
<td>.59</td>
<td>.35</td>
<td>4.12</td>
<td>1,118</td>
<td>63.75</td>
<td>&lt;.001**</td>
<td>3.10 - 5.14</td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

These data suggests that students use their History knowledge and skills learnt to help achieve in the EE and ToK. The level of association between History and TEE using the Pearson correlation coefficient is r = .38 and the level of association between History and ToKT is 3 = 59. The adjusted R Square, adjusted for the number of explanatory terms in the model, varies between 6% (H criteria) and 35% (ToKT) suggesting other factors play a role in the EE and ToK achievement levels, but this is a model accounting for the high level of achievement in the EE and ToK.

History influences all outcomes as per the regression equation (p < .05). Overall History accounts for 14 % of the variance in the TEE (p < .001), with a 1 part increase in History giving on average a 2.27 increase in the TEE, while a 1 part increase in History gives a 4.12 increase in the ToKT (p < .001). These data suggest that ToK has a greater influence in ToK.
7.3.6 ITGS as subject predictor of achievement

The results are shown in Table 7.10 of the extent to which the achievement level in the EE and ToK was predicted by ITGS.

Table 7.10 ITGS as a subject predictor of achievement levels in the EE and ToK (N = 30)

<table>
<thead>
<tr>
<th>Subject</th>
<th>R</th>
<th>Adjusted R Square</th>
<th>Unstandardised Coefficient B</th>
<th>df</th>
<th>F</th>
<th>p value</th>
<th>95% Confidence Interval for B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
</tr>
<tr>
<td>GCEE</td>
<td>.72</td>
<td>.51</td>
<td>3.74</td>
<td>1, 28</td>
<td>30.83</td>
<td>&lt; .001**</td>
<td>2.36</td>
</tr>
<tr>
<td>SpEE</td>
<td>.70</td>
<td>.46</td>
<td>2.67</td>
<td>1, 28</td>
<td>26.09</td>
<td>&lt; .001**</td>
<td>1.60</td>
</tr>
<tr>
<td>H Criteria</td>
<td>.48</td>
<td>.20</td>
<td>0.43</td>
<td>1, 27</td>
<td>8.05</td>
<td>.009**</td>
<td>0.12</td>
</tr>
<tr>
<td>TEE</td>
<td>.74</td>
<td>.52</td>
<td>6.62</td>
<td>1, 28</td>
<td>32.85</td>
<td>&lt; .001**</td>
<td>4.26</td>
</tr>
<tr>
<td>ToK E</td>
<td>.57</td>
<td>.30</td>
<td>2.94</td>
<td>1, 27</td>
<td>12.83</td>
<td>.001**</td>
<td>1.26</td>
</tr>
<tr>
<td>ToK O</td>
<td>.56</td>
<td>.29</td>
<td>2.26</td>
<td>1, 27</td>
<td>12.39</td>
<td>.002**</td>
<td>0.94</td>
</tr>
<tr>
<td>ToK T</td>
<td>.71</td>
<td>.48</td>
<td>5.27</td>
<td>1, 28</td>
<td>28.19</td>
<td>&lt; .001**</td>
<td>3.24</td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

The results for ITGS show a higher level of association than other domain areas, with the EE varying between $r = .48$ and $r = .74$ ($p < .001$), and ToK achievement outcomes, between $r = .56$ and $r = .71$ ($p < .01$), suggesting this knowledge is of particular help. In this study, the adjusted R Square for the achievement levels is higher when compared to other subject areas, suggesting the proportion of variability in the model is less and that fewer outside factors play a role in the EE and ToK achievement levels. Of note is the H criteria (creativity measure) with $r = .48$ ($p = .009$) and adjusted $r$ square of .2.

ITGS influences all outcomes as per the regression equation ($p < .01$), with a 1 part increase in ITGS giving a 6.62 increase in the TEE, while a 1 part increase in ITGS gives a 5.27 increase in the ToKT ($p < .001$). Of note is that all students in this sample presented for English A1.
7.3.7 Psychology as subject predictor of GCEE

The extent to which the achievement level in the EE and ToK was predicted by Psychology are shown in Table 7.11

Table 7.11 Psychology as a subject predictor of achievement levels in the EE and ToK (N = 109)

<table>
<thead>
<tr>
<th>Subject</th>
<th>R</th>
<th>Adjusted R Square</th>
<th>Unstandardised Coefficient B</th>
<th>df</th>
<th>F</th>
<th>p value</th>
<th>95% Confidence Interval for B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
</tr>
<tr>
<td>GCEE</td>
<td>.42</td>
<td>.17</td>
<td>1.59</td>
<td>1, 108</td>
<td>22.87</td>
<td>&lt; .001**</td>
<td>0.93</td>
</tr>
<tr>
<td>SpEE</td>
<td>.53</td>
<td>.27</td>
<td>1.09</td>
<td>1, 108</td>
<td>41.66</td>
<td>&lt; .001**</td>
<td>0.75</td>
</tr>
<tr>
<td>H Criteria</td>
<td>.34</td>
<td>.10</td>
<td>0.30</td>
<td>1, 108</td>
<td>13.61</td>
<td>&lt; .001**</td>
<td>0.14</td>
</tr>
<tr>
<td>TEE</td>
<td>.47</td>
<td>.22</td>
<td>2.56</td>
<td>1, 112</td>
<td>38.08</td>
<td>&lt; .001**</td>
<td>1.66</td>
</tr>
<tr>
<td>ToK E</td>
<td>.20</td>
<td>.03</td>
<td>1.02</td>
<td>1, 108</td>
<td>4.40</td>
<td>.038*</td>
<td>0.06</td>
</tr>
<tr>
<td>ToK O</td>
<td>.50</td>
<td>.24</td>
<td>1.44</td>
<td>1, 108</td>
<td>35.40</td>
<td>&lt; .001**</td>
<td>0.96</td>
</tr>
<tr>
<td>ToK T</td>
<td>.40</td>
<td>.15</td>
<td>2.62</td>
<td>1, 112</td>
<td>21.46</td>
<td>&lt; .001**</td>
<td>1.50</td>
</tr>
</tbody>
</table>

*Correlation is significant at the .05 level (2-tailed)
**Correlation is significant at the .01 level (2-tailed)

These data show a moderately high level of association between the Psychology subject area and TEE (r = .47) and ToKT (r = .40). The adjusted R Square varies between 3% and 27%, suggesting that while other factors play a role in the EE and ToK achievement levels, subject domain is important. Psychology influences all outcomes as per the regression equation (p < .05). A 1 part increase in Psychology gives on average a 2.56 increase in the TEE score (p < .001) and for ToK a 1 part increase results on average in a 2.62 increase in the ToKT.

7.3.8 Biology as subject predictor of achievement

The extent to which the achievement level in the EE and ToK was predicted by Biology are shown in Table 7.12
Table 7.12  Biology as a subject predictor of achievement levels in the EE and ToK (N = 31)

<table>
<thead>
<tr>
<th>Subject</th>
<th>R</th>
<th>Adjusted R Square</th>
<th>Unstandardised Coefficient B</th>
<th>df</th>
<th>F</th>
<th>p value</th>
<th>95% Confidence Interval for B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
</tr>
<tr>
<td>GCEE</td>
<td>.37</td>
<td>.11</td>
<td>1.66</td>
<td>1, 29</td>
<td>4.65</td>
<td>.04*</td>
<td>0.09</td>
</tr>
<tr>
<td>SpEE</td>
<td>.51</td>
<td>.24</td>
<td>1.28</td>
<td>1, 29</td>
<td>10.39</td>
<td>.003**</td>
<td>0.47</td>
</tr>
<tr>
<td>H Criteria</td>
<td>.48</td>
<td>.20</td>
<td>0.46</td>
<td>1, 24</td>
<td>7.11</td>
<td>.01*</td>
<td>0.11</td>
</tr>
<tr>
<td>TEE</td>
<td>.44</td>
<td>.17</td>
<td>3.03</td>
<td>1, 30</td>
<td>7.20</td>
<td>.01*</td>
<td>0.72</td>
</tr>
<tr>
<td>ToK E</td>
<td>.33</td>
<td>.07</td>
<td>1.13</td>
<td>1, 24</td>
<td>2.85</td>
<td>.1</td>
<td>-0.25</td>
</tr>
<tr>
<td>ToK O</td>
<td>.27</td>
<td>.04</td>
<td>0.71</td>
<td>1, 24</td>
<td>1.92</td>
<td>.2</td>
<td>-0.35</td>
</tr>
<tr>
<td>ToK T</td>
<td>.41</td>
<td>.14</td>
<td>2.11</td>
<td>1, 30</td>
<td>6.20</td>
<td>.02*</td>
<td>0.38</td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

These data suggests biological knowledge and skills learnt influence achievement in the EE (r = .44, p = .01). The measure of creativity, H criteria has a Pearson Correlation Coefficient of .48 (p = .01), accounting for 20% of variability in the model, adjusted for the number of explanatory factors. Statistically, this measure is similar for ITGS.

Biology influences all EE outcomes in the regression equation (p < .05), while only influencing the ToKT, r = .41, (p < .05)

The adjusted R Square for achievement levels, adjusted for the number of explanatory terms in the model, varies between 4% and 24%, suggesting other factors play a role in the EE and ToK achievement levels, with the subject domain being important.

7.3.9 Visual Arts as subject predictor of achievement

The extent of the association between Visual Arts and achievement levels in the EE and ToK, and Visual Arts as a predictor using regression modelling are examined in Table 7.13.
Table 7.13  Visual Arts as a subject predictor of achievement levels in the EE and ToK (N = 43)

<table>
<thead>
<tr>
<th>Subject</th>
<th>R</th>
<th>Adjusted R Square</th>
<th>Unstandardised Coefficient B</th>
<th>df</th>
<th>F</th>
<th>p value</th>
<th>95% Confidence Interval for B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
</tr>
<tr>
<td>GCEE</td>
<td>.26</td>
<td>.05</td>
<td>0.92</td>
<td>1, 41</td>
<td>3.06</td>
<td>.09</td>
<td>-0.14</td>
</tr>
<tr>
<td>SpEE</td>
<td>.36</td>
<td>.11</td>
<td>0.58</td>
<td>1, 41</td>
<td>6.08</td>
<td>.02*</td>
<td>0.11</td>
</tr>
<tr>
<td>H Criteria</td>
<td>.37</td>
<td>.12</td>
<td>0.38</td>
<td>1, 40</td>
<td>6.37</td>
<td>.02*</td>
<td>0.08</td>
</tr>
<tr>
<td>TEE</td>
<td>.30</td>
<td>.07</td>
<td>1.50</td>
<td>1, 41</td>
<td>4.12</td>
<td>.05*</td>
<td>0.01</td>
</tr>
<tr>
<td>ToK E</td>
<td>.18</td>
<td>.01</td>
<td>0.63</td>
<td>1, 40</td>
<td>1.38</td>
<td>.2</td>
<td>-0.45</td>
</tr>
<tr>
<td>ToK O</td>
<td>.39</td>
<td>.13</td>
<td>0.85</td>
<td>1, 40</td>
<td>6.95</td>
<td>.01**</td>
<td>0.20</td>
</tr>
<tr>
<td>ToK T</td>
<td>.41</td>
<td>.15</td>
<td>1.47</td>
<td>1, 41</td>
<td>8.13</td>
<td>.007**</td>
<td>0.43</td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

These data suggests that use of visual art knowledge and skills help achieve in the EE (r = .30, p = .05) and ToK (r = .41, p = .007). The adjusted R Square varies between .01 and .15, being adjusted for the number of explanatory terms in the model. This suggests other factors play a role in the EE and ToK achievement levels.

The Visual Arts has a moderate association with the H criteria (r = .37, p = .02). Visual Art influences the SpEE, H criteria and TEE outcomes (p < .05), and is significant (p < .01) for the ToK O and ToKT in the regression equation model.

7.3.10 Relationship between subject area and creativity as measured by the H criteria

Domain knowledge consists of declarative and procedural knowledge and is seen as a necessary condition the processing of new knowledge in that domain (Alexander, 1992; Alexander & Judy, 1988). A knowledge base reflecting past learning is seen as a requirement for the conversion of information into knowledge, the ability to retrieve skills, and elaboration as a progression of adding ideas to the process being learnt and the essay being developed (Feldhusen, 1995).
The relationship between subject domain knowledge and creativity outcomes was assessed using a Pearson Chi-square independence test, to examine whether the independent variable, subject score affects the dependent creativity variable, the H criteria. Of the total number in the sample, 728 student results, 670 (92.0%) were valid data sets with 58 (8.0%) missing. A cross tabulation analysis in Table 7.14 below of
subject domain score with the H criteria revealed a significant relationship between these two variables.

The subject area score and H criteria Crosstabulation table suggests a link between the independent and dependent variable, with a higher subject score attracting the higher H criteria score. A statistical significant relationship was found to exist with $t \chi^2 (20, n = 670) = 110.44, p < 0.001$ (Appendix 7.5, Relationship between subject score and H criteria). This indicates the null hypothesis be rejected, that no difference exists between subject score and H criteria and the acceptance of the alternate hypothesis, that an effect causing a measurable difference exits. This suggests that subject competency is a condition for creativity. The effect size using Cramer’s V is .20 with $p < .001$.

To further aid the interpretation, the H criteria scores were charted for each subject score in Figure 7.2 below

**Figure 7.2** Bar chart of crosstabulation estimates between the H criteria score and subject score
This indicates the higher the achievement score for the subject domain the EE is written in, the higher the creativity score as measured by the H criteria. A student scoring a 6 or 7 for the subject area result is a strong indicator of creativity in the EE.

7.3.11 H criteria as a measure of subject creativity

The H criteria as a measure of subject creativity was examined by comparing the mean score of the H criteria for each subject. Five hundred and thirty one student results were used in an ANOVA F test model to examine the relationship between the mean scores of the H criteria for each subject and associated levels of significance. The results are entered in Table 7.15 below.

Table 7.15 H criteria means for each subject

<table>
<thead>
<tr>
<th>Subject</th>
<th>N</th>
<th>Mean</th>
<th>Standard Error</th>
<th>F</th>
<th>Anova df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>English A1</td>
<td>73</td>
<td>2.47</td>
<td>.12</td>
<td>2.80</td>
<td>7.523</td>
<td>.007</td>
</tr>
<tr>
<td>Chinese A1</td>
<td>79</td>
<td>2.53</td>
<td>.09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History</td>
<td>119</td>
<td>2.50</td>
<td>.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economics</td>
<td>48</td>
<td>2.75</td>
<td>.11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychology</td>
<td>113</td>
<td>2.14</td>
<td>.09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ITGS</td>
<td>31</td>
<td>2.45</td>
<td>.15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>26</td>
<td>2.50</td>
<td>.22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Arts</td>
<td>42</td>
<td>2.26</td>
<td>.21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>531</strong></td>
<td><strong>2.43</strong></td>
<td><strong>.04</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The findings of these data suggest that the H criteria mean score for each subject domain are on average different (p = .007) suggesting a subject effect is present.

To facilitate the interpretation of data, the H criteria means for each subject was graphed, highlighting the range of means between subjects in Figure 7.3 below.
These data was further analysed by examining in Figure 7.4 below, the H criteria subject means and confidence intervals. The mean differences between the H criteria, associated levels of significance and confidence intervals for each subject are shown in Appendix 7.6. Multiple comparison procedures are used to compare means and to analyse which H criteria means are on average statistically significant in difference. It can be determined that a statistically significant difference ($p = .049$) exists between Psychology and Economics, but not between any other H criteria means.
These findings suggest that the H criteria is a robust assessment tool assessing creativity in a consistent manner over the different subjects.

7.4 Use of creative thinking strategies

It is hypothesised that the ease of use of creative thinking strategies predict achievement in the EE and ToK. The extent to which these figural and verbal creativity scores are associated with the EE and ToK achievement outcomes, are examined using the Pearson product moment correlation. Correlation procedures are used to observe the strength of association between the creativity and achievement outcomes, based on the assumption that a linear relationship exists between these 2 sets of variables. To facilitate the interpretation of data the figural and verbal dimensions of the TTCT are taken as the explanatory variables. The named creativity factors are listed and described in Table 7.16.

The extent to which a school effect may be present in the ease of use of creative thinking strategies and the EE and ToK, achievement outcomes, were examined using ANOVA procedures. ANOVA was used to compare the school mean score for each
explanatory variable and whether statistically significant differences exist between the schools.

These data were further examined as to whether cultural differences, as measured by student mother tongue or native language, have an effect on creative thinking skills and the EE and ToK achievement outcomes. ANOVA procedures were used to compare the language mean score for each explanatory variable and whether statistically significant differences emerged between the two language groupings.

Data was collected from five schools labelled Schools 10, 20, 35 and 55. One hundred and sixty six students completed the Figural A and Verbal A forms of the TTCT questionnaire. The achievement outcomes data for the EE and ToK was provided by IBCA which was matched to the TTCT scores. Not all student EE and ToK achievement outcomes data from IBCA were available, resulting in 109 complete data sets for the EE and 164 data sets for the ToK when examining the association between the TTCT explanatory variables and achievement outcomes. For the schools data 166 student results were used, and for the effect of language on creative thinking skills, 160 student results were available.

7.4.1 TTCT Figural associations with achievement outcomes

The degree of association between the figural explanatory variables and achievement outcomes was examined using the Pearson correlation coefficient, the data shown in Table 7.16 (Appendix 7.7, TTCT correlations coefficients with EE and ToK outcomes).
<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Explanatory variable description</th>
<th>GCEE</th>
<th>SpEE</th>
<th>H criteria</th>
<th>TEE</th>
<th>ToKE</th>
<th>ToKO</th>
<th>ToKT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Figural fluency</strong></td>
<td>Learner capacity to generate a large number of germane figural images, with subsequent scores in other dimensions being dependent on the relevance of the respondent’s ideas.</td>
<td>PCC</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.02</td>
<td>0.09</td>
<td>0.09</td>
<td>0.09</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>Pearson Correlation p value</td>
<td></td>
<td>0.8</td>
<td>0.34</td>
<td>0.3</td>
<td>0.2</td>
<td>0.6</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Figural originality</strong></td>
<td>Learner capacity to produce unusual and distinctive replies, measured on the basis of normative data and prepared lists.</td>
<td>PCC</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.01</td>
<td>0.12</td>
<td>0.09</td>
<td>0.07</td>
<td>0.12</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>Pearson Correlation p value</td>
<td></td>
<td>&gt; 0.9</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.1</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Figural elaboration</strong></td>
<td>Learner ability to develop, ‘embellish’ and elaborate ideas, based on the assumptions that ‘...the minimum primary responses to the stimulus figure is a single response’ and the elucidation of detail is an outcome of creative ability (Torrance et. el, 1992, p.3).</td>
<td>PCC</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.01</td>
<td>0.06</td>
<td>-0.01</td>
<td>0.05</td>
<td>-0.01</td>
<td>0.19*</td>
</tr>
<tr>
<td></td>
<td>Pearson Correlation p value</td>
<td></td>
<td>0.9</td>
<td>0.5</td>
<td>0.9</td>
<td>0.5</td>
<td>0.9</td>
<td>0.02</td>
</tr>
<tr>
<td>Figural abstractness</td>
<td>Learner ability to synthesize and organise the creative thinking process. This measure is based on the notion that creativity requires the learner to know the essence of the problem, to be able to encapsulate the information and represent this level of abstractness in the given title.</td>
<td>Pearson Correlation</td>
<td>p value</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>.15</td>
<td>.12</td>
<td>.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>.24*</td>
<td>.011</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>.18*</td>
<td>.03</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>.21**</td>
<td>.01</td>
<td>.001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>.25**</td>
<td>.06</td>
<td>&lt; .001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>.15</td>
<td>.06</td>
<td>.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>.21**</td>
<td>.28</td>
<td>.001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>.01</td>
<td>.001</td>
<td>.01</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>.18**</td>
<td>&lt; .001</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Figural resistance to premature closure</th>
<th>A measure of the construct that a learner must delay and ‘keep open’ the processing of information to mentally create new and original ideas</th>
<th>Pearson Correlation</th>
<th>p value</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>.05</td>
<td>.6</td>
<td>.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.12</td>
<td>.2</td>
<td>.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.08</td>
<td>.4</td>
<td>.4</td>
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<td></td>
<td></td>
<td>.13</td>
<td>.10</td>
<td>.10</td>
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<td></td>
<td></td>
<td>.16*</td>
<td>.05</td>
<td>.05</td>
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<tr>
<td></td>
<td></td>
<td>-.01</td>
<td>.9</td>
<td>.9</td>
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<tr>
<td></td>
<td></td>
<td>.14</td>
<td>.08</td>
<td>.08</td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)
These data suggest that the Figural creativity explanatory variables show varying levels of association with the achievement outcomes of the EE, creativity and ToK. Of note is the lack of statistical association between figural fluency and the achievement outcomes \((p > .05)\) for both the EE and ToK. Figural fluency is one of the most critical facets of the TTCT, as a measure of learner ability to generate many and relevant images, on which subsequent scores in other creative dimensions depend. A response in this construct must be considered pertinent before succeeding creativity dimensions can be scored.

Figural items in the TTCT are designed to encourage the articulation of figural representation rather than closure. Figural elaboration is a measure of learner ability to develop and embellish ideas, the attention to the elaboration of this detail being the result of creative ability. This data suggest that figural elaboration plays a role with the ToKO \((p = .02)\), but not with other outcomes. Figural resistance to premature closure is designed to measure the extent that a student can ‘keep open’ the processing of information and create new ideas. These findings suggest that no association exists with the EE outcomes, but there is a statistically significant association \((p = .05)\) with the ToKE and approaching significance \((p = .08)\) with the ToKT.

The score for Figural originality is dependent on the unusualness of the response. These findings suggest that novel and imaginative responses do not play a role with the EE and ToK.

Of all explanatory variables, Figural abstractness shows statistically significant correlations \((p < .05)\), with EE and ToK achievement outcomes, GCEE being the exception \((p = .15)\), and the ToKO which is approaching significance \((p = .06)\). This construct is founded on the notion that creativity requires an abstraction of ideas, measuring the extent to which a title moves beyond the labelling of the pictures drawn. This suggests that student ability to understand, discern, distinguish the relevant information, to understand the essence of the problem or question being examined, to distil and bring together the relevant elements of this information is an important facet of creative thinking for both the EE and ToK.
7.4.2 TTCT Verbal associations with achievement outcomes

The degree of association between the verbal explanatory variables and achievement outcomes was examined using the Pearson correlation coefficient, the data shown in Table 7.17.

The set of correlations for all verbal explanatory variables with the ToKE and ToKT achievement outcomes are statistically significant ($p = 0.00$ or $< 0.001$). These associations highlight the importance of student ability to produce many and varied ideas (fluency), to change their use of strategies (flexibility) and to produce fresh and unusual ideas (originality). These findings suggest an important role for verbal creativity in the understanding of knowledge through the ToKE and ToKT.
Table 7.17  Pearson Correlation Coefficients for TTCT Verbal creativity explanatory variables and achievement outcomes for the EE and ToK.

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Explanatory variable description</th>
<th>GCEE</th>
<th>SpEE</th>
<th>H criteria</th>
<th>TEE</th>
<th>ToKE</th>
<th>ToKO</th>
<th>ToKT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal fluency</td>
<td>Learner capacity to produce relevant questions or ideas with words</td>
<td>Pearson Correlation p value</td>
<td>.01</td>
<td>.16</td>
<td>.07</td>
<td>.10</td>
<td>.26**</td>
<td>.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbal flexibility</td>
<td>Learner capability to produce diverse ideas, using a variety of strategies. Low scores may indicate a small range of responses reflecting ‘... rigid thinking habits, limited knowledge and/or experience, limited intellectual energy, and /or low motivation’ (Torrance, 2008, p.8).</td>
<td>Pearson Correlation p value</td>
<td>.01</td>
<td>.15</td>
<td>.07</td>
<td>.09</td>
<td>.28**</td>
<td>.10</td>
</tr>
<tr>
<td>Verbal originality</td>
<td>A measure of the capability of the learner to move beyond the obvious and common and produce ideas that require ‘intellectual energy’.</td>
<td>Pearson Correlation p value</td>
<td>-.03</td>
<td>.13</td>
<td>.04</td>
<td>.07</td>
<td>.27**</td>
<td>.10</td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)
No statistically significant correlations exist between verbal explanatory variables and the ToKO, or with any aspect of the EE.

While it is disappointing to report the lack of association between the figural (with the exception of abstractness) and verbal constructs with the EE, this suggests students have difficulty with the broadness of the EE task. To display academic creativity in the EE as discussed in Chapter One requires the development of a research question, the transfer of established concepts, the use of creative processes and the re-prioritisation of ideas. Students are confronted with a situation of creating a question and developing a solution for which they have no prior learning experiences.

7.4.3 School effect TTCT Figural explanatory variables

The school effect on creativity was examined by comparing the mean score for each TTCT figural explanatory variable and school. The data set consisted of 181 valid entries used to examine the school effect. An ANOVA F test model was used to compare the mean scores, and level of significance, found in Table 7.18 below (Appendix 7.8, School effects on TTCT).
### Table 7.18  School mean scores for TTCT Figural explanatory variables

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>School</th>
<th>N</th>
<th>Mean</th>
<th>Standard Error</th>
<th>F</th>
<th>Anova df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figural fluency</td>
<td>10.00</td>
<td>44</td>
<td>22.20</td>
<td>1.10</td>
<td>2.10</td>
<td>3,161</td>
<td>.10</td>
</tr>
<tr>
<td></td>
<td>20.00</td>
<td>67</td>
<td>25.18</td>
<td>0.80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35.00</td>
<td>26</td>
<td>22.00</td>
<td>1.48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>55.00</td>
<td>28</td>
<td>23.79</td>
<td>1.45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>165</td>
<td></td>
<td>23.65</td>
<td>0.56</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Figural originality</td>
<td>10.00</td>
<td>44</td>
<td>15.09</td>
<td>0.74</td>
<td>2.12</td>
<td>3,161</td>
<td>.10</td>
</tr>
<tr>
<td></td>
<td>20.00</td>
<td>67</td>
<td>16.69</td>
<td>0.60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35.00</td>
<td>26</td>
<td>15.92</td>
<td>0.99</td>
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<tr>
<td></td>
<td>55.00</td>
<td>28</td>
<td>14.11</td>
<td>0.91</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>165</td>
<td></td>
<td>15.70</td>
<td>0.39</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Figural elaboration</td>
<td>10.00</td>
<td>44</td>
<td>7.02</td>
<td>0.30</td>
<td>5.02</td>
<td>3,161</td>
<td>.002**</td>
</tr>
<tr>
<td></td>
<td>20.00</td>
<td>67</td>
<td>6.10</td>
<td>0.22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35.00</td>
<td>26</td>
<td>5.35</td>
<td>0.25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>55.00</td>
<td>28</td>
<td>6.46</td>
<td>0.39</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td></td>
<td>6.29</td>
<td>0.15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Figural abstractness</td>
<td>10.00</td>
<td>44</td>
<td>11.55</td>
<td>0.88</td>
<td>5.27</td>
<td>3,161</td>
<td>.002**</td>
</tr>
<tr>
<td></td>
<td>20.00</td>
<td>67</td>
<td>12.60</td>
<td>0.78</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35.00</td>
<td>26</td>
<td>12.19</td>
<td>1.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>55.00</td>
<td>28</td>
<td>7.46</td>
<td>0.96</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>165</td>
<td></td>
<td>11.38</td>
<td>0.48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Figural resistance</td>
<td>10.00</td>
<td>44</td>
<td>13.66</td>
<td>0.58</td>
<td>4.58</td>
<td>3,161</td>
<td>.004**</td>
</tr>
<tr>
<td></td>
<td>20.00</td>
<td>67</td>
<td>15.64</td>
<td>0.34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35.00</td>
<td>26</td>
<td>15.23</td>
<td>0.50</td>
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<td></td>
<td>55.00</td>
<td>28</td>
<td>13.82</td>
<td>0.62</td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>165</td>
<td></td>
<td>14.74</td>
<td>0.25</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

In assessing these data the mean score of each figural variable for schools are on average, significantly different (p < .05), with figural fluency (p = .10) figural...
originality (p = .10) approaching statistical significance. This suggests a school effect is present for figural explanatory variables.

### 7.4.4 Figural explanatory variables

To facilitate the interpretation of data, the means for each school was graphed for figural thinking strategies (Figure 7.5) highlighting the range of means between schools.

#### Figure 7.5 School effect on figural thinking strategies

These data were further analysed by examining the level of significance between means through multiple comparisons in Figure 7.6 below. The school means are displayed in Table 7.18, while the mean difference between schools, associated levels of significance and confidence intervals for each figural explanatory variable are shown in Appendix 7.8. Multiple comparison procedures were used to make pair wise comparisons between means, and to analyse which means are on average statistically significant in difference.
Multiple comparisons suggest no significant differences between schools for figural fluency and originality. A significant statistical difference, $p < .004$, emerges between schools 10 and 35 for elaboration, suggesting students from school 10 are more able to
develop and elaborate ideas. It is worth noting that school 35 (N = 26) has a smaller standard error of the mean, .25 in comparison to School 10, .30. These findings also suggest that schools 10 and 20 approach statistical significance, p = .09. The findings for figural abstractness suggest significant differences (p < .05) between schools 10, p = .05, school 20, p = .002, school 35, p = .04 and school 55. This suggests that students from schools 10, 20 and 35 are more able to synthesize information and understand the essence of the problem.

Resistance to premature closure is based on the assumption that less creative persons will fail to consider all information, reducing the chances of generating more powerful ideas and images. Differences emerge between schools 10 and 20, p = .02, (Appendix 7.8) for resistance to premature closure. This suggest students from school 20 are possibly more able to keep open the processing of information when creating new ideas and more likely to consider all information. It should be noted that statistical significance is approached, p = .09 for schools 20 and 55, with school 55 having the higher mean.

It should be noted that these data suggest no statistical significant differences (p > .05) exist between schools for figural fluency and figural originality.

7.4.5 School effect on TTCT Verbal explanatory variables

The school effect on verbal creativity was examined by comparing the mean score for each explanatory variable and school. One hundred and seventy one student responses were used in an ANOVA F test model to examine the relationship between the mean scores of the explanatory variables for each school and associated levels of significance as presented in Table 7.19 below.
Table 7.19  School means scores for TTCT Verbal explanatory variables

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>School</th>
<th>N</th>
<th>Mean</th>
<th>Standard Error</th>
<th>F</th>
<th>Anova df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal fluency</td>
<td>10.00</td>
<td>38</td>
<td>69.87</td>
<td>3.24</td>
<td>15.72</td>
<td>3,157</td>
<td>&lt; .001**</td>
</tr>
<tr>
<td></td>
<td>20.00</td>
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<td>19.97</td>
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<td>51.51</td>
<td>1.62</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

In analysing these data, the findings suggest the mean score for each verbal variable for schools are on average significantly different (p < .001), suggesting a school effect is present.

7.4.6  Verbal explanatory variables

To facilitate the interpretation of data, the means for each school was graphed for verbal thinking strategies (Figure 7.7) highlighting the range of means between schools.
These data were further analysed by examining the level of significance between means through multiple comparisons in Table 7.19. The school means are shown in Table 7.19, while the mean difference between schools, associated levels of significance and confidence intervals for each verbal explanatory variable are shown in Appendix 7.8. Multiple comparison procedures are used to make pair wise comparisons between means and to analyse which means are on average significantly different.

It can be determined that statistically significant differences exist between some schools and cohorts of schools. The following Graph 7.8 displays the multiple comparisons for each school.
Multiple comparisons suggest significant differences between schools 10, 20, 35 and school 55 for verbal fluency, flexibility and originality. For verbal fluency, statistical significant differences exist between school 10 (p = .002), school 20 (p < .001), school 35, (p < .001) and school 55. For verbal flexibility and originality statistically significant differences exist between schools 10, 20, 35 and school 55 (p < .001). These data suggest that for all learners, students at school 55 have a lower mean and confidence limits, suggesting lower capacity to produce questions, diverse ideas and mover beyond the obvious and common. In the data set for school 55, the majority of students are from Asia with Chinese as their first language, suggesting student responses are mediated by language.
7.4.7 Language

The effect of language on creative thinking skills are now examined by comparing means for Group 1 (native English speakers) and Group 4 (categorised as native Chinese speakers and native Indonesian speakers) in Table 7.20 (Appendix 7.9, Language effect on TTCT).

Table 7.20 Language effect on TTCT Creative Thinking Skills

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Language Group</th>
<th>N</th>
<th>Mean</th>
<th>Standard Error</th>
<th>F</th>
<th>Anova df</th>
<th>p value</th>
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</thead>
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<td>23.48</td>
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<td>0.37</td>
<td>1,157</td>
<td>.6</td>
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<tr>
<td></td>
<td>4.00</td>
<td>37</td>
<td>24.30</td>
<td>1.22</td>
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<td></td>
</tr>
<tr>
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<td>0.45</td>
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<td></td>
<td>4.00</td>
<td>37</td>
<td>14.41</td>
<td>0.79</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
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<td>0.39</td>
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</tr>
<tr>
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<td>6.26</td>
<td>0.16</td>
<td>1.38</td>
<td>1,157</td>
<td>.2</td>
</tr>
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<td></td>
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<tr>
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<td>78.11</td>
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<td>49.78</td>
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<td></td>
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<td></td>
<td>51.28</td>
<td>1.66</td>
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</table>
These data suggest that for figural thinking strategies, statistically significant ($p > .05$) differences exist with Figural abstractness ($p < .001$), while Figural originality ($p = .06$) and resistance to premature closure ($p = .07$) are approaching significance between the two language groups. All verbal thinking strategy measurements have statistically significant ($p < .001$) differences with Group 1 students having the higher mean. To facilitate the interpretation of data, the means for each explanatory variable between language groups were graphed in Figure 7.9, highlighting the range of means.

**Figure 7.9 Language effect on figural thinking strategies**

This graph displays a range of means with a statistically significant difference ($p < .001$) for figural abstractness. This suggests that Group 1 native speakers rate this more highly than Group 4. There are no other statistically significant ($p > .05$) results.
Figure 7.10 displays the means for verbal creative thinking strategies, the differences between Group 1 and Group 4 being statistically significant (p < .001).

In the figural dimension of the TTCT, these findings suggest a statistical significant difference (p < .001) between Group 1 and Group 4 students for Figural abstractness, with Figural originality (p = .06) and Figural resistance (p = .07) approaching significance with Group 1 students having the higher mean. Group 4 students have the higher mean for Figural fluency and Figural elaboration but this is not significant. With Figural abstractness, student responses to the Picture Construction and Picture Completion activities suggest Group 1 students are more able to organise their thinking processes and synthesize available information.

In the Verbal assessment of creativity Group 1 students have a statistically significant (p < .001) higher mean than Group 4 students for all verbal explanatory variables. In this survey Group 4 students are from China and Indonesia, having completed their education to Year 10 level and then attend school in the West. This suggests that Group 4 results are mediated by the level of language competence, these students still in the process of becoming fully bilingual. It can be reasonably inferred, these students have not as yet overcome the complexities of learning in a second language.
To further investigate whether Group 1 (native English speakers) and Group 3 (native Chinese speakers) differ in the use of thinking skills, an independent samples t test to compare Group 1 and Group 3 was computed in Table 7.21 (Appendix 7.9).

**Table 7.21 Language effect on TTCT Creative Thinking Skills using independent samples t test**

<table>
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<tr>
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<th>N</th>
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<th>Standard Deviation</th>
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<td>8.68</td>
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<td>9.43</td>
<td>5.35</td>
<td>127</td>
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</tr>
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<td>3.00</td>
<td>13</td>
<td>27.46</td>
<td>11.21</td>
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<td></td>
<td>34.97</td>
<td>10.25</td>
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<td></td>
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<tr>
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<td>18.89</td>
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</tr>
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</table>

An independent samples t-test was conducted comparing Group 1 students to Group 3 students in the use of creative thinking skills. Levene’s test for equality of variances was used to establish that the variances of the two populations did not differ (Appendix
There was no significant statistical difference (p < .05) in the scores for the two groups of students for figural fluency, figural originality and figural elaboration. Statistically significant difference emerged for figural abstractness between Group 1 \( t(133) = 2.53, p = .01 \) and Group 3 with Group 1 having a higher mean (\( M = 12.41, \ SD = 5.96 \)) than Group 3 (\( M = 8.08, \ SD = 5.04 \)); and Figural resistance to premature closure \( t(133) = 2.49, p = .01 \) and Group 1 (\( M = 15.02, \ SD = 3.19 \)) having the higher mean than Group 3 (\( M = 12.69, \ SD = 3.30 \)).

For the variables verbal fluency, verbal flexibility and verbal originality significant differences exist for the scores between Group 1 and Group 3. For verbal fluency Group 1 (\( M = 78.11, \ SD = 23.09 \)) scored a higher mean than Group 3 (\( M = 47.69, \ SD = 23.48 \)) suggesting that students in Group 1 are more able to organise their thinking processes and synthesize available information.

Results for verbal flexibility indicate Group 1 (\( M = 42.49, \ SD = 9.43 \)) has a higher mean (p < .001) than Group 3 (\( M = 27.46, \ SD = 11.21 \)) suggesting that Group 1 students are more able to produce diverse ideas while Group 3 may have more rigid thinking patterns, more limited knowledge and lower motivation (Torrance, 2008, p. 8). For verbal originality Group 1 (\( M = 56.53, \ SD = 18.89 \)) has a statistically significant (p < .001) higher mean than Group 3 (\( M = 33.77, \ SD = 18.74 \)). This suggests that Group 1 learners can move beyond the obvious and common and produce ideas that require ‘intellectual energy’.
7.5 Results for learning self-determined behavioural regulation

It is hypothesised that students show a preference for autonomous or self-determined learning behavioural regulation. The extent to which these self-regulation learning strategies predict achievement in the EE and ToK is examined. Correlation procedures are used to observe the strength of association between the creativity and achievement outcomes, based on the assumption that a linear relationship exists between these two sets of variables. To facilitate the interpretation of data, the autonomous and controlled regulation dimensions of learning self regulation (LSR) were taken as the explanatory variables. The named learning self regulation variables are listed and described in Table 7.21.

The extent to which a school effect may be present in the preferred use of autonomous or self-determined behavioural regulation and the EE and ToK achievement outcomes, were examined using ANOVA procedures. ANOVA was used to compare the school mean score for each explanatory variable and whether statistically significant differences exist between the schools.

This data was further examined as to whether cultural differences, as measured by student mother tongue or native language, have an effect on the preferred use self-determined behavioural regulation and the EE and ToK achievement outcomes. ANOVA procedures were used to compare the language mean score for each explanatory variable and whether statistically significant differences emerged between the two language groupings.

Data was collected from three schools labelled Schools 10, 50 and 60. Two hundred and eighteen students completed the learning self-regulation questionnaire. The achievement outcomes data for the EE and ToK was provided by IBCA which was matched to the LSR scores. Not all student EE and ToK achievement outcomes data from IBCA was available, resulting in 197 data sets for the GCEE and SPEE, 209 for the H criteria and 217 for the TEE,. Two hundred and eighteen data sets for the ToK were used when examining the association between the LSR explanatory variables and
achievement outcomes. For the school’s data the same number of student results were used and for the effect of language on the LSR, 218 student results were available.

The degree of association between the two factors, autonomous regulation and controlled regulation with the dependent variables was examined using the Pearson correlation coefficient for each relationship. This data is shown in Table 7.22 Pearson correlation coefficient for learning self regulation factors with achievement and creativity (Appendix 7.10, Learning self-regulation correlations).
Table 7.22  Pearson correlation coefficient for learning self-regulation factors with achievement and creativity outcomes

<table>
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<tr>
<th>Explanatory Variables</th>
<th>Explanatory variable description</th>
<th>GCEE</th>
<th>SpEE</th>
<th>H Criteria</th>
<th>TEE</th>
<th>ToKE</th>
<th>ToKO</th>
<th>ToKT</th>
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<td></td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autonomous regulation</td>
<td>Learner regulation of behaviour that results in free engagement and involvement in the EE and ToK, who view the tasks as interesting, enjoyable, challenging or formed from personal interest.</td>
<td>.07</td>
<td>.09</td>
<td>.13</td>
<td>.09</td>
<td>.18**</td>
<td>.38**</td>
<td>.31**</td>
</tr>
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<td>.07</td>
<td>.2</td>
<td>.008</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Controlled regulation</td>
<td>Learner behaviour is supported by social context and dependent on supervisor comment and learner perception of how others recognise learner behaviours. Feelings that one has to achieve high grades to be a worthy person.</td>
<td>.16*</td>
<td>.16*</td>
<td>.18**</td>
<td>.19**</td>
<td>18*</td>
<td>.17*</td>
<td>.20**</td>
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<td>.03</td>
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<td>.006</td>
<td>.009</td>
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</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)
These data suggest that the explanatory variables show varying levels of association with the achievement outcomes of the EE, creativity and ToK.

Student preference for self-determined behavioural regulation suggests ‘Autonomous regulation’ is approaching significance \( (r = .13, p = .07) \) for achievement in the H criteria outcome. Autonomous regulation would appear not to influence the other EE outcomes. These findings also suggest that autonomous behavioural regulation does influence student achievement in the ToKE \( (p < .001, r = .38) \) and is associated with achievement in the ToKO \( (p = .008) \) and the ToKT \( (p < .001) \) score.

Controlled regulation is an important influence on student behaviour which is supported by social context where the perceptions of others and the need to comply with outside direction, such as supervisor comments, are an important persuasion. Controlled regulation was found to have a statistically significant associations with all EE \( (p < .05) \) and ToK outcomes \( (p < .05) \).

Of note is that both explanatory variables are associated with the ToK outcomes, suggesting that the free engagement and involvement in the ToK tasks requires a balance with learner dependence on supervisor comments and behaviours dependent on outside perceptions of the need to achieve high grades to be a worthy person.

The measure of academic creativity (H criteria) is associated with controlled regulation \( (r = .18, p = .006) \) and s approaching significance for autonomous regulation \( (r = .13, p = .07) \). This suggests a balance is required, with students believing as important the improving of the skills of research, questioning, subject understanding and independence that autonomous regulation brings, contrasted with the desire to be perceived as good at research yet showing dependence on being told what to think and complying with supervisor suggestions.
7.5.1 School effect

The school effect on learning self-regulation is examined by comparing means between schools using an ANOVA model to examine these relationships (Appendix 7.11, LSR school effect).

Table 7.23 Learning self-regulation factor descriptives for schools

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>School</th>
<th>Mean</th>
<th>Standard error</th>
<th>F</th>
<th>ANOVA df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomous regulation</td>
<td>10</td>
<td>5.46</td>
<td>0.08</td>
<td>34.35</td>
<td>2, 215</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>4.49</td>
<td>0.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>5.56</td>
<td>0.16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>218</strong></td>
<td><strong>5.05</strong></td>
<td><strong>0.07</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Controlled regulation</td>
<td>10</td>
<td>4.57</td>
<td>0.06</td>
<td>7.81</td>
<td>2, 215</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>4.28</td>
<td>0.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>4.57</td>
<td>0.08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>248</strong></td>
<td><strong>4.44</strong></td>
<td><strong>0.04</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In assessing these data, a difference in means (see Table 7.23) for learning self-regulation factors, autonomous regulation and controlled regulation emerges between schools, suggesting a school effect. To facilitate the interpretation of data, the means for each of the self-learning factors between schools were graphed. These highlight for each explanatory variable, a range of means between schools, suggesting a significant statistical difference (p < .05) between schools (Figure 7.11).
These data was further analysed by examining the level of significance between means through multiple comparisons in the Table below.

Table 7.23 displays the mean difference between schools, the associated levels of significance and confidence intervals for each explanatory variable. As can be determined from Table 7.23, statistically significant differences exist between certain schools with autonomous and controlled regulation. The following Figure 7.12 displays the multiple comparisons for school effect on these explanatory variables.

**Figure 7.11  School effect on learning self-regulation factors**

**Figure 7.12  Learning self regulation factors by school**
Multiple comparison procedures suggest statistically significant differences, $p < .001$ between school 50 and schools 10 and 60 for autonomous regulation. These findings suggest that students from school 50 do not regulate their behaviour to freely engage in the extend essay and ToK as enjoyable and challenging tasks in the same way as schools 10 and 60. These findings also suggest that, for controlled regulation, school 50 has a lower mean than school 10 ($p = .002$) and school 60 ($p = .02$), suggesting that learner behaviour is less supported by social context, supervisor comment and outside perception that encourage high achievement.

### 7.5.2 Language effect

The effect of language on learning self-regulation factors was then examined by comparing means for Group 1 (native English speakers) and Group 3 (native Chinese speakers) as presented in Table 7.24 below (Appendix 7.12, LSR language effect).

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Language group</th>
<th>N</th>
<th>Mean</th>
<th>Standard error</th>
<th>F</th>
<th>ANOVA df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomous regulation</td>
<td>1</td>
<td>173</td>
<td>4.96</td>
<td>0.08</td>
<td>4.43</td>
<td>1, 197</td>
<td>.04</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>26</td>
<td>5.41</td>
<td>0.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>199</td>
<td>5.02</td>
<td>0.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Controlled regulation</td>
<td>1</td>
<td>173</td>
<td>4.45</td>
<td>0.04</td>
<td>.67</td>
<td>1, 197</td>
<td>.7</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>26</td>
<td>4.40</td>
<td>0.12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>199</td>
<td>4.44</td>
<td>0.04</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It should be noted that for autonomous regulation the difference in means is statistically significance ($p < .04$) suggesting Group 3 has a higher mean than Group 1. These data suggests that no statistical difference exists between means for controlled regulation ($p = .05$).
To facilitate the interpretation of data, the means for each of the two self-learning explanatory factors between language groups were graphed, highlighting the range of means in figure 7.13.

**Figure 7.13 Language effect on learning self-regulation factors**

![Bar chart showing the comparison of autonomous and controlled regulation between Language 1 and Language 3](chart.png)

A statistically significant difference ($p<.05$) exists between Group 1 and Group 3 students for autonomous regulation ($p = .04$) suggesting that learners from Group 3 are more likely to view the tasks as interesting and enjoyable. No significant difference ($p > .05$) exists between Group 1 and Group 3 for controlled regulation ($p = .7$). This result suggests that both groups of students rely on a degree of controlled regulation with learners depending on supervisor suggestions and outside perceptions of their behaviours for successful completion of the EE and ToK.

### 7.6 Motivation self-regulation and achievement

It is hypothesised that students show a preference for autonomous or self-determined motivation behavioural regulation. The extent to which these self-regulation motivation strategies predict achievement in the EE and ToK is examined. Correlation procedures are used to observe the strength of association between the creativity and achievement outcomes, based on the assumption that a linear relationship exists between these two sets of variables. To facilitate the interpretation of data the amotivation, external
regulation, introjected regulation, identified regulation and intrinsic motivation dimensions of motivation self regulation (MSR) were taken as the explanatory variables. The named learning self regulation variables are listed and described in Table 7.25.

The extent to which a school effect may be present in the preferred use of self-regulation strategies and the EE and ToK achievement outcome’s, were examined using ANOVA procedures. ANOVA was used to compare the school mean score for each explanatory variable and whether statistically significant differences exist between the schools.

These data was further examined to explore whether cultural differences, as measured by student mother tongue or native language, have an effect on the preferred use of self-determined behavioural regulation and the EE and ToK achievement outcomes. ANOVA procedures were used to compare the language mean score for each explanatory variable and determine whether statistically significant differences emerged between the two language groupings.

Data was collected from three schools labelled Schools 10, 50 and 60. Two hundred and four students completed the motivation self-regulation questionnaire. The achievement outcomes data for the EE and ToK was provided by IBCA which was matched to the MSR scores. Not all student EE and ToK achievement outcomes data from IBCA was available, resulting in 181 data sets for the GCEE and SPEE, 192 for the H criteria and 203 for the TEE. Two hundred and four data sets for the ToK were used when examining the association between the MSR explanatory variables and achievement outcomes. For the school’s data the same number of student result’s were used, and for the effect of language on the MSR, 204 student results were available.

Self regulation examines student preference for the different motivational reasons or goals that give rise to actions. These data suggest that the explanatory variables amotivation, identified regulation and intrinsic motivation play a role in the ToK achievement outcomes while external and introjected regulation do not. These data also
suggests that amotivation has an association with the EE outcomes and external and introjected regulation with the GCEE, SpEE and TEE (Appendix 7.13, MSR correlations with achievement outcomes).

The concept of amotivation is designed to indicate the extent to which students are neither intrinsically or extrinsically motivated, that is, to be without intention or motivation for the behaviours associated with the EE and ToK. These data suggests a negative association with all component outcomes of the EE and ToK, that increased feelings of lack of purpose lead to decreasing achievement outcomes.

The least autonomous form of extrinsic motivation is external regulation, where learning behaviours are engaged in for external eventualities such as rewards and punishments with the reasons for performing these behaviours not being internalised. This data suggests that as these behaviours are engaged in achievement outcomes fall. This data has moderately strong negative (p < .05) associations for the EE (with the exception of the H criteria) and no statistically significant (p > .05) associations with the ToK outcomes.

The more autonomous form of extrinsic motivation, introjected regulation, suggests students engage in the EE for reasons of self-worth, or for avoiding feelings of self-guilt. These data suggest that as students self impose these sanction directing behaviours results for the GCEE, SpEE and TEE decrease (p < .05) while no statistically significant (p < .05) associations exist for the H criteria and ToK outcomes, although it should be noted that the ToKO approaches significance (p = .07).

Identified regulation is the extent to which a student has valued the EE and ToK learning behaviours and accepted the regulation of these behaviours as their own. This data suggests that no such identification is made with the EE (p > .05), while students presenting for the ToK oral and essay (p < .01) have accepted the value of ToK learning in their goals and regulate their learning behaviours willingly to meet these goals through identification.
### Table 7.25 Pearson correlation coefficients for motivation self-regulation with achievement and creativity outcomes

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Explanatory variable description</th>
<th>GCEE</th>
<th>SpEE</th>
<th>H criteria</th>
<th>TEE</th>
<th>ToKE</th>
<th>ToKO</th>
<th>ToKT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amotivation</td>
<td>Amotivation is evidenced through the lack of self determination and the nonexistence of intrinsic or extrinsic motivation. This suggests the learner views the EE and ToK as serving no purpose, leading to a passive approach.</td>
<td>Pearson Correlation</td>
<td>-0.16*</td>
<td>-0.15*</td>
<td>-0.18*</td>
<td>-0.18**</td>
<td>-0.14*</td>
<td>-0.21**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Significance (2 tailed)</td>
<td>0.03</td>
<td>0.05</td>
<td>0.01</td>
<td>0.09</td>
<td>0.04</td>
<td>0.002</td>
</tr>
<tr>
<td>External regulation</td>
<td>Describes a low degree of self-determination with behaviours that are engaged in to obtain an external reward and/or avoid punishment</td>
<td>Pearson Correlation</td>
<td>-0.17*</td>
<td>-0.18*</td>
<td>-0.12</td>
<td>-0.16*</td>
<td>-0.09</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Significance (2 tailed)</td>
<td>0.02</td>
<td>0.01</td>
<td>0.09</td>
<td>0.03</td>
<td>0.20</td>
<td>0.9</td>
</tr>
<tr>
<td>Introjected regulation</td>
<td>A moderately low level of self-determination, with self imposed sanctions directing behaviours of self worth such as self-guilt or ego enhancement.</td>
<td>Pearson Correlation</td>
<td>-0.15*</td>
<td>-0.15*</td>
<td>-0.11</td>
<td>-0.17*</td>
<td>0.02</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Significance (2 tailed)</td>
<td>0.05</td>
<td>0.05</td>
<td>0.1</td>
<td>0.02</td>
<td>0.8</td>
<td>0.07</td>
</tr>
<tr>
<td>Identified regulation</td>
<td>A form of extrinsic regulation with the conscious valuing of an activity that gives rise to behaviours that are identified with one’s own goals. A moderately high level of self-determination.</td>
<td>Pearson Correlation</td>
<td>0.01</td>
<td>0.01</td>
<td>0.07</td>
<td>0.03</td>
<td>0.2**</td>
<td>0.3**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Significance (2 tailed)</td>
<td>0.9</td>
<td>p &gt; .9</td>
<td>0.3</td>
<td>0.7</td>
<td>0.004</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td>Intrinsic motivation</td>
<td>Student behaviours are evidenced by the free engagement in the EE and ToK because of the interest and enjoyment gained.</td>
<td>Pearson Correlation</td>
<td>-0.002</td>
<td>-0.003</td>
<td>0.04</td>
<td>0.03</td>
<td>0.16*</td>
<td>0.3**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Significance (2 tailed)</td>
<td>p &gt; .9</td>
<td>p &gt; .9</td>
<td>0.6</td>
<td>0.7</td>
<td>0.03</td>
<td>p &lt; .001</td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)
Student preference for the intrinsic valuing of research as a motivational factor has an association with ToK achievement (p < .05) but not with the EE outcomes (p > .05). Intrinsic motivation encompasses the ‘... the active engagement with tasks that student’s find interesting and that, in turn, promote growth’ (Deci & Ryan, 2000). It is worth noting that while the EE and ToK can be characterised as novel and interesting, these data suggests that student involvement with the EE is not strong (GCEE r = -.002, SpEE r = -.003; H criteria r = .4 and TEE r = .03) nor significant (p>.05). For the ToK there is a stronger positive association (ToKE, r = .16, p = .03; ToKO, r = .3, p < .001; ToKT, r = .2, p < .001).

7.6.1 School effect

The school effect on motivation self-regulation is examined by comparing means between schools. An ANOVA model was used to examine the relationship between the schools. Table 7.26 displays the mean difference between schools, the associated levels of significance and confidence intervals for each explanatory variable (Appendix 7.14).

<table>
<thead>
<tr>
<th>Explanatory variable</th>
<th>School</th>
<th>N</th>
<th>Mean</th>
<th>Standard error</th>
<th>F</th>
<th>ANOVA df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amotivation</td>
<td>10</td>
<td>84</td>
<td>1.89</td>
<td>.09</td>
<td>11.65</td>
<td>2, 201</td>
<td>&lt; 0.001**</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>95</td>
<td>2.65</td>
<td>.11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>25</td>
<td>2.50</td>
<td>.32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>204</td>
<td>2.32</td>
<td>.08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External regulation</td>
<td>10</td>
<td>84</td>
<td>4.02</td>
<td>.10</td>
<td>0.78</td>
<td>2, 201</td>
<td>.46</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>95</td>
<td>4.12</td>
<td>.11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>25</td>
<td>4.30</td>
<td>.25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>204</td>
<td>4.10</td>
<td>.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introjected regulation</td>
<td>10</td>
<td>84</td>
<td>3.58</td>
<td>.12</td>
<td>3.15</td>
<td>2, 201</td>
<td>.05*</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>95</td>
<td>3.27</td>
<td>.11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>25</td>
<td>3.83</td>
<td>.28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>204</td>
<td>3.47</td>
<td>.08</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Identified regulation  
10  84  5.11  .10  17.59  2, 201  < .001**
50  95  4.37  .11
60  25  5.42  .13
Total  204  4.81  .08

Intrinsic motivation  
10  84  4.61  .11  19.92  2, 201  < .001**
50  95  3.90  .13
60  25  5.34  .18
Total  204  4.76  .08

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

The school means for the explanatory variables are examined. These data suggests that a statistical significant difference in means between schools (see Table 7.26) exists for amotivation (p < .001), introjected regulation (p < .05), identified regulation (p < .001) and intrinsic motivation (p < .001). To facilitate the interpretation of data, the means for each of the self-learning motivation explanatory variables between schools were graphed in Figure 7.14 below.

** Figure 7.14 ** School effect on motivation self regulation factors

This data was further analysed by examining the level of significance between means through multiple comparisons in the Figure 7.15 below.
As can be determined from Table 7.26, statistically significant differences exist between certain schools. The following graphs in Figure 7.15 display the multiple comparisons for school effect on these explanatory variables.

**Figure 7.15 School effect and motivation self regulation**
Multiple comparison procedures suggest that statistically significant (p < .001) differences exist between schools for amotivation, identified regulation, intrinsic motivation, and introjected regulation (p < .05) with no statistically significant difference between schools for external regulation (p = .46).

This data suggests that school 10 has a lower mean than school 50 with a statistically significant difference of p < .001, and school 60, p = .046 for amotivation. This data suggests that students at school 10 have a more purposeful and proactive involvement with the EE and ToK.

Differences also emerge with identified regulation and intrinsic motivation. School 50 has a lower and statistically significant difference (p < .001) in means from school 60 and school 10 for identified regulation, suggesting that student valuing and acceptance of these behaviours as their own for the EE and ToK is higher in these two schools. A similar result exists for intrinsic motivation (p < .001) between schools where student engagement and interest, promoting behavioural growth in the EE and ToK tasks is higher for students in schools 10 and 60 than school 50. A difference also emerges between schools 10 and 60 (p < .02) with students from school 60 having the higher mean.

It should be noted that explanatory variable introjected regulation approaches statistical significance (p = .09) between schools 50 and 60.

7.6.2 Language effect

The effect of language on motivation self-regulation is examined by comparing means for Group 1 (native English speakers) and Group 3 (native Chinese speakers) can be seen in Appendix 7.15 (MSR language effect).
Table 7.27  Motivation self-regulation factor descriptives for language groupings

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Language group</th>
<th>N</th>
<th>Mean</th>
<th>Standard error</th>
<th>F</th>
<th>ANOVA df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amotivation</td>
<td>1</td>
<td>173</td>
<td>2.30</td>
<td>.08</td>
<td>0.17</td>
<td>1, 202</td>
<td>.7</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>31</td>
<td>2.40</td>
<td>.27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>204</td>
<td>2.32</td>
<td>.08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External regulation</td>
<td>1</td>
<td>173</td>
<td>4.12</td>
<td>.08</td>
<td>0.03</td>
<td>1, 202</td>
<td>.6</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>31</td>
<td>4.01</td>
<td>.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>204</td>
<td>4.10</td>
<td>.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introjected regulation</td>
<td>1</td>
<td>173</td>
<td>3.39</td>
<td>.08</td>
<td>5.21</td>
<td>1, 202</td>
<td>.02*</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>31</td>
<td>3.90</td>
<td>.23</td>
<td></td>
<td></td>
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<td></td>
<td>Total</td>
<td>204</td>
<td>3.47</td>
<td>.08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identified regulation</td>
<td>1</td>
<td>173</td>
<td>4.73</td>
<td>.09</td>
<td>5.40</td>
<td>1, 202</td>
<td>.02*</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>31</td>
<td>5.22</td>
<td>.13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>204</td>
<td>4.81</td>
<td>.08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intrinsic motivation</td>
<td>1</td>
<td>173</td>
<td>4.25</td>
<td>.09</td>
<td>12.13</td>
<td>1, 202</td>
<td>.001**</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>31</td>
<td>5.05</td>
<td>.15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>204</td>
<td>4.37</td>
<td>.08</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

These data suggests that Group 3 has a higher mean, statistically significant for introjected regulation (p = .02), indentified regulation (p = .02) and intrinsic motivation (p = .001), while Group 3 has a higher mean but not statistically significant for amotivation (p = .7) and Group 1 a higher mean for external regulation (p = .6).

The means for each motivation explanatory factor has been graphed (Figure 7.16) to facilitate the interpretation of data.
The graph indicates that for each explanatory variable there is a difference in means which is significant \((p < .05)\) for introjected and identified regulation and intrinsic motivation. These findings for introjected regulation suggest Group 3 students \((p = .02)\) have stronger extrinsic pressures which encourage task engagement but this engagement is not accepted as their own. Students engage in these tasks for reasons of self-worth or the avoidance of guilt or shame, not for any reasons of self worth. Group 3 students participate in the EE and ToK not because they want to, but because they believe this is what ‘good students’ should do.

Identified regulation allows students to more closely identify with the value of the activity and accept the relevance of the activity as their own. This data suggests that Group 3 students \((p = .02)\) more closely connect with the value of the EE and ToK, recognising the importance of researching and questioning as a way of learning, being well disposed to engagement in these two tasks.

These findings also suggest the explanatory variable intrinsic motivation is rated more highly by Group 3 native Chinese speakers than Group 1 \((p = .001)\), where Group 3 students value active engagement with the EE and ToK, enjoying learning by researching, questioning and the pleasure of discovering ‘new things’.
No significant difference (p > .05) exists between Group 1 and Group 3 students with the explanatory variables amotivation and external regulations. This suggests that both groups are amotivated, and rely on external regulation when completing the EE and ToK.

7.7 **A balanced use of intrinsic and extrinsic motivations to learn**

It is hypothesised that students show a preference for a balanced use of intrinsic and extrinsic motivations to learn. The extent to which these intrinsic or mastery belief scores predict achievement in the EE and ToK is examined. Factor analysis was used to uncover the latent structures of these sets of variables associated with this hypothesis, and reduce the number of variables to a small number of factors, believed to ‘... reflect underlying processes that have created the correlations among the variables’ (Tabachnick, Barbara G. & Fidell, Linda S., 2001, p. 582). SPSS procedures were used to extract eigenvalues over 1.0, with a rotated solution using varimax (a orthogonal rotation of the factor axes maximising the variance of the squared loadings and assuming the factors are uncorrelated). Items with a loading of less than .4 were suppressed and sorted by size. This process provided 16 initial factors associated with the hypothesis. This process was repeated and forced 5 explanatory factors with the hypotheses.

The Kaiser-Meyer-Olkin measure of sampling adequacy is .75, with total variance explained of 34.72 % for five factors. Tests of reliability suggest that Factor 1 (N of cases = 265, N of items = 9) gives an Alpha of .70, Factor 2 (N of cases = 264, N of items = 7) gives a Alpha of .79, Factor 3 (N of cases = 270, N of items = 8) gives a Alpha of .74, Factor 4 (N of cases = 284, N of items = 8) gives a Alpha of .46 and Factor 5 (N of cases = 287, N of items = 3) gives a Alpha of .60.

The extracted and named explanatory variables can be found in Table 7.28 and are listed below.

Component 1  Intrinsic motivation

---

227
Component 2  Mastery learning
Component 3  Self - perception as a learner
Component 4  External influences
Component 5  Use of time during learning

The extent to which a school effect may be present in the preferred use of motivation strategies to learn and the EE and ToK achievement outcomes was examined using ANOVA procedures. ANOVA was used to compare the school mean for each explanatory variable and whether statistically significant differences exist between schools.

These data was further examined to determine whether cultural differences, as measured by student mother tongue or native language, has an effect on the preferred use of self-determined behavioural regulation and the EE and ToK achievement outcomes. ANOVA procedures were used to compare the language mean score for each explanatory variable and whether statistically significant differences emerged between the two language groupings.

Data was collected from three schools labelled Schools 10, 30, 40, and 50. Three hundred and two students completed the questionnaire on their perceived preference of use of motivation strategies. The achievement outcomes data for the EE and ToK was provided by IBCA which was matched to the motivations scores. Not all student EE and ToK achievement outcomes data from IBCA was available, resulting in 227 data sets for the GCEE and SPEE, 278 for the H criteria and 302 for the TEE,. Two hundred and seventy six data sets for the ToKE and ToKO, and 302 for the ToKT were used when examining the association between the explanatory variables and achievement outcomes. For the school’s data the same number of student results were used, and for the effect of language on the BHTL, 302 student results were available.
<table>
<thead>
<tr>
<th>Question</th>
<th>Component 1</th>
<th>Component 2</th>
<th>Component 3</th>
<th>Component 4</th>
<th>Component 5</th>
<th>Communaliites</th>
</tr>
</thead>
<tbody>
<tr>
<td>BHTL 45</td>
<td>When I get an assignment or test back I go over it and try to see where I had made mistakes and correct what I know</td>
<td>.55</td>
<td></td>
<td></td>
<td></td>
<td>.38</td>
</tr>
<tr>
<td>BHTL 27</td>
<td>My success as a student depends more how I handle the learning than on the people who teach me</td>
<td>.54</td>
<td></td>
<td></td>
<td></td>
<td>.34</td>
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<tr>
<td>BHTL 26</td>
<td>If I come to a task or topic that is difficult or hard, I try working on it in different ways until I can understand it or do it.</td>
<td>.53</td>
<td></td>
<td></td>
<td></td>
<td>.37</td>
</tr>
<tr>
<td>BHTL 7</td>
<td>I like to do challenging and interesting tasks when I am learning</td>
<td>.53</td>
<td></td>
<td></td>
<td></td>
<td>.47</td>
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<tr>
<td>BHTL 21</td>
<td>I try to keep track of what works for me when I learn a topic or do tasks</td>
<td>.50</td>
<td></td>
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<td>.28</td>
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<tr>
<td>BHTL 49</td>
<td>When I am learning a new topic, I have my own standard or level that I want to achieve at</td>
<td>.45</td>
<td></td>
<td></td>
<td></td>
<td>.31</td>
</tr>
<tr>
<td>BHTL 36</td>
<td>The more effort I put into learning an idea, the better I am likely to know it.</td>
<td>.43</td>
<td></td>
<td></td>
<td></td>
<td>.26</td>
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<tr>
<td>BHTL 16</td>
<td>I prefer tasks that are more difficult and challenging than tasks that I can do easily</td>
<td>.42</td>
<td></td>
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<td>.36</td>
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<tr>
<td>BHTL 3</td>
<td>I enjoy working on topics that are new and different from what I already know</td>
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<td>.26</td>
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<tr>
<td>BHTL 24</td>
<td>I like to learn topics by asking questions and making links with what I know rather than learning cut and dried facts</td>
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<td>.76</td>
</tr>
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<td>BHTL 4</td>
<td>I learn topics and subjects best by taking them in and memorising them rather than by analysing and taking them apart</td>
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<td>.72</td>
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<tr>
<td>BHTL 40</td>
<td>I find I learn topics and subjects best by analysing them and taking them apart rather than taking them in and memorising them</td>
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<td></td>
<td></td>
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<td>.71</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
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<td>Score 2</td>
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<td>----------------------------------------------------------------------------------------------</td>
<td>---------</td>
<td>---------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BHTL 37</td>
<td>I learn topics better when they are taught as cut and dried facts rather than when I need to ask questions about the ideas and make links between them</td>
<td>.71</td>
<td>.59</td>
<td></td>
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</tr>
<tr>
<td>BHTL 47</td>
<td>I don’t waste time trying to link what I am learning in a subject to what I already know; I just like to take it in</td>
<td>.48</td>
<td>.45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BHTL 6</td>
<td>When I am learning new topics I like to ask myself questions about them</td>
<td>.46</td>
<td>.42</td>
<td></td>
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<tr>
<td>BHTL 35</td>
<td>I try to link what I am learning in a subject to anything I already know about the topic</td>
<td>.45</td>
<td>.35</td>
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<tr>
<td>BHTL 29</td>
<td>I begin to doubt I can be a successful learner when a topic is hard to learn or tasks are difficult to do</td>
<td>.71</td>
<td>.51</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BHTL 25</td>
<td>I feel bad about myself as a learner when I have difficulty learning a topic or when I make errors</td>
<td>.67</td>
<td>.51</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>BHTL 44</td>
<td>When I put a lot of effort but don’t succeed I feel helpless</td>
<td>.58</td>
<td>.41</td>
<td></td>
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<td>BHTL 42</td>
<td>Needing to learn a difficult topic or do a hard task doesn’t worry me</td>
<td>.55</td>
<td>.42</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BHTL 11</td>
<td>I don’t feel that I am a poor learner when I find a topic difficult or when I make errors</td>
<td>.52</td>
<td>.30</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>BHTL 1</td>
<td>I believe that I can learn topics that are hard and do tasks that are difficult</td>
<td>.49</td>
<td>.41</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>BHTL 15</td>
<td>When I don’t do well on a topic or task, it is because I am not up to the necessary standard</td>
<td>.49</td>
<td>.30</td>
<td></td>
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</tr>
<tr>
<td>BHTL 33</td>
<td>When I need to learn a difficult topic or do a hard task, I worry about how well I will do</td>
<td>.49</td>
<td>.31</td>
<td></td>
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<tr>
<td>BHTL 31</td>
<td>I believe that my success at school is determined by factors that I can’t control</td>
<td></td>
<td>.60</td>
<td></td>
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<tr>
<td>BHTL 39</td>
<td>If you are not intelligent it doesn’t matter how hard you try, you won’t do as well as others who are more intelligent</td>
<td>.57</td>
<td>.38</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
intelligent

BHTL 34  When I don’t do well on a topic or task, it is because I haven’t had good teachers .49 .43
BHTL 9   How you go about learning new topics or doing tasks show how intelligent you are. -.48 .30
BHTL 8   It doesn’t matter how much effort I put into learning an idea, I won’t learn it any better if I lack the necessary intelligence .47 .41
BHTL 32  The results you get in a test or exam show how intelligent you are. .46 .33
BHTL 2   My success as a student depends more on how good my teachers are at teaching, rather than on me .43 .32
BHTL 28  When I study, I prefer to work on the tasks that have been set: I don’t like to waste time deviating from these .62 .42
BHTL 38  When I study I am happy to spend time thinking about ideas that are off the topic and away from the set tasks .61 .44
BHTL 20  I put most of my study time working on topics that I think will be on exams or tests .61 .40

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalisation
Rotation converged in 7 iterations

<table>
<thead>
<tr>
<th></th>
<th>Eigenvalues</th>
<th>Percentage of variance</th>
</tr>
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<td>4.61</td>
</tr>
<tr>
<td></td>
<td>1.99</td>
<td>3.98</td>
</tr>
</tbody>
</table>

The degree of association between the 5 explanatory variables and the dependent variables was examined using the Pearson correlation coefficient for each relationship. This data is shown in Table 7.29 Pearson correlation coefficients for beliefs about how to learn (Appendix, 7.16., BHTL correlations and achievement outcomes).
### Table 7.29 Pearson correlation coefficients for BHTL and achievement and creativity outcomes

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Explanatory variable description</th>
<th>GCEE</th>
<th>SpEE</th>
<th>H Criteria</th>
<th>TEE</th>
<th>ToKE</th>
<th>ToKO</th>
<th>ToKT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intrinsic motivation</td>
<td>A measure of student engagement in learning, the enjoying of the challenge and difficulty in understanding the EE and ToK, working on different ways to understand and complete the tasks. This ensures fulfilment of personal and learning goals.</td>
<td>Pearson Correlation</td>
<td>.2**</td>
<td>.2**</td>
<td>.14*</td>
<td>.2**</td>
<td>.3**</td>
<td>.3**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2 tailed)</td>
<td>.001</td>
<td>.001</td>
<td>.016</td>
<td>.001</td>
<td>p &lt; .001</td>
<td>p &lt; .001</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>227</td>
<td>227</td>
<td>278</td>
<td>302</td>
<td>276</td>
<td>276</td>
<td>302</td>
</tr>
<tr>
<td>Mastery learning</td>
<td>Student demonstrates clarity in learning through asking questions, linking new knowledge to prior knowledge, and analysis.</td>
<td>Pearson Correlation</td>
<td>.14</td>
<td>.16</td>
<td>.18</td>
<td>.12</td>
<td>.27**</td>
<td>.2**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2 tailed)</td>
<td>.03</td>
<td>.019</td>
<td>.003</td>
<td>.34</td>
<td>p &lt; .001</td>
<td>p &lt; .001</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>227</td>
<td>227</td>
<td>278</td>
<td>302</td>
<td>276</td>
<td>276</td>
<td>302</td>
</tr>
<tr>
<td>Self perception as a learner</td>
<td>Learner self perception about ability, success, level of difficulty, and helplessness, suggesting lack of clarity in goal setting.</td>
<td>Pearson Correlation</td>
<td>-.04</td>
<td>-.06</td>
<td>-.02</td>
<td>-.06</td>
<td>.03</td>
<td>-.10</td>
</tr>
<tr>
<td></td>
<td>Sig. (2 tailed)</td>
<td>-.5</td>
<td>.3</td>
<td>.8</td>
<td>.3</td>
<td>.6</td>
<td>.104</td>
<td>.9</td>
</tr>
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<td></td>
<td>N</td>
<td>227</td>
<td>227</td>
<td>278</td>
<td>302</td>
<td>276</td>
<td>276</td>
<td>302</td>
</tr>
<tr>
<td>External influences</td>
<td>Student academic success is determined by external factors over which the learner has no control.</td>
<td>Pearson Correlation</td>
<td>.15*</td>
<td>.18**</td>
<td>.16**</td>
<td>.11</td>
<td>.11</td>
<td>.12*</td>
</tr>
<tr>
<td></td>
<td>Sig. (2 tailed)</td>
<td>.020</td>
<td>.007</td>
<td>.009</td>
<td>.061</td>
<td>.064</td>
<td>.041</td>
<td>.011</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>227</td>
<td>227</td>
<td>278</td>
<td>302</td>
<td>276</td>
<td>276</td>
<td>302</td>
</tr>
<tr>
<td>Use of time during learning</td>
<td>Suggests student focus on the use of time is to complete set and examinable tasks, while happy to think about ideas that are not directly related to the EE and ToK.</td>
<td>Pearson Correlation</td>
<td>.02</td>
<td>.04</td>
<td>.07</td>
<td>.03</td>
<td>.3**</td>
<td>.13**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2 tailed)</td>
<td>.7</td>
<td>.6</td>
<td>.3</td>
<td>.6</td>
<td>p &lt; .001</td>
<td>.026</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td></td>
<td>N</td>
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<td>227</td>
<td>278</td>
<td>302</td>
<td>276</td>
<td>276</td>
<td>302</td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)
These findings suggest that explanatory variables’ 1, 2, 4 and 5 show varying levels of association with the achievement outcomes, while 3 is statistically not significant (p > .05). The construct, My approach to learning, is a composite of student dispositions and actions towards their learning, with statistically significant associations (p < .05) with the EE and ToK outcomes. This reflects the notion of intrinsic motivation where the EE and ToK tasks are pursued for their own sake, the enjoyment, challenge, interest, and satisfaction that are inherent in the task itself. Explanatory variable 2, Learning any topic, suggest students like to learn topics by asking questions, analysing and making links between ideas, being statistically significant with all outcomes (p < .05). The explanatory variable, Factors determining academic success, suggests this factor is not significant (p > .05) with the TEE and ToKE, but significant (p < .05) with the other achievement outcomes. Use of time during learning suggests students have a balanced approach in the use of time, preferring to work on set tasks, but happy to think about ideas away from these set tasks. The association with the ToK outcomes are statistically significant (p < .05), but not with the EE (p < .05).

7.7.1 School effect

The school effect on beliefs about how to learn was examined by comparing means between schools. An ANOVA model was used to examine the relationship between explanatory variables and school means (Appendix 7.17, BHTL and school effect).

These data suggests that a difference in means for the beliefs about how to learn explanatory variables, intrinsic motivation, mastery learning, external influences and use of time during learning, exists between schools, suggesting a school effect is present. To facilitate the interpretations of data, the means for each of the factors between schools was graphed (Figure 7.17).
Table 7.30  Factor descriptives for BHTL based on school

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>School</th>
<th>N</th>
<th>Mean</th>
<th>Standard error</th>
<th>F</th>
<th>ANOVA df</th>
<th>p</th>
</tr>
</thead>
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<tr>
<td>Intrinsic motivation</td>
<td>10</td>
<td>104</td>
<td>3.80</td>
<td>0.04</td>
<td>9.855</td>
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<td>&lt; .001**</td>
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<tr>
<td></td>
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<td>50</td>
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<td>3.42</td>
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</tr>
<tr>
<td>External influences</td>
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<td>104</td>
<td>3.68</td>
<td>0.05</td>
<td>4.403</td>
<td>4,297</td>
<td>.002**</td>
</tr>
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<td>34</td>
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<tr>
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<td>30</td>
<td>52</td>
<td>3.39</td>
<td>0.07</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>40</td>
<td>16</td>
<td>3.53</td>
<td>0.09</td>
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<td></td>
<td>50</td>
<td>96</td>
<td>3.45</td>
<td>0.05</td>
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</tr>
<tr>
<td>Total</td>
<td>302</td>
<td></td>
<td>3.54</td>
<td>0.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of time during</td>
<td>10</td>
<td>104</td>
<td>2.58</td>
<td>0.07</td>
<td>7.942</td>
<td>4,297</td>
<td>.001**</td>
</tr>
<tr>
<td>learning</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
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<td></td>
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<td>34</td>
<td>3.00</td>
<td>0.13</td>
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<td></td>
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<td></td>
<td>30</td>
<td>52</td>
<td>2.79</td>
<td>0.10</td>
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<td></td>
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<tr>
<td></td>
<td>40</td>
<td>16</td>
<td>2.77</td>
<td>0.19</td>
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<td>50</td>
<td>96</td>
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<td>302</td>
<td></td>
<td>2.59</td>
<td>0.04</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

These graphs show that for each factor there is a range of means between schools with the data suggesting that there is a significant difference (p< .01) between schools with factors 1, 2, 4 and 5 in Figure 7.17.
This data was further analysed by examining the level of significance between means through multiple comparisons. As can be determined from Table 7.30, statistically significant differences exist between certain schools. The following graphs in Figure 7.18 display the multiple comparisons for school effect on these explanatory variables.
These findings suggest that on average there are statistically significant differences in the performance levels between schools for intrinsic motivation ($p < .001$), mastery learning ($p = .001$), external influences ($p = .002$) and use of time during learning ($p = .001$). These data also suggests there are no significant differences between schools for self perception as a learner ($p = .2$). It is worth noting that school 40 ($N = 16$) has a relatively wider confidence interval, suggesting greater variability in data, (Table 7.30) and less reliability in the sample estimates of the mean. This is possibly due to the relatively smaller sample size. Notably, this pattern emerges for all effects, suggesting that the results for this school should be ignored. Schools 10, 20, 30 and 50 have relatively smaller confidence intervals resulting in more precise survey results.

Statistically significant differences emerge for intrinsic motivation between school 50 and school 10 ($p < .001$), school 20 ($p < .001$) and school 30 ($p = .009$), suggesting that students at school 50 are the least engaged in the learning tasks associated with the EE and ToK. With explanatory variable mastery learning, student learning through questioning, linking new
knowledge to prior knowledge and analysis suggests statistically significant differences between school 50 and 20 (p = .003) and school 50 and 30 (p = .006), with school 50 having the lower mean.

With external influences student academic success is determined by factors over which the learner perceives having no control, with differences between school 10 and school 30 (p = .003) and school 10 and school 50 (p = .008), with school 10 having the higher mean. This suggests that students at school 30 and 50 have a strong perception of the role that intelligence and the teacher plays in achievement and that lack of success can be apportioned to these reasons.

Use of time is to complete set and examinable tasks, while happy to think about ideas that are not directly related to the EE and ToK. Statistically significant differences emerge between school 50 and 20 (p < .001), school 50 and 30 (p = .001), and approaching significance for school 50 and 10 (p = .06). This finding suggests that students in school 20 and 30 while focussing on their use of time, also think beyond the immediate tasks.

### 7.7.2 Language effect

The effect of language on beliefs about how to learn was examined by comparing means for Group 1 (native English speakers) and Group 4 (native Indonesian speakers [17] and native Chinese [19] speakers) and presented in Table 7.31 (Appendix 7.18, BHTL and language effect).
Table 7.31  BHTL factor descriptives for language groupings

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Language group</th>
<th>N</th>
<th>Mean</th>
<th>Standard error</th>
<th>F</th>
<th>ANOVA df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>250</td>
<td>3.65</td>
<td>0.03</td>
<td>.65</td>
<td>1,284</td>
<td>.4</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>36</td>
<td>3.72</td>
<td>0.07</td>
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<tr>
<td></td>
<td>Total</td>
<td>286</td>
<td>3.66</td>
<td>0.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mastery learning</td>
<td>1</td>
<td>250</td>
<td>3.51</td>
<td>0.04</td>
<td>.21</td>
<td>1,284</td>
<td>.7</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>36</td>
<td>3.56</td>
<td>0.09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>286</td>
<td>3.52</td>
<td>0.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self perception as a learner</td>
<td>1</td>
<td>250</td>
<td>3.09</td>
<td>0.04</td>
<td>1.38</td>
<td>1,284</td>
<td>.2</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>36</td>
<td>2.96</td>
<td>0.09</td>
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<td></td>
<td>Total</td>
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<td>3.07</td>
<td>0.04</td>
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</tr>
<tr>
<td>External influences</td>
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<td>3.55</td>
<td>0.03</td>
<td>2.34</td>
<td>1,284</td>
<td>.12</td>
</tr>
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<td>4</td>
<td>36</td>
<td>3.42</td>
<td>0.09</td>
<td></td>
<td></td>
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<td></td>
<td>Total</td>
<td>286</td>
<td>3.53</td>
<td>0.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of time during learning</td>
<td>1</td>
<td>250</td>
<td>2.54</td>
<td>0.05</td>
<td>2.74</td>
<td>1,284</td>
<td>.10</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>36</td>
<td>2.76</td>
<td>0.10</td>
<td></td>
<td></td>
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<td>Total</td>
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<td>2.57</td>
<td>0.04</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Correlation is significant at the .01 level (2-tailed)**
*Correlation is significant at the .05 level (2-tailed)*

These data suggests that while Group 1 has a higher mean for explanatory variables 3 and 4, and Group 4 a higher mean for factors 1, 2 and 5, there is no significant difference (p > .05) between language groupings. It should be noted that explanatory variable 5, use of time during learning, is approaching significance (p < .05). The means for each of the explanatory factors between the language groupings are graphed below (Figure 7.19).
These data suggests that for both language groups there is no statistically significant difference (p < .05) between the two, suggesting a similar reliance on each of the explanatory variables for successful completion of the EE and ToK. It should be noted that use of time during learning approaches significance (p = .08) with group 4 language students having the higher mean, suggesting these students are more likely on average to focus on the use of time in completing their set work, but are also prepared to think beyond the immediate tasks.

To further investigate whether Group 1 (native English speakers) and Group 3 (native Chinese speakers) differ in their use of thinking skills, and independent samples t test to compare Group 1 and Group 3 was computed in Table 7.32 (Appendix 7.18).
Table 7.32  BHTL factor descriptives for language groupings using independent samples t test

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Language group</th>
<th>N</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>t</th>
<th>df</th>
<th>p value</th>
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</thead>
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<td></td>
</tr>
<tr>
<td>Intrinsic motivation</td>
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<td>0.50</td>
<td>-1.30</td>
<td>267</td>
<td>.2</td>
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<td></td>
<td>3</td>
<td>19</td>
<td>3.80</td>
<td>0.51</td>
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<td></td>
</tr>
<tr>
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<td>Total</td>
<td>269</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mastery learning</td>
<td>1</td>
<td>250</td>
<td>3.51</td>
<td>0.69</td>
<td>-1.57</td>
<td>267</td>
<td>.12</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>19</td>
<td>3.56</td>
<td>0.46</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Total</td>
<td>269</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Self perception as a</td>
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<td>250</td>
<td>3.09</td>
<td>0.63</td>
<td>1.61</td>
<td>267</td>
<td>.11</td>
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<td>19</td>
<td>2.85</td>
<td>0.50</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>External influences</td>
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<td>250</td>
<td>3.55</td>
<td>0.48</td>
<td>1.63</td>
<td>267</td>
<td>.10</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>19</td>
<td>3.36</td>
<td>0.49</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>269</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of time</td>
<td>1</td>
<td>250</td>
<td>2.54</td>
<td>0.75</td>
<td>-2.19</td>
<td>267</td>
<td>.03</td>
</tr>
<tr>
<td>during learning</td>
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<td>19</td>
<td>2.76</td>
<td>0.63</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>269</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

An independent samples t-test was conducted comparing Group 1 students to Group 3 students in their motivational preferences. Levene’s test for equality of variances was used to establish that the variances of the two populations did not differ (Appendix 7.9).

There was no significant statistical difference (p < .05) in the scores for the two groups of students for intrinsic motivation, mastery learning, self perception as a learner and external influences. This suggests a similar reliance on each of the explanatory variables for successful completion of the EE and ToK. A statistically significant difference emerged for use of time between Group 1 (t(267) = -2.19, p = .03) and Group 3 with Group 3 having a higher mean (M = 2.76, SD = 0.63) than Group 1 (M = 2.54, SD = 0.75). It should be noted that use of time during learning approaches significance (p = .10) with group 4 language students having the higher mean, suggesting these students are more likely on average to
focus on the use of time in completing their set work, but are also prepared to think beyond the immediate tasks.

7.8 Approaches to learning and achievement

In the present study it is hypothesised that achievement in the EE and ToK is predicted by a balanced use of deep, surface and achieving motive and strategy approaches to learning. A student approach to learning is a combination of motive and strategy. The extent to which scores in surface, deep and achieving motives and strategy use are associated with the EE, creativity and ToK achievement outcomes is examined using linear correlation procedures. To facilitate the interpretation of data the learning approach beliefs and strategies were taken as the explanatory variables. The named explanatory factors are listed and described in Table 7.33.

The extent to which a school effect may be present was examined using ANOVA procedures. ANOVA was used to compare the school mean score for each explanatory variable and whether statistically significant differences can exist between schools. This data was further examined to determine whether cultural differences have an effect on learning approach beliefs and strategies and the achievement outcomes. ANOVA procedures were used to compare the language mean scores for each explanatory variable and whether statistically significant differences emerge between the two language groupings.

Data was collected from three schools labelled Schools 10, 20, 30, and 50. Two hundred and forty seven students completed the questionnaire on their learning approach beliefs and strategies. The achievement outcomes data for the EE and ToK was provided by IBCA which was matched to the beliefs and strategies scores. Not all student EE and ToK achievement outcomes data from IBCA were available, resulting in 247 data sets for the GCEE, SPEE, and TEE, and 243 for the H criteria. Two hundred and forty seven data sets for the ToKE, ToKO, and ToKT were used when examining the association between the explanatory variables and achievement outcomes. For the school’s data 247 student results were used, and the same number for the effect of language on learning beliefs and strategies (Appendix, 7.19, LPQ correlations with achievement outcomes).
These findings suggest that varying levels of association exist between student approaches and achievement outcomes, with no statistically significant (p > .05) relationship between achievement motivation and the EE and ToK outcomes. A negative association (r = -.15) between deep motivation and the SpEE (p = .02) is suggested by this finding. Apart from this association this data suggests no associations are found between student approaches to learning and the EE. This is a disappointing result as it would be reasonably expected that a balanced use of learning approach beliefs and strategies are needed for achievement in the EE.

These findings suggest that surface motivation is the dimension of learning approach beliefs that motivates students in the ToKE and ToKT (p < .05), suggesting that students who seek to meet the minimal requirements for the ToKE and ToKT will see a fall in their results. Surface, deep and achievement strategies are statistically significant (p < .05), with the exception of surface strategy and ToKO (p = .2) and used by students when engaging in the ToKE, ToKO and the ToKT.
<table>
<thead>
<tr>
<th>Student Approach</th>
<th>Explanatory variable descriptions</th>
<th>GCEE</th>
<th>SpEE</th>
<th>H score</th>
<th>TEE</th>
<th>ToKE</th>
<th>ToK O</th>
<th>ToKT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Motivation</td>
<td>A measure of student ability to meet minimal requirements for learning, to retain knowledge and meet external criterion</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pearson Correlation</td>
<td>- .08</td>
<td>- .03</td>
<td>.05</td>
<td>- .07</td>
<td>- .17**</td>
<td>- .12</td>
<td>- .18**</td>
</tr>
<tr>
<td></td>
<td>p value</td>
<td>.2</td>
<td>.6</td>
<td>.5</td>
<td>.3</td>
<td>.007</td>
<td>.07</td>
<td>.003</td>
</tr>
<tr>
<td>Deep Motivation</td>
<td>Reflects the desire to know more about a topic, to develop a competence in an area of knowledge because of an intrinsic interest in what is being learnt</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pearson Correlation</td>
<td>- .10</td>
<td>- .15*</td>
<td>- .06</td>
<td>- .12</td>
<td>- .01</td>
<td>- .01</td>
<td>- .03</td>
</tr>
<tr>
<td></td>
<td>p value</td>
<td>.12</td>
<td>.02</td>
<td>.4</td>
<td>.07</td>
<td>.8</td>
<td>.9</td>
<td>.6</td>
</tr>
<tr>
<td>Achievement Motivation</td>
<td>Seeks to achieve understanding at a level relative to others. High achievement outcomes are wanted irrespective of interest in the topic.</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pearson Correlation</td>
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<td>- .03</td>
<td>.02</td>
<td>- .03</td>
<td>- .04</td>
<td>.12</td>
<td>- .02</td>
</tr>
<tr>
<td></td>
<td>p value</td>
<td>.7</td>
<td>.7</td>
<td>.7</td>
<td>.7</td>
<td>.5</td>
<td>.06</td>
<td>.8</td>
</tr>
<tr>
<td>Surface Strategy</td>
<td>Learners seek to memorise information, linking ideas in an unquestioning way to be reproduced through rote learning.</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pearson Correlation</td>
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<td>.01</td>
<td>-.07</td>
<td>- .03</td>
<td>-.128*</td>
<td>- .08</td>
<td>-.12*</td>
</tr>
<tr>
<td></td>
<td>p value</td>
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<td>.3</td>
<td>.7</td>
<td>.04</td>
<td>.2</td>
<td>.04</td>
</tr>
<tr>
<td>Deep Strategy</td>
<td>Meaning by questioning of ideas pursuing a better understanding, linking new ideas to what is already known, examining these ideas from different perspectives and applying these ideas in unfamiliar situations</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pearson Correlation</td>
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<td>.02</td>
<td>.04</td>
<td>.04</td>
<td>.19**</td>
<td>.16*</td>
<td>.20**</td>
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<td>p value</td>
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<td>.7</td>
<td>.6</td>
<td>.6</td>
<td>.002</td>
<td>.01</td>
<td>.001</td>
</tr>
<tr>
<td>Achievement Strategy</td>
<td>Learner focus is on structuring knowledge to most efficiently maximise achievement outcomes.</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pearson Correlation</td>
<td>.10</td>
<td>.12</td>
<td>.10</td>
<td>.11</td>
<td>.16**</td>
<td>.24**</td>
<td>.21**</td>
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<td></td>
<td>p value</td>
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<td>.07</td>
<td>.12</td>
<td>.08</td>
<td>.007</td>
<td>.001</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)
This suggests a balanced use of approach strategies are engaged by students when completing the ToKE, ToKO and the ToKT.

7.8.1 School effect

The school effect on the learning process was examined by comparing school means for the explanatory variables (Table 7.34). An ANOVA model was used to examine these relationships (Appendix 7.20, LPQ and school effect).

Table 7.34 Learning process questionnaire explanatory variable descriptives for schools

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>School</th>
<th>N</th>
<th>Mean</th>
<th>Standard error</th>
<th>F</th>
<th>ANOVA df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface motivation</td>
<td>10</td>
<td>64</td>
<td>19.27</td>
<td>.38</td>
<td>6.50</td>
<td>3, 243</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>34</td>
<td>18.32</td>
<td>.62</td>
<td></td>
<td></td>
<td></td>
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<td>30</td>
<td>52</td>
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<td>.53</td>
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<tr>
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</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)
These data suggests that statistical differences ($p < .01$) in school means for the explanatory variables in the learning process exist between schools, suggesting a school effect is present. To facilitate the interpretation of data, the means for each explanatory variable between schools was graphed. These graphs (Figure 7.20) show that for each explanatory variable, there is a range of means between schools with the data suggesting there is a significant difference ($p < .001$), between certain schools.

Figure 7.20  School mean scores for LPQ explanatory variables

These data was further analysed by examining the level of significance between means through multiple comparisons in Graph 7.21 below. As can be determined from Table 7.34 significant statistical differences exist between certain schools which are displayed below.
Multiple comparisons suggest that, on average, significant statistical differences ($p < .001$) exist between schools for all explanatory variables. It is worth noting that these findings suggest school 20 has the highest mean score for deep motivation and the use
of deep and achievement strategies. School 50 on average, has the highest mean score for surface motivation, school 10 for achievement motivation, and school 30 for the use of surface strategies.

Statistically significant differences emerge for surface motivation between schools 50 and 30 (p = .001) and approaching significance between schools 50 and 20 (p = .07). This suggests that students from school 50 are motivated to meet the minimal requirements for learning, to retain knowledge and meet external criterion. These findings for explanatory variable, deep motivation suggest statistically significant differences between school 30 and schools 10, 20 and 50 (p < .001), where students from school 30 have the lowest intrinsic interest in what is being learnt and least desire to develop a degree of competence in that knowledge domain. Achievement motivation has the same pattern with school 30 having the lowest mean to schools 10, 20 and 50 (p < .001), suggesting students at this school have the least desire to achieve an understanding at the same level relative to others.

Statistically significant differences emerge for the use of surface strategies between school 30 and school 10 (p < .001), school 20 (p < .001) and school 50 (p < .001), suggesting that students at school 30 are more likely to memorise information and link ideas in an unquestioning way, reproducing this information through rote learning for the EE and ToK tasks. A difference exists for students at school 20 and school 50 (p = .003), with school 50 having the higher mean.

With explanatory variable, deep strategy, schools 20 (p< .001) and 10 (p = .002) have a statistically significant higher mean than school 30 and schools 20 (p = .001) and 10 (p = .02) a statistically higher mean than school 50. This suggests that students at schools 20 and 20 seek to establish their understanding in the EE and ToK through the questioning of ideas and linking new ideas to what is already known.

With the use of achievement strategies, school 50 has the lower mean to school 10 (p < .001), school 20 (p < .001) and approaching significance for school 30 (p = .05). Statistical significance is also approached between schools 20 and 30 (p = .06), with
school 20 having the higher mean. These findings suggest that students at schools 20 and 30 are more likely to structure their knowledge in such a way to most efficiently maximise achievement outcomes.

7.8.2 Language effect

The effect of language on the learning processes was examined by comparing means for Group 1 (native English A1 speakers) and Group 3 (native Chinese speakers).

Table 7.35 Learning process questionnaire explanatory variable descriptives for languages

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</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

These data suggests that Group 1 has a higher mean, significant (p < .05) for Surface, Deep and Achievement motivation, while Group 3 has a higher mean than Group 1 (p < .001) for the use of surface strategy. All other means are not statistically significant (p > .05). To further facilitate the interpretation of data, the means for each learning
process explanatory variable between languages was graphed in Figure 7.22 (Appendix 7.21).

This graph suggests that the explanatory variables surface, deep and achievement motivation are rated more highly by Group 1, while surface strategy is rated more highly by Group 3 native speakers. Group 1 learners show a preference to meet the minimal requirements for learning, to know more about a topic and develop a competency in their approach to learning because of an intrinsic interest in what is being learnt, balanced by seeking to achieve an understanding of the content, relative to others. Student engagement in the EE and ToK tasks through the use of surface strategies suggests that Group 3 students show a preference towards memorising information and linking ideas in an unquestioning way, reproducing them through rote learning.

**Figure 7.22 Language effect on LPQ factors**

![Diagram](image)

No significant difference (p < .05) exists between Group 1 and Group 3 for explanatory variables deep and achievement strategies. While Group1 has a higher mean for the use
of deep strategies, and Group 3 in the use of achievement strategies, this suggests that both groups of students rely on the use of these strategies.

7.9 The role of literacy in achievement and creativity

In this present study it is hypothesised that achievement in the EE and Theory of Knowledge is predicted by student ability to convert written information into knowledge. The extent to which the literacy scores in comprehension, vocabulary and logical relationships are associated with the EE, creativity (H criteria) and ToK achievement outcomes is examined using linear correlation procedures. To facilitate the interpretation of data, three literacy dimensions measured in the test were taken as the explanatory variables. The degree of association between these 3 explanatory factors and the dependent variables was examined using the Pearson correlation coefficient for each relationship. This data is shown in Table 7.36 (Appendix 7.22, Literacy correlations). The extent to which a school effect may be present was examined using ANOVA procedures. ANOVA was used to compare the school mean score for each explanatory variable and whether statistically significant differences exist between schools. These data was further examined to determine whether cultural differences have an effect on student ability to convert written information to knowledge. ANOVA procedures were used to compare the language mean scores for each explanatory variable and whether statistically significant differences emerge between the two language groupings.

Data was collected from four schools labelled Schools 10, 40, 80, and 90. One hundred and eighty one students completed the questionnaire on comprehension, vocabulary and logical relationship variables of creativity. The achievement outcomes data for the EE and ToK was provided by IBCA which were matched to the beliefs and strategies scores. Not all student EE and ToK achievement outcomes data from IBCA was available, resulting in different numbers of data sets for the GCEE, SPEE,H criteria and TEE and similarly for the ToKE, ToKO, and ToKT when examining the association between the explanatory variables for the school and language effect (Table 7.37 and 7.38).
Table 7.36 Pearson correlation coefficient for literacy factors with achievement and creativity outcomes

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<th>H</th>
<th>TEE</th>
<th>ToKE</th>
<th>ToKO</th>
<th>ToKT</th>
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<tr>
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<td>Logical relationships</td>
<td>Skills tested are classified into using appropriate connectives, drawing analogies, and recognising principles of organisation in the text.</td>
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** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)
For the school’s data 183 student results were used. It should be noted that School 90 was an International school with the majority of students speaking Chinese as their native tongue. Varying levels of association of the explanatory variables with the achievement outcomes of the EE, creativity and ToK, are suggested by this data.

These data suggests that students are more able to understand the main ideas and discriminate between necessary and supporting information in developing an understanding knowledge through the ToK (p < .05), than in the enhancement of knowledge through the EE (p > .05). The comprehension of written material requires an applied knowledge of sentence structure and recall of sequences of ideas and information that more closely associates with the ToKT (r = .84, p < .01) than with the TEE (r = .03, p = .7).

These data also suggests the ToK tasks lend themself to the construction of meaning and the ability to apply ideas to new situations more so than in the EE. A third aspect of comprehension is the learner ability to evaluate the logical structure and identify the purpose of writing a work, which these findings suggest is more closely associated with ToK than the EE.

These data suggest a strong association between logical relationships and ToK outcomes (r = .5). This association suggests that students who recognise these relationships between words, sentences and ideas have a closer association with ToKT (r = .52, p < .01) but not with the TEE (r = .01, p = .9).

In measuring the extent of a student’s word knowledge, participants are asked to choose a synonym for a given word, with twenty word questions to complete. As the words are not tested in context it should be noted that some students may not recognise words in isolation, but can provide meaning when sighted in context (Goodman, 1995). The degree of association with ToK was significant (p < .01), but did not associate with the EE (p > .05).
Students completing this questionnaire came from 2 language backgrounds. The students in this study had either English (Group 1) as a mother tongue, or Group 3, Chinese as a mother tongue and presented for the IB Diploma in English.

### 7.9.1 School effect

The school effect on literacy is examined by comparing means of the explanatory variables between schools. An ANOVA model was used to examine the relationship between the school means (Appendix 7.23, Literacy and school effect).

#### Table 7.37 Literacy factor descriptives for schools

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<td>.70</td>
<td>.02</td>
<td>36.19</td>
<td>3, 179</td>
<td>.01</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>37</td>
<td>.62</td>
<td>.02</td>
<td>29.19</td>
<td>3, 179</td>
<td>.001**</td>
</tr>
<tr>
<td></td>
<td>90</td>
<td>117</td>
<td>.41</td>
<td>.01</td>
<td>22.19</td>
<td>3, 179</td>
<td>.01</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>183</td>
<td>.50</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

These findings suggest that a difference in means (see Table 7.37) for the literacy explanatory variables, Comprehension, Logical relationships and Vocabulary exists.
between schools (p < .01), suggesting a school effect is present. Comment should be made that Schools 10, 40, and 80 were predominantly Group 1 learners while School 90 were predominantly Group 3 learners.

To facilitate the interpretation of data, the means for each literacy explanatory variable was graphed (Figure 7.23). Visually it can be seen that differences exist between all schools, but school 90 has a lower mean for all 3 explanatory variables.

**Figure 7.23 School effect on literacy factors**

These data was further analysed by examining the level of significance between school means for the explanatory variables through multiple comparisons in the Figure 7.24 below.
As noted earlier, School 90 is an international school with close to all students being Chinese native speakers. These findings suggest that there is a statistically significant difference ($p < .001$) between school 90 and all other schools suggesting that language plays a mediating role in these results.

It is worth noting that School 10 ($N = 13$) and School 40 ($N = 14$) have relatively higher standard error of the mean for comprehension than school 80 and 90, while school 10 has a relatively higher standard error of the mean for logical relationships and vocabulary. This suggests that at least for school 10, there exists greater variability in the data set and less reliability in the sample estimates of the mean. This is possibly due
to the relatively smaller sample size. Importantly for each explanatory variable there is no statistically significant difference between the school means for school 10, 40 and 60.

7.9.2 Language effect

The effect of language on the literacy factors were then examined by comparing means for Group 1 (native English speakers) and Group 3 (native Chinese speakers) in Table 7.38 (Appendix 7.24, Literacy and language effect).

Table 7.38  Literacy factor descriptives for language groupings

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Language group</th>
<th>N</th>
<th>Mean</th>
<th>Standard error</th>
<th>F</th>
<th>ANOVA df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comprehension</td>
<td>1</td>
<td>85</td>
<td>.63</td>
<td>.02</td>
<td>84.941</td>
<td>2, 178</td>
<td>&lt; .001**</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>91</td>
<td>.31</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>181</td>
<td>.46</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logical relationships</td>
<td>1</td>
<td>87</td>
<td>.71</td>
<td>.01</td>
<td>151.268</td>
<td>2, 178</td>
<td>&lt; .001**</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>89</td>
<td>.37</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>181</td>
<td>.53</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vocabulary</td>
<td>1</td>
<td>87</td>
<td>.64</td>
<td>.02</td>
<td>93.370</td>
<td>2, 180</td>
<td>&lt; .001**</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>91</td>
<td>.37</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>183</td>
<td>.50</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

These data suggests that Group 1 has a significantly (p < .01) higher mean than Group 3 for all 3 explanatory variables. To further facilitate the interpretation of data, the means for each of the literacy explanatory factors between language groups were graphed in Figure 7.25 below.
This graph indicates that for each explanatory variable the means for Group 1 are higher than for Group 3 (p < .01). This suggests Group 1 learners who are constructing an understanding of knowledge in their English mother tongue are more adept with English as a medium of instruction.

Group 3 learners construct knowledge in a language that is not their mother tongue, the language profile of such students having 2 (or more) languages in their learning continuum. This suggests these students are less proficient in the use of English and the use of English as medium of instruction is an issue.

7.10 The role of self-efficacy in the EE

It is hypothesised that achievement in the EE is predicted by the degree of student self-efficacy to learn or achieve. The extent to which self-efficacy predicts achievement in the EE and creativity is examined. To facilitate the interpretation of data, exploratory factor analysis was used to establish which independent variables formed into explanatory factors that reflect the underlying self-efficacy factors. SPSS procedures were used to extract eigenvalues over 1.0 with a rotated solution using varimax, items with a loading of under .4 being suppressed. The Kaiser-Meyer-Olkin measure of
sampling adequacy is .90, with total variance explained of 55.36 %. This process provided two factors associated with the hypothesis. The questionnaire was designed emphasising the enhancement of knowledge (creativity). Tests of reliability suggest that Factor 1 (N of cases = 191, N of items = 9) gives an Alpha of .87, and Factor 2 (N of cases = 194, N of items = 3) gives a Alpha of .78.

The extraction and named self-efficacy factors are listed below and found in Table 7.39:
Component 1 Creative aspect of the EE
Component 2 Use of ideas

<table>
<thead>
<tr>
<th>Question</th>
<th>Component 1</th>
<th>Component 2</th>
<th>Communalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEEE 7</td>
<td>.77</td>
<td>.62</td>
<td></td>
</tr>
<tr>
<td>SEEE 4</td>
<td>.76</td>
<td>.63</td>
<td></td>
</tr>
<tr>
<td>SEEE 8</td>
<td>.71</td>
<td>.55</td>
<td></td>
</tr>
<tr>
<td>SEEE 6</td>
<td>.71</td>
<td>.53</td>
<td></td>
</tr>
<tr>
<td>SEEE 5</td>
<td>.69</td>
<td>.55</td>
<td></td>
</tr>
<tr>
<td>SEEE 9</td>
<td>.62</td>
<td>.45</td>
<td></td>
</tr>
<tr>
<td>SEEE 15</td>
<td>.57</td>
<td>.38</td>
<td></td>
</tr>
<tr>
<td>SEEE 11</td>
<td>.55</td>
<td>.45</td>
<td></td>
</tr>
<tr>
<td>SEEE 14</td>
<td>.52</td>
<td>.43</td>
<td></td>
</tr>
<tr>
<td>SEEE 10</td>
<td>.83</td>
<td>.73</td>
<td></td>
</tr>
<tr>
<td>SEEE 12</td>
<td>.81</td>
<td>.71</td>
<td></td>
</tr>
<tr>
<td>SEEE 13</td>
<td>.74</td>
<td>.62</td>
<td></td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalisation
Rotation converged in 7 iterations

Eigenvalues | 5.48 | 1.16
Percentage of variance | 45.68 | 9.68
The extent of association between the two explanatory factors and EE outcomes were examined using the Pearson correlation coefficient. This data is shown in Table 7.40.

The extent to which a school effect may be present was examined using ANOVA procedures. ANOVA was used to compare the school mean score for each explanatory variable and whether statistically significant differences exist between schools. These data was further examined as to whether cultural differences have an effect on learning approach beliefs and strategies and the achievement outcomes. ANOVA procedures were used to compare the language mean scores for each explanatory variable.

Data was collected from three schools labelled Schools 10, 50 and 60. One hundred and ninety five students completed the questionnaire on the degree of self-efficacy. The achievement outcomes data for the EE and ToK was provided by IBCA which was matched to the self-efficacy scores. Not all students EE achievement outcomes data from IBCA was available, resulting in 183 data sets for the GCEE, SPEE, and H criteria, and 194 for the TEE. For the schools data 195 student results were used and 182 for the effect of culture on self-efficacy in the EE (Appendix 7.25, SEEE correlations with EE achievement outcomes)
Table 7.40  Pearson correlation coefficient for SEEE and EE achievement outcomes

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Explanatory variable descriptions</th>
<th>GCEE</th>
<th>SpEE</th>
<th>H Criteria</th>
<th>TEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creative aspect of the EE</td>
<td>Learner capacity to think in creatively about the EE by searching and thinking in new ways, creating one’s own representation of the topic.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of ideas</td>
<td>A measure of the construct that a learner must re-organise, re-prioritise and transfer ideas from one topic or area of knowledge to another.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Pearson Correlation</th>
<th>p value</th>
<th>Pearson Correlation</th>
<th>p value</th>
<th>Pearson Correlation</th>
<th>p value</th>
<th>Pearson Correlation</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>183</td>
<td>183</td>
<td>183</td>
<td>194</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creative aspect of the EE</td>
<td>- .07</td>
<td>.3</td>
<td>- .05</td>
<td>.5</td>
<td>- .03</td>
<td>.7</td>
<td>- .06</td>
<td>.4</td>
</tr>
<tr>
<td>Use of ideas</td>
<td>- .04</td>
<td>.6</td>
<td>- .04</td>
<td>.6</td>
<td>- .01</td>
<td>.8</td>
<td>- .04</td>
<td>.6</td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)
These data suggests that the explanatory variables show negative and low levels of association with the achievement outcomes of the EE that are not significant (p > .05). Student belief about their capacity to think creatively about the EE suggest low levels of confidence in their capacity to be creative and low expectations when approaching the EE that they will be creative. This is suggested by the explanatory variable ‘Creative aspects of the EE’, where the level of association with the achievement outcomes are negative. These data suggests that students find it difficult to ‘learn enough about the topic of your essay and be able to think creatively about it’, ‘... to link ideas in new ways ...’, ‘think in possibilities ...’ and ‘look at ideas from different perspectives’.

Explanatory variable, ‘Use of ideas’, suggests students lack confidence in their ability to ‘identify spontaneously aspects that don’t fit or match what you expected’, in their ability to transfer ideas to different domains, and re-organising and re-prioritising their knowledge of a topic.

### 7.10.1 School effect

The school effect on self-efficacy and the EE was examined using an ANOVA model to study the relationship between the school means (Appendix 7.26).

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>School</th>
<th>N</th>
<th>Mean</th>
<th>Standard error</th>
<th>F</th>
<th>ANOVA df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creative aspect of the EE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>64</td>
<td>3.63</td>
<td>.06</td>
<td>5.05</td>
<td>2,192</td>
<td>.007**</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>94</td>
<td>3.40</td>
<td>.07</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>37</td>
<td>3.77</td>
<td>.64</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>225</td>
<td>3.51</td>
<td>.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of ideas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>64</td>
<td>3.27</td>
<td>.09</td>
<td>2.96</td>
<td>2,192</td>
<td>.05</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>94</td>
<td>3.30</td>
<td>.09</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>60</td>
<td>37</td>
<td>3.63</td>
<td>.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>225</td>
<td>3.35</td>
<td>.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

These data suggests a significance statistical difference in means (p = .007) for self-efficacy in the creative aspect of the EE, and the use of ideas (p = .05) between schools,
suggesting a school effect is present. To further facilitate the interpretation of data the means of each self-efficacy explanatory variable were graphed as shown in Figure 7.26.

**Figure 7.26 Self-efficacy EE by school**

These data were further analysed by examining the level of significance between school means for the two explanatory variables through multiple comparisons in Figure 7.27 below. As can be determined from Table 7.41 statistically significant differences exist between certain schools. The flowing Figure 7.27 examines the school effect on these variables.

**Figure 7.27 School effect on SEEE**
These findings suggest that on average there are statistically significant differences (p = .016, in the performance levels between schools 50 and 60 in the creativity aspect of the EE when means and confidence intervals are compared. These data suggests that students at school 60 have an improved capacity to think in creative and new ways about the EE and in creating their representation of the chosen topic. It should be noted that a result approaching significance exists between school 10 and 50 (p = .10) suggesting a similar outcome for school 10 when compared to school 50.

For the use of ideas, a statistically significant finding is approached where p = .08 for school 60 and school 10, suggesting students from school 60 are more able to reorganise, re-prioritise and transfer ideas from one topic area to another.

7.10.2 Language effect

The effect of self-efficacy on the EE explanatory variables was examined by comparing means for Group 1 and Group 3 native speakers (Appendix 7.27, SEEE and language effect).

<table>
<thead>
<tr>
<th>Table 7.42 Language effect on SEEE factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explanatory Variables</td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td>Creative aspect of the EE</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Use of ideas</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

These data suggest that no statistically significant differences exist between Group 1 and Group 3 language cohorts for these 2 explanatory variables. The means for each self efficacy EE explanatory variables are graphed in figure 7.28 below.
These data as graphed suggests that for each explanatory variable there is a range of means for which there is no significant difference (p > .05).

7.11 The role of self-efficacy in ToK

It is hypothesised that achievement in the ToK is predicted by the degree of student self-efficacy to learn or achieve. The extent to which self-efficacy predicts achievement in the ToK is examined. To facilitate the interpretation of data, exploratory factor analysis was used to establish which independent variables formed into explanatory factors that reflect the underlying self-efficacy factors. SPSS procedures were used to extract eigenvalues over 1.0 with a rotated solution using varimax, items with a loading of under .4 being suppressed. The Kaiser-Meyer-Olkin measure of sampling adequacy is .89, with total variance explained of 55.06 %. This process provided three factors associated with the hypothesis (Table 7.43, Rotated Component Matrix for SEToK).
### Table 7.43 Rotated Component Matrix for SEToK

<table>
<thead>
<tr>
<th>Question</th>
<th>Component 1</th>
<th>Component 2</th>
<th>Component 3</th>
<th>Communalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEToK 19 Understanding the different ways of knowing</td>
<td>.81</td>
<td></td>
<td></td>
<td>73</td>
</tr>
<tr>
<td>SEToK 20 Understanding the different areas of knowledge</td>
<td>.73</td>
<td></td>
<td></td>
<td>.62</td>
</tr>
<tr>
<td>SEToK 12 Reflect on your analysis and change your ideas</td>
<td>.67</td>
<td></td>
<td></td>
<td>.55</td>
</tr>
<tr>
<td>SEToK 13 Initiate discussion about the problem(s) of knowledge</td>
<td>.65</td>
<td></td>
<td></td>
<td>.47</td>
</tr>
<tr>
<td>SEToK 18 Recognising other viewpoints, values and biases?</td>
<td>.59</td>
<td></td>
<td></td>
<td>.57</td>
</tr>
<tr>
<td>SEToK 10 Search in new directions about your topic</td>
<td>.60</td>
<td></td>
<td></td>
<td>.47</td>
</tr>
<tr>
<td>SEToK 2 Work out the problem of knowledge appropriate to the topic</td>
<td></td>
<td>.80</td>
<td></td>
<td>.66</td>
</tr>
<tr>
<td>SEToK 1 Work out the problem of knowledge implied or suggested in the essay title</td>
<td></td>
<td>.77</td>
<td></td>
<td>.64</td>
</tr>
<tr>
<td>SEToK 3 Develop your own ideas</td>
<td>.60</td>
<td></td>
<td></td>
<td>.52</td>
</tr>
<tr>
<td>SEToK 4 Put your ideas together in novel and inventive ways</td>
<td>.60</td>
<td></td>
<td></td>
<td>.48</td>
</tr>
<tr>
<td>SEToK 8 Learn enough about your topic to be able to think creatively about it</td>
<td>.59</td>
<td></td>
<td></td>
<td>.59</td>
</tr>
<tr>
<td>SEToK 9 Link ideas in new ways, make big leaps in understanding</td>
<td>.55</td>
<td></td>
<td></td>
<td>.51</td>
</tr>
<tr>
<td>SEToK 7 Evaluate the problem(s) of knowledge being discussed</td>
<td>.53</td>
<td></td>
<td></td>
<td>.52</td>
</tr>
<tr>
<td>SEToK 5 Develop your own plan of action and decide by yourself the steps you will take?</td>
<td>.41</td>
<td></td>
<td></td>
<td>.41</td>
</tr>
<tr>
<td>SEToK 16 Justify your main arguments</td>
<td>.76</td>
<td></td>
<td></td>
<td>.70</td>
</tr>
<tr>
<td>SEToK 15 Use examples to illustrate your arguments</td>
<td>.73</td>
<td></td>
<td></td>
<td>.57</td>
</tr>
<tr>
<td>SEToK 17 Evaluate your main arguments</td>
<td>.71</td>
<td></td>
<td></td>
<td>.64</td>
</tr>
<tr>
<td>SEToK 14 Structure your essay in a clear and logical way</td>
<td>.69</td>
<td></td>
<td></td>
<td>.56</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalisation
Rotation converged in 7 iterations

Eigenvalues

<table>
<thead>
<tr>
<th></th>
<th>7.35</th>
<th>1.68</th>
<th>1.43</th>
</tr>
</thead>
</table>

Percentage of variance

|          | 38.67 | 8.85 | 7.53 |
The questionnaire was designed emphasising the criteria to which the ToK is written. Test of reliability suggest that Factor 1 (N of cases = 199, N of items = 6) gives an Alpha of .82, Factor 2 (N of cases = 200, N of items = 8) gives a Alpha of .86, and Factor 3 (N of cases = 202, N of items = 4) gives an Alpha of .79. The extracted and named self-efficacy factors are listed below.

Component 1  An understanding of knowledge
Component 2  Being creative about knowledge
Component 3  Use of argument

The extent of association between the three explanatory factors and EE outcomes were examined using the Pearson correlation coefficient. This data is shown in Table 7.44, Pearson correlation coefficient for self-efficacy factors and ToK achievement.

The extent to which a school effect may be present was examined using ANOVA procedures. ANOVA was used to compare the school mean score for each explanatory variable and whether statistically significant differences exist between schools. These data were further examined as to whether cultural differences have an effect on learning approach beliefs and strategies and the achievement outcomes. ANOVA procedures were used to compare the language mean scores for each explanatory variable.

Data was collected from three schools labelled Schools 10, 50 and 60. Two hundred and three students completed the questionnaire on the degree of self-efficacy. The achievement outcomes data for the ToK was provided by IBCA which was matched to the self-efficacy scores. Two hundred and three data sets were used for the schools data and 190 data sets for the effect of culture on self-efficacy in the ToK.

The extent of association between the 3 explanatory factors and ToK achievement outcomes, were examined using the Pearson correlation coefficient. These data are shown in Table 7.44, Pearson correlation coefficient for self-efficacy factors and ToK achievement (Appendix 7. 28, SEToK and correlation coefficients).
Table 7.44  Pearson correlation coefficient for self-efficacy factors and ToK achievement

<table>
<thead>
<tr>
<th>Dependent variables</th>
<th>Explanatory variable description</th>
<th>N</th>
<th>ToKE</th>
<th>ToKO</th>
<th>ToKT</th>
</tr>
</thead>
<tbody>
<tr>
<td>An understanding of knowledge</td>
<td>In seeking an understanding of knowledge, learner capacity to think in original ways about a topic searching and linking ideas to create new understandings, and the learner ability to understand and reflect on the different ways of knowing and areas of knowledge in the ToK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Being creative in the construction of knowledge</td>
<td>A measure of learner ability to recognise uncertainties and limitations of knowledge, biases in approach to knowledge, and the developing and linking of ideas, combining them in creative ways.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of argument</td>
<td>Learner capacity to demonstrate the viability of an argument(s) and an assessment of the implications and limitations of these arguments.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pearson Correlation  

<table>
<thead>
<tr>
<th>N</th>
<th>203</th>
<th>203</th>
<th>203</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>-0.05</td>
<td>0.05</td>
<td>-0.01</td>
</tr>
<tr>
<td>p value</td>
<td>0.5</td>
<td>0.5</td>
<td>p &gt; .9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>N</th>
<th>203</th>
<th>203</th>
<th>203</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>-0.03</td>
<td>0.10</td>
<td>0.04</td>
</tr>
<tr>
<td>p value</td>
<td>0.7</td>
<td>0.2</td>
<td>0.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>N</th>
<th>203</th>
<th>203</th>
<th>203</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>-0.01</td>
<td>0.01</td>
<td>0.001</td>
</tr>
<tr>
<td>p value</td>
<td>0.9</td>
<td>0.9</td>
<td>p &gt; .9</td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)  
* Correlation is significant at the .05 level (2-tailed)
These data suggest that the explanatory variables show low levels of association with the achievement outcomes of the ToK that are not significant (p > .05). Student self perception of their level of confidence in approaching the achievement tasks in ToK is low for all explanatory variables and outcomes. Requesting students to report on how well they expect to develop an understanding of knowledge, to recognise the uncertainties of knowledge and be creative in the construction of knowledge, and student capacity to assess the viability, implications and limitations of these arguments, provides the opportunity to assess learner understanding, competence and confidence in meeting the set criteria.

In constructing an understanding of knowledge, these results suggest that students are unable to make confident judgements about their understanding and application of the ToK criteria when approaching the ToKE and ToKO tasks. Comment should also be made that while measuring self-efficacy is task specific, a range of task situations can be faced by students that require similar self efficacy. Self-efficacy in one task context can be transferred to other tasks (Bandura, 1997). It is suggested these results for self-efficacy in the ToK (p > .05) are similar to self-efficacy and its association with the EE (p > .05) outcomes.

### 7.11.1 School effect

The school effect on self-efficacy ToK was examined by comparing means between schools using an ANOVA model for the analysis (Table 7.45).
Table 7.45   SEToK factor descriptives for schools

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>School</th>
<th>N</th>
<th>Mean</th>
<th>Standard error</th>
<th>F</th>
<th>ANOVA df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>An understanding of knowledge</td>
<td>10</td>
<td>72</td>
<td>3.44</td>
<td>.07</td>
<td>1.26</td>
<td>2,200</td>
<td>.3</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>94</td>
<td>3.43</td>
<td>.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>37</td>
<td>3.63</td>
<td>.13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>217</td>
<td></td>
<td>3.47</td>
<td>.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Being creative about knowledge</td>
<td>10</td>
<td>72</td>
<td>3.48</td>
<td>.07</td>
<td>.59</td>
<td>2,200</td>
<td>.6</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>94</td>
<td>3.59</td>
<td>.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>37</td>
<td>3.50</td>
<td>.11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>217</td>
<td></td>
<td>3.53</td>
<td>.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of argument</td>
<td>10</td>
<td>72</td>
<td>3.82</td>
<td>.07</td>
<td>.10</td>
<td>2,200</td>
<td>.4</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>94</td>
<td>3.79</td>
<td>.08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>37</td>
<td>3.63</td>
<td>.09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>217</td>
<td></td>
<td>3.77</td>
<td>.05</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

These data (Appendix 7.29, SEToK and school effect) indicate there are no significant differences (p > .05) in means between schools, suggesting a school effect is not present. To facilitate the interpretation of data, the means for each self-efficacy ToK explanatory variables was graphed (Figure 7.29). These graphs indicate that for each explanatory variable there is a range of means.

Figure 7.29   School effect on SEToK
This data was further analysed by examining the level of significance between means through multiple comparisons in Figure 7.30 below.

**Figure 7.30**  SEToK with school effect

Multiple comparisons suggest that on average no statistically significant differences between schools for all three explanatory variables emerge. These findings suggest that student self perception of their level of confidence in approaching the achievement tasks in ToK are similar between all school respondents.
7.11.2 Language effect

The effect of language on self-efficacy ToK explanatory variables was examined by comparing means for Group 1 (native English speakers) and Group 3 (native Chinese speakers) (see Appendix 7.30, SEToK and language effect).

Table 7.46 Effect of SEToK factor descriptives on language groupings

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Languages</th>
<th>N</th>
<th>Mean</th>
<th>Standard error</th>
<th>F</th>
<th>ANOVA Df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>An understanding of knowledge</td>
<td>Group 1</td>
<td>162</td>
<td>3.47</td>
<td>.05</td>
<td>.01</td>
<td>1, 188</td>
<td>.9</td>
</tr>
<tr>
<td></td>
<td>Group 3</td>
<td>28</td>
<td>3.45</td>
<td>.12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>190</td>
<td>3.46</td>
<td>.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Being creative about knowledge</td>
<td>Group 1</td>
<td>162</td>
<td>3.57</td>
<td>.05</td>
<td>1.29</td>
<td>1, 188</td>
<td>.3</td>
</tr>
<tr>
<td></td>
<td>Group 3</td>
<td>28</td>
<td>3.43</td>
<td>.12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>190</td>
<td>3.55</td>
<td>.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of argument</td>
<td>Group 1</td>
<td>162</td>
<td>3.81</td>
<td>.05</td>
<td>1.22</td>
<td>1, 188</td>
<td>.3</td>
</tr>
<tr>
<td></td>
<td>Group 3</td>
<td>28</td>
<td>3.65</td>
<td>.12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>190</td>
<td>3.78</td>
<td>.05</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

These data suggest that while Group 1 has the highest mean for each explanatory variable, that on average no statistically significant differences emerge between schools for all three explanatory variables.

The means for each self efficacy ToK explanatory variables are graphed (Figure 7.31) to facilitate the interpretation of data.
These data, as graphed, suggests that for each explanatory variable there is a range of means for which there is no significant difference (p > .05). These results suggest that there is on average no statistical significant difference (p > .05) in the self-efficacy of students in either language groups

7.12 The influence of language on achievement and creativity

The various ToK and EE outcomes are investigated according to Group 1 and Group 3 language categories. The differences in means between the achievement outcomes were examined. To facilitate the interpretation of data Cohen’s d was used to determine the meaningfulness of statistical significance (p value) between means. While mentioned before, Group 1 consists of students whose native or mother tongue is English A1 and Group 3 students whose mother tongue is Chinese A1. The sample used in assessing the influence of language is a compilation of data collected for the previous questionnaires.
The mean score, standard deviation, level of significance and Cohen’s d are shown for the achievement outcomes for students in Group 1 and Group 3 in Table 7.47, (The influence of language on the EE and ToK achievement outcomes).
<table>
<thead>
<tr>
<th></th>
<th>SSEE</th>
<th>GCEE</th>
<th>SpEE</th>
<th>H criteria</th>
<th>TEE</th>
<th>ToKE</th>
<th>ToKO</th>
<th>ToKT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>537</td>
<td>465</td>
<td>465</td>
<td>518</td>
<td>549</td>
<td>536</td>
<td>536</td>
<td>555</td>
</tr>
<tr>
<td>Group 3</td>
<td>138</td>
<td>128</td>
<td>128</td>
<td>128</td>
<td>138</td>
<td>138</td>
<td>138</td>
<td>138</td>
</tr>
<tr>
<td>Mean</td>
<td>5.58</td>
<td>16.22</td>
<td>7.62</td>
<td>2.36</td>
<td>23.64</td>
<td>25.29</td>
<td>15.18</td>
<td>40.57</td>
</tr>
<tr>
<td>Group 1</td>
<td>5.92</td>
<td>17.83</td>
<td>8.83</td>
<td>2.59</td>
<td>24.72</td>
<td>21.42</td>
<td>13.96</td>
<td>35.38</td>
</tr>
<tr>
<td>Group 3</td>
<td>1.17</td>
<td>4.33</td>
<td>2.56</td>
<td>1.09</td>
<td>7.01</td>
<td>5.69</td>
<td>3.19</td>
<td>7.61</td>
</tr>
<tr>
<td>SD</td>
<td>1.17</td>
<td>3.62</td>
<td>1.93</td>
<td>0.99</td>
<td>8.59</td>
<td>5.98</td>
<td>3.86</td>
<td>8.59</td>
</tr>
<tr>
<td>p value</td>
<td>.002</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.024</td>
<td>.12</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Cohen’s D</td>
<td>-.30</td>
<td>-.39</td>
<td>-.50</td>
<td>-.22</td>
<td>-.15</td>
<td>.67</td>
<td>.37</td>
<td>.66</td>
</tr>
<tr>
<td>95 % Confidence Interval</td>
<td>- .40</td>
<td>- .78</td>
<td>- .73</td>
<td>- .32</td>
<td>- .73</td>
<td>.19</td>
<td>.10</td>
<td>.03</td>
</tr>
<tr>
<td>Lower limit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>95 % Confidence Interval</td>
<td>-.15</td>
<td>.24</td>
<td>-.16</td>
<td>-.05</td>
<td>1.29</td>
<td>1.67</td>
<td>1.01</td>
<td>2.10</td>
</tr>
<tr>
<td>Upper limit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Correlation is significant at the .01 level (2-tailed)**
*Correlation is significant at the .05 level (2-tailed)
These findings suggest there are differences along the language groupings 1 and 3 for the achievement outcomes in ToK and the EE.

The mean score results for achievement in the EE was higher for Group 3 students, and statistically significant (p < .05) with the exception of the TEE (p = .12), suggesting Group 3 students display a greater ability when enhancing knowledge. (Greater disposition toward the enhancement of knowledge)

Cohen’s d was calculated using the mean, standard deviation and sample sizes. For the subject score the EE was written in, and the EE achievement outcomes, the effect size for each component was small and negative according to Cohen’s conventions of research in the social sciences (Cohen, 1988). Cohen’s d suggests the magnitude of the interval between the means while significant (p < .05), it can be inferred that this difference is small due to the size effect of the sample population.

The mean scores for the ToK suggest students in Group 1 have higher levels of achievement in the ToKE, ToKO and ToKT than those in Group 3 (p < .001). These data indicates that students in Group 1 have demonstrated a greater understanding of knowledge than those students in Group 3. Cohen’s d suggests that the effect size for each ToK achievement outcome is moderate and positive.

Analysis of the subject area choice in which the EE was written provides a partial explanation for the higher level of achievement obtained by Group 3 students. Table 7.48, EE subject area choice for Group 1 and Group 3 students, indicates the subject area that students chose to write their EE and suggests 2 clear differences. Of the total sample of Group 1 students, 12% chose to present for their EE in Language A1 English, while for the Group 3 cohort, 63% of students chose their native language. The second difference to emerge is in the Group 3 subject area, Individuals and society, where 65 % of Group 1 students select a subject from this category, while for Group 3 students, 16 % have a preference for a subject choice in this area.
Table 7.48 EE subject area choice for Group 1 and Group 3 students

<table>
<thead>
<tr>
<th>Diploma subject grouping</th>
<th>Total number of students from Group 1 (%)</th>
<th>Total number of students from Group 3 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of students from Group 1 (%)</td>
<td>Total number of students from Group 3 (%)</td>
<td></td>
</tr>
<tr>
<td>Group 1: Language A1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>64 (12%)</td>
<td>85 (63%)</td>
</tr>
<tr>
<td>Group 2: Second language</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indonesian B</td>
<td>2</td>
<td>English B</td>
</tr>
<tr>
<td>Chinese B</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>French B</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Spanish B</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Japanese B</td>
<td>1</td>
<td>13 (2%)</td>
</tr>
<tr>
<td>Group 3: Individuals and society</td>
<td></td>
<td></td>
</tr>
<tr>
<td>History</td>
<td>115</td>
<td>History</td>
</tr>
<tr>
<td>Economics</td>
<td>38</td>
<td>Economics</td>
</tr>
<tr>
<td>Philosophy</td>
<td>11</td>
<td>Philosophy</td>
</tr>
<tr>
<td>ITGS</td>
<td>36</td>
<td>ITGS</td>
</tr>
<tr>
<td>Geography</td>
<td>5</td>
<td>Geography</td>
</tr>
<tr>
<td>Psychology</td>
<td>143</td>
<td>Psychology</td>
</tr>
<tr>
<td>Business &amp; Man</td>
<td>6</td>
<td>Business &amp; Man</td>
</tr>
<tr>
<td>Social Anthropology</td>
<td>2</td>
<td>Social Anthropology</td>
</tr>
<tr>
<td></td>
<td>354 (65%)</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>Subject</td>
<td>Students</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------</td>
<td>----------</td>
</tr>
<tr>
<td><strong>Group 4: Sciences</strong></td>
<td>Biology</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Chemistry</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Physics</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Environmental</td>
<td>1</td>
</tr>
<tr>
<td><strong>Group 5: Mathematics and Computer Science</strong></td>
<td>Mathematics</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Computer Science</td>
<td>Nil</td>
</tr>
<tr>
<td><strong>Group 6: The Arts</strong></td>
<td>Theatre Arts</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Visual Arts</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>Music</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>World Religions</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>547</td>
</tr>
</tbody>
</table>
In the Table 7.49 below, the student percentage within each Diploma subject grouping is given.

Table 7.49  Percentage of students writing an EE within each Diploma subject grouping

<table>
<thead>
<tr>
<th>IB Diploma Subject Groupings</th>
<th>Language Group</th>
<th>N</th>
<th>% within a subject group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1: Language A1</td>
<td>Group 1</td>
<td>64</td>
<td>43.0</td>
</tr>
<tr>
<td></td>
<td>Group 3</td>
<td>85</td>
<td>57.0</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>149</td>
<td>100</td>
</tr>
<tr>
<td>Group 2: Second language</td>
<td>Group 1</td>
<td>13</td>
<td>76.5</td>
</tr>
<tr>
<td></td>
<td>Group 3</td>
<td>4</td>
<td>23.5</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>18</td>
<td>100</td>
</tr>
<tr>
<td>Group 3: Individuals and society</td>
<td>Group 1</td>
<td>354</td>
<td>94.1</td>
</tr>
<tr>
<td></td>
<td>Group 3</td>
<td>22</td>
<td>5.9</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>376</td>
<td>100</td>
</tr>
<tr>
<td>Group 4 and 5: Sciences and Mathematics</td>
<td>Group 1</td>
<td>62</td>
<td>75.6</td>
</tr>
<tr>
<td></td>
<td>Group 3</td>
<td>20</td>
<td>24.4</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>82</td>
<td>100</td>
</tr>
<tr>
<td>Group 6: The Arts</td>
<td>Group 1</td>
<td>53</td>
<td>89.8</td>
</tr>
<tr>
<td></td>
<td>Group 3</td>
<td>6</td>
<td>10.2</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>Group 1</td>
<td>547</td>
<td>80.2</td>
</tr>
<tr>
<td></td>
<td>Group 3</td>
<td>135</td>
<td>19.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>682</td>
<td>100</td>
</tr>
</tbody>
</table>

An examination of the relationship between Group 1 and Group 3 student subject choices for the EE in Table 7.49 indicates that of the total number of students selecting Language A1 to write their EE in, a higher proportion (57.0%) were from Group 3, while fewer from Group 3 (5.9%) chose to write their EE in Individuals and Society,
contributing to this significant result. This suggests that students display a tendency to choose a subject area that is unique to their background.

The relationship between the language groupings 1 and 3 and achievement outcomes for the EE and ToK was examined using a Pearson Chi-square independence test, to examine whether the independent variable, language group affects the dependent achievement outcome variables for the EE and ToK (Appendix 7.31, Role of language). Of the total number in the sample of 716 students, the number of valid data sets varied between N = 593 (N = 123 missing [17.2%]) and N = 693 (N = 23 missing [3.2%]). A summary of the Cross tabulation analysis in Table 7.50 below of the language groupings with the achievement scores for the EE and ToK outcomes reveals a significant relationship between these two variables.

<table>
<thead>
<tr>
<th>Table 7.50</th>
<th>Chi – square tests for language Groupings 1 and 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achievement outcomes</td>
<td>Pearson Chi-square value</td>
</tr>
<tr>
<td>SSEE</td>
<td>21.73</td>
</tr>
<tr>
<td>GCEE</td>
<td>50.25</td>
</tr>
<tr>
<td>SpEE</td>
<td>50.63</td>
</tr>
<tr>
<td>H Criteria</td>
<td>10.43</td>
</tr>
<tr>
<td>TEE</td>
<td>64.32</td>
</tr>
<tr>
<td>ToKE</td>
<td>85.17</td>
</tr>
<tr>
<td>ToKO</td>
<td>42.09</td>
</tr>
<tr>
<td>ToKT</td>
<td>1.18</td>
</tr>
</tbody>
</table>

In further analysis of the subject area choice in which the EE was written, the Pearson Chi-Square test goodness of fit measure was used. The subject area in which EE was written and the achievement outcomes for each of the 2 language groups suggests an association between the independent and dependent variables, that the cultural group influences the achievement outcomes for the EE (with the exception of the H criteria) and ToK outcomes. The result, \( \chi^2 (6) = 2.01 \), \( p < .001 \), supports the contention that in the subject area the EE was written in there was difference in between Group 1 and Group 3.
7.13 Chapter summary

These results suggest that students perceive the EE as the more cognitively demanding task. Reasons given are the amount and depth of research required, time required for researching and drafting, ability to write a long essay and the creating of one’s own topic question or hypothesis. Student rating of the learning categories indicate that students perceived the EE as more difficult with a higher mean difference when compared to the ToK in the range of phases, structuring of responses, self-control and motivation. This suggests lack of familiarity with the cognitive processes, information processing strategies, attitudes to learning and beliefs required to enhance knowledge. Further, it is argued that the nature of the EE task is broader and the learning complexities greater due to the non-automated cognitive processes required for the cognitive demands of the EE. This result acts as a context for an understanding of the findings for the following hypotheses.

These data indicate a strong link between subject area knowledge and the use of this knowledge for creativity and the enhancing of knowledge through the EE. These data also suggest that the subject knowledge acts to inform the ToK as a unifying element in the Diploma. These data were also examined for the level of association using the Pearson correlation coefficient, and regression procedures to analyse the extent to which achievement in the EE and ToK was predicted by various subject domains. Statistically significant correlations (p < .05) were found to exist between English A1, History, ITGS and Psychology and all achievement outcomes. Chinese A1, and Economics, correlated with all ToK outcomes with Biology correlating with all EE outcomes (p < .05). This suggests the ability to recall and apply relevant subject knowledge is an important influence on achievement in the EE and ToK.

A knowledge base reflecting past learning, the ability to retrieve skills and the elaboration and addition of ideas in the process of learning (Feldhusen, 1995), was assessed using a Chi-square independence test, of the influence the subject score has on the creativity variable, the H criteria. A significant relationship (p < .01) was shown to exist between subject domain score and the H criteria. Further analysis of the H criteria
in terms of subject areas suggests that the H criteria is a robust measure of creativity across subject domains.

The ease of use of creative thinking strategies measured by verbal and figural creativity scores to achievement outcomes was examined. These findings suggest that figural items in the TTCT, with the exception of figural abstractness, play no role in the achievement scores for the EE and ToK. The verbal TTCT items correlate strongly (p < .01) with the ToKE and ToKT, with no statistically significant (p > .05) correlations with the EE achievement outcomes. This suggests students have difficulty in developing questions and ideas, consistent with the interpretation as discussed above, that the EE task is broader and the learning complexities greater than the ToK.

Learning self regulation behaviour factors, autonomous regulation and controlled regulation, correlate with all ToK outcomes (p < .05), while controlled regulation correlates (p < .05) with all EE outcomes. The result for autonomous regulation suggests that students view the ToK task as interesting, enjoyable and challenging, with learner behaviour that freely engages in the ToK but not the EE task. Learner behaviour that is supported by context, supervisor comment and perceptions of others is required for achievement in both tasks. Motivation, self regulation factors, amotivation, external regulation and introjected regulation have statistically significant (p < .05) negative associations with the EE achievement outcomes, suggesting that lack of purpose, the engagement in learning behaviours for the purpose of rewards or avoiding punishment, and engaging in learning activities to avoid self guilt, leads to decreasing achievement outcomes. Identified regulation and intrinsic motivation have statistically significant (p < .01) associations with the ToK achievement outcomes, suggesting that for the ToK, students have identified with the learning behaviours associated with ToK and have a preference for the intrinsic valuing of research in this discipline.

It is hypothesised that students show a preference for a balanced use of intrinsic and extrinsic motivations to learn that predict achievement in the EE and ToK. In the BHTL, these findings suggest that intrinsic motivation plays an important role in the EE (p < .05) and ToK (p < .001) for all achievement outcomes, while external influences
play a significant role in the EE (p < .05), with the exception of the TEE (p = .061) which approaches statistical significance, and ToKE (p = .064). Both the ToKO and ToKT are statistically significant (p < .05). It should be noted that mastery learning (p < .001) and use of time during learning (p < .05) have significant associations with the ToK outcomes.

The premise underlying the use of the approaches to learning questionnaire (LPQ) is achievement in the EE and ToK is predicted by a balanced use of deep, surface and achieving motivations and strategies. These findings suggest that the increased use of surface motivation and surface strategies lead to falling achievement outcomes in the ToK, while the use of deep and achievement strategies show positive associations (p < .01) with the ToKE, ToKO and ToKT outcomes. No associations of note exist for approaches to learning and the EE achievement outcomes.

It is hypothesised that student achievement in the EE and ToK is predicted by student ability to convert written information into knowledge. The Pearson correlation coefficient for literacy factors comprehension, logical relationships and vocabulary are statistically significant (p < .001) and strong for all ToK achievement outcomes, while no associations are found for the EE outcomes.

Student self efficacy hold strong subject specific components, (Bong, 2001a; Bandura, 1997)) and it is hypothesised that the degree of self efficacy associates with the relevant EE and ToK achievement outcomes. The findings for both sets of questionnaires indicate that no statistically significant (p > .05) association could be found between the explanatory variables and the achievement outcomes. The questionnaires were designed in terms of the criteria to which both tasks are written, suggesting that students, in constructing an understanding of knowledge in the ToK and enhancing their knowledge through the EE, are unable to make confident judgements in their application of the criteria to the respective task.

School effects emerge with all learning factors. The TTCT figural explanatory variables elaboration, abstractness and resistance to premature closure and all verbal
explanatory variables have on average statistically significant differences (p < .01), suggesting a school effect is present. Data for the learning self regulation suggest clear differences emerge between schools for all behavioural factors (p < .01) and for all motivation self regulation factors (p < .05) with the exception of external regulation (p = .5). For BHTL, intrinsic motivation, mastery learning, external influences and use of time during learning all emerge as having statistically significant differences (p < .01) between schools, and for the approaches to learning statistically significant (p < .001) results occur for all explanatory variables. Clear differences that are statistically significant (p < .001) emerge for all 3 literacy factors between schools. The findings for SEE suggest significant differences exist between schools for the explanatory variable, ‘creative aspect of the EE’ (p = .007) and approaching significance for the ‘use of ideas’ (p = .05). For SEToK, no significant (p > .05) were found to exist between schools.

Language effects emerge with the TTCT, for figural abstractness, between Group 1 and Group 4 (p < .001) and Group 1 and Group 3 (p = .01) and approaching statistical significance, p = .06 for figural originality (Group 4) and figural resistance to premature closure, p = .07 (Group 4) with Group 1 having the higher mean in both cases. All verbal explanatory variables are statistical significant (p < .001) with Group 1 having the higher mean when compared to Group 4 and Group 3. These data for learning self regulation suggest that no statistically significant differences emerges between languages (p > .05), but it should be noted that autonomous regulation approaches significance (p = .06) with Group 3 having the higher mean. For motivation self regulation factors, statistically significant differences emerge for introjected regulation (p = .02), identified regulation (p = .02) and intrinsic motivation (p = .001), with group 3 having the higher mean for each factor.

No language differences emerge with the BHTL questionnaire, although the factor ‘use of time during learning’ approaches significance (p = .08) with Group 4 students having the higher mean, and a statistically significant result (p = .02) when compared to Group 3 students. With the approaches to learning, statistically significant results emerge for deep and achievement motivation (p < .01), Group 1 having the higher mean, and surface strategy (p < .001), Group 3 having the higher mean. Clear differences emerge
between Groups 1 and Group 3 for all literacy factors (p < .001), suggesting that Group 1 students are more able to construct an understanding of knowledge in their mother tongue, English, than are Group 3 students. These data for SEE and SEToK suggest no differences between language groupings have arisen.

In comparing the mean scores for EE and ToK achievement outcomes along language groupings, (Group 1 and Group 3), statistically significant (p < .05) differences were found to exist for all achievement outcomes. Using Cohen’s d to estimate the size effect of the sample population it emerges that while the EE outcomes have higher means for Group 3, it can be inferred that this difference is small due to the size effect of the sample population. Group 1 has higher levels of achievement in the ToK than Group 3, and using Cohen’s d, the effect size for each ToK achievement outcome is moderate and positive.
Chapter 8
Discussion of results

8.1 Overview

The results so far in this exploratory study of the influence of learner factors on achievement in the EE and ToK show that students perceive the EE as the more cognitively demanding task. The learner factors that predict achievement in the ToK as a way of understanding knowledge and the EE as a means of enhancing knowledge, are analysed in the context of why this trend in relative difficulty occurs. Reference is made to school effect and language effects on achievement outcomes, and the extent to which these two variables play a part in determining these achievement outcomes.

In examining why these trends in relative difficulty occur, a theoretical framework is given, forming the foundation to an understanding of why the EE is the relatively more cognitively demanding task. Learning complexity is shaped by the number of non-automated cognitive processes that must be employed to achieve explicit learning objectives (Lohman, 1989; Snow, 1996). If the task is new, greater time may be required in understanding the required cognitive processes. If a task is poorly defined, more non-automated cognitive processes are required in this situation.

Where tasks are well defined, fewer measurable cognitive processes are required for a course of action. As discussed in chapter 5, learning complexity is characterised by prior knowledge, thinking skills and the motivations brought to the learning processes. It is further argued that different cultural backgrounds add another dimension to complexity. While the degree of complexity can vary between students, complexity is conceptualised by the following factors:

- Subject area knowledge
- Thinking skills
  - Approaches to learning
  - Creative thinking skills
Literacy strategies

• Motivations brought to the learning process
  o Mastery and performance
  o Self-regulation
  o Self-efficacy

• Language

The interpretation of these results and the influence of these learning factors on understanding and enhancing knowledge will be discussed in this chapter.

8.2 Comparative cognitive difficulty of the EE and ToK

These data suggests the EE is perceived by students as the more demanding task. This is indicated by the range of cognitive factors and processes that students gave as reasons. The open ended nature of Task 1 elicited a range of responses from students, indicating a series of cognitive processes and factors that were given reasons as presented in Table 7.1 and 7.2. These self perceptions were further confirmed in Task 2 where students were required to compare the relative demands of the EE and ToK on learning criteria, as presented in Figure 7.1 and Table 7.3.

The appropriateness of these tasks is evidenced through the consistency in learner response between the open ended task requiring students to give reasons why one task was the more demanding and the questionnaire requiring comparisons of the relative demands of the EE and ToK. Students indicated that the EE was perceived as the more demanding in both tasks. Due to the exploratory nature of this investigation, these results are not supported directly by other findings. In the context of the argument presented in this thesis, students find the EE the more demanding task and it is suggested that the sample of students is representative of the general student population. These tasks produce results that are considered valid outcomes for this research.

Learning complexity arises with an increase in the number of non-automated cognitive processes that a learning task requires (Clarke et al., 2006). An increase in the number
of task components, the relationship between these components and the newness of these components, require more non-automated cognitive processes which increases cognitive complexity. The nature of the EE is such that it requires the construction of an ill defined problem or question, the collection of evidence and the use of this evidence to argue a position or case which is perceived by students as being cognitively demanding.

Student responses indicate difficulty in defining a suitable topic, identifying the existence of a problem, delineating its scope and setting goals, the time required to set about solving such a problem and that the defined question or issue may require a redefinition and conceptualisation. The implication of this finding is that methodological knowledge is challenging and forms a new learning experience for students. The identification of a problem, the links between sub questions and prior knowledge are abstract and the cognitive processes are all new and lack clarity for the student. The area of research methodology requires students to confront concepts and processes with which they are barely familiar, tentatively introduced through subject domains, and further examined in ToK from the perspective of developing a ‘critical capacity to evaluate beliefs and knowledge claims’ and making ‘interdisciplinary connections’ (ToK Guide, 1999). The research methodology particular to subject domain knowledge, understood and developed from ToK, and applied to the EE can be difficult for a student to comprehend.

The reasons given in Table 7.1 suggest student lack of familiarity with the non-automated cognitive processes required for enhancing knowledge. To formulate a precise research question or hypothesis, research to the appropriate depth, use time in researching, drafting and refining the issue and the ability to communicate this in a 4000 word essay, all involve cognitive processes that many students employ for the first time and are rated as being more demanding.

This result is further substantiated with the graded mean differences between the EE and ToK in Figure 7.1 and Table 7.3, suggesting that students find the writing up of the EE topic, the continuous nature of the task, the defining of the guiding issue, the
development of an action plan, the collection of the relevant information and trying new ways of working and exploring ideas as more demanding. To solve a problem and enhance knowledge requires a range of learning and information processing strategies, attitudes to learning and beliefs are necessary for the conversion process of information to knowledge. The student responses suggest the nature of the EE is broader and the learning complexities greater.

Overall, this questionnaire has shown that students are largely concerned with working out a guiding issue or question for the EE, the difficulties associated with the amount and depth of research, the continuous nature and time required for writing up the essay and developing an action plan. These results suggest that the time required for writing up the question is the most demanding aspect for the students. Students appear to be neutral on which task is more demanding when responding to the difficulties of motivation, the transfer of ideas from a subject to the EE task, and developing an understanding of the topic and question being researched. Students found the ToK more demanding when examining ideas from different perspectives and having to think more deeply.

8.3 Subject area knowledge

For students to transform existing knowledge into ideas and solutions, learning complexity and the creative process must be understood in relation to domain knowledge that reflects prior learning, the ability to retrieve these ideas and add them to new and emerging processes and products or outcomes.

8.3.1 Subject area knowledge and achievement

Problem recognition occurs with respect to the declarative and procedural knowledge students have about a subject area, with prior knowledge influencing student ability to define and represent a problem (Pretz, et al., 2003). The correlation between the subject score the EE was written in, and achievement in the EE and ToK is statistically significant (p < .001) for all associations. This suggests that the knowledge base is a
condition for knowledge enhancement and informing student understanding of knowledge.

In formulating a precise research question, recognising the existence and scope of such an issue and mentally representing a problem can require a number of cognitive stages. Student subject area knowledge facilitates quicker learning with fewer cognitive stages required, compared to students with less prior knowledge in task specific situations (Elen & Clark, 2006, p. 28).

These findings are consistent with the views expressed by Perkins (1990) and Rob & Glasser, (1985), confirming the importance of domain knowledge as a necessary condition for student achievement, not only in Biology, History and Psychology (Alexander, 2003), and from this research, English, Economics, ITGS, Biology and Visual Arts (for the EE). Further, these findings indicate that subject area knowledge acts as a strong predictor of knowledge enhancement (EE), and understanding of knowledge (ToK) in English, Economics, History, ITGS, Psychology, Biology and Visual Arts.

English as a predictor of achievement in this study suggests that language plays a more important role in ToK than in the EE. This finding is consistent with a stated ToK objective, the ‘... use oral and written language to formulate and communicate ideas clearly’ (ToK Syllabus, 1999, p. 5). Further, in Criteria B, Quality of Analysis, ‘... an excellent level of critical reflection and insight; the discussion is detailed and the argument are logically valid; the main points are cogently justified and evaluated and there is effective acknowledgement of their implications; counter-claims are identified and thoroughly justified’, implies good use of the English language. In Criteria D, Structure, Clarity and Logical Coherence, students are graded on ‘... concise introduction, and a clear logically coherent development of the argument leading to an effective conclusion; concepts and distinctions are succinctly defined and clarified’, consistent with the use of language to articulate and communicate ideas. A similar emphasis on the use of English in the ToK oral is absent.
These criteria suggest that the precise use of wording and definitions is required for the ToK, and students are aware that the use of language in thinking skills plays an important role in predicting achievement in the ToK. These findings also suggest a clear benefit of English A1 in English EE outcomes.

A similar pattern exists for Chinese A1 as a predictor of achievement in the ToK. These findings suggest that the Chinese A1 language skills play an important role in the writing of and achievement outcomes for the ToK in the same way as English A1. What is less clear is the role of Chinese A1 in predicting achievement in the GCEE, SpEE and H criteria (p > .05) while playing a role in the TEE (p < .001). Further analysis is required to establish why these findings suggest a difference between English A1 and Chinese A1 and the extent to which the criteria might be procedural.

It is observed that a pattern emerges with Group 3 subjects where the subject area knowledge is a predictor of the GCEE, TEE, ToKE and ToKT and a weaker predictor numerically for the SpEE, H criteria and ToKO. This suggests the teaching of ToK thinking skills creates learning experiences that challenge students, encouraging critical reasoning and the capacity to evaluate through an inquiry method of questioning.

These findings suggest that Economics is a better predictor of ToK than the EE, while Economics is numerically smaller as a predicator than English for the EE. This result that Economics is a predictor of achievement in the ToK is consistent with the view that Economics ‘... is a method rather than a doctrine, an apparatus of the mind, a technique of thinking, which helps its possessors to draw correct conclusions’ (J. M. Keynes as quoted in Heyne, 1980, p. 4). This is consistent with the view that the teaching of economics improves student critical thinking skills (Boag & Stranabau, 2009; Brown, Hoag & Boudreau, 1995).

The subject History acts as a better predictor of achievement in the EE than Economics and is similar numerically in predictive power to English A1. The strength of History as a predictor in the ToK essay and the ToKT is partially explained by the development in student understanding of historiography and the use of historical examples.
The ITGS course and its methodologies (prior to the first examinations for SL and HL in 2007), were closely aligned with the research skills developed in the EE and ToK. The ITGS IA Portfolio is researched based with varied content requirements. Students can choose as a starting point any aspect of the impact of IT on the individual or society. The emphasis placed by teachers is not on knowledge of the hardware and software, with the consequence that little technical knowledge is required to be learnt, but rather an analysis into and evaluation of the impact and use of IT. The examination questions in ITGS were largely based on ‘real life’ IT situations requiring research and analysis, with Papers 1, 2 and 3 based on modified situations from the Internet and newspapers. The implication for IT teachers was to emphasise the development of skills rather than subject area knowledge. Since the review of the ITGS course (first examinations 2007), a re-balancing and alignment between software and hardware knowledge and the necessary analytical and evaluative ITGS skills has occurred, with greater emphasis on knowledge. A focus group of 2 IBO Deputy Chief examiners was established to analyse the ITGS issues.

Reflecting this change has been the examination papers in ITGS (May 2009 examinations) and the IA Portfolio, Criteria B and D, emphasising the description and explanation of the software and hardware (ITGS Study Guide, 2006). It should be noted that the software and hardware questions are still situated in the context of newspapers and the Internet, with emphasis on research and analysis located in ‘real life’ contexts. It is not unreasonable to expect that despite these modifications to the curriculum and assessment criteria, continued high correlations would be found.

The conclusion to be drawn on the nature of ITGS and the examination of these issues is the close alignment with ToK issues. These findings suggest a strong correlation and predictive power due to the use of research, analytical and evaluative skills in ITGS which are also used in the ToK oral, and ToK essay. This is consistent with the findings of Dalton & Goodrum (1991) and Hopson, Simms & Knezek (2001-2002) who suggest that ITGS provides students with active learning, authentic tasks that challenge, are complex in nature and encourage higher-order thinking skills.
With Psychology it is of note that while the predictive pattern is similar to other Group 3 subjects, Psychology breaks with the pattern in that ToKO has a higher mean score than ToKE. This may suggest that examples from Psychology are more commonly used in the oral than in the essay.

Biology acts as a stronger predictor for the GCEE, SpEE and TEE but less so numerically for ToKE and ToKT. It is to be noted with Visual Arts that the subject is a poor predictor of achievement outcomes in the EE and in the ToK, but only marginally with the TEE and ToKT. This suggests that the visual skills developed in Visual Arts are of less use in the EE and ToK when compared to other domain areas. This result is of interest as the IB Visual Arts course requires students to be skilled in both historical methodology and art criticism, developing these sets of skills in a cultural context (Anderson, 1994).

With the exception of ITGS it should be noted that Biology and English A1 are the most robust predictors of achievement in the TEE while Chinese A1 and English A1 are strong predictors for the ToKT. It should also be noted that subject area, while a poor predictor of creativity as measured by the H criteria, is statistically significant (p < .05) with the exception of Chinese A1 and Economics.

In conclusion, the learning of declarative knowledge in each domain area can be challenging. The learning of procedural knowledge in each domain has students encountering concepts, and methodologies or processes that are novel and perhaps unheard of. The scientific process, historical methodology and the artist approach to a pictorial composition can all be distant from a student’s daily learning activities. The association between theory and practice can be difficult to perceive, making such learning activities challenging.

It should be noted that in the EE the selection of subject area and topic question or issue is the choice of the student. Eighty per cent of students chose their HL subject which requires greater understanding of the domain and, it is reasonable to assume, a greater
level of interest. Students also choose an issue for the ToKO, while the ToKE is selected from one of 10 prescribed titles.

8.3.2 Subject area knowledge and creativity

While divergent thinking is seen as important, this alone does not lead to creativity. Relevant subject area knowledge and skills are seen as fundamental to creative ideas (Amabile, 1983a; Hayes, 1989; Urban, 1995, 2002).

The data presented in Table 7.5 supports the view that students in this study depend on subject domain knowledge for the enhancement of knowledge as measured through the H criteria. These data establish a link between student ability to employ their knowledge for academic creativity in the EE. Creative thinking requires management of ideas from a knowledge domain and creative thinking occurring when ideas are transferred, adapted and combined in different ways. These findings suggest that subject competency is a necessary condition for creativity and consistent with the views of Schank, (1988); Feldman, (1988); Walberg, (1988); Baer, (1998); Cropley & Cropley, (2000); Rubenstein, (2000); Feldhusen, (2002) and Han (2003).

The use of the knowledge base is critical in the managing and re-prioritisation of ideas, in the development, adaption and combination of ideas that result in a useful outcome. While little research has been conducted on subject specific domains and the relationship to creativity, these findings suggest there is some variation between subject areas and the scoring of creativity by the H criteria.

The mean score for creativity in Psychology, the application of the H criteria, is lower than the mean scores in other subjects, and the difference statistically significant (p < .05) when compared to the creativity score for economics. This may suggest that assistant examiners in Psychology are harsher and provide a more literal interpretation to the H score, with unrealistic expectations of student ability to interpret and analyse, and the degree of originality in student work. It may also signal the nature of the psychology EE as a literature review, the H criteria reflecting a simplistic view of the
information gained, without original reflection and low level cognition of the literature. Reflection and the greater use of higher order thinking skills, it is argued, would convert this information into knowledge and enable students to display their creativity. This finding would suggest this is least likely with Psychology.

This raises the issue as to whether there is a standard set of questions that can be raised in IB Diploma subjects and the extent to which limitations are placed on being creative. It is instructive to read the EE Guide (1998). In Group 1 (Language A1) subjects, candidates are advised that ‘...there should be a compromise between building on the wisdom of more experienced literary critics ...’ and ‘... their personal views on the way the author has treated the subject’. (IBO, 1998, p. 29). In Economics, students are encouraged to have ‘... a comprehensive and original selection of economic information,’ and that ‘it is likely that relevant and imaginative primary sources have been used’ (IBO, 1998, p. 67). Students of History are encouraged in their use of ‘... primary and secondary sources’, to analyse these sources, and ‘... demonstrate a good awareness of the value and limitation of the sources used ...’ (IBO, 1998, p. 81, 83), while building their argument and historical knowledge. In ITGS candidates are encouraged ‘... to develop and explore a research question in a disciplined and imaginative way’, (IBO, 1998, p. 85), while Biology suggests that ‘... data be collected by the candidate through experimentation .... alternatively, essays may be based on data ... ideally from primary sources, and manipulated or analysed in an original way ...’ (IBO, 1998, p. 39). Visual Arts candidates are helped to ‘...identify and chose appropriate sources, both primary and secondary, and appropriate methods of research’, with the proviso for such students that the ‘... focus should be clearly on a research question ... the response being predominantly verbal (IBO, 1998, p. 130).

In contrast, instructions for Psychology EEs recognise that a high level of interest is often created ‘... from candidates who have had no formal training in the formulation of a psychological problem or issue’ and ‘... EE based on empirical/experimental work is discouraged’ (IBO, 1998, p. 116). The nature of the EE encouraged is in the development of a ‘... coherent argument ...’, ‘reviewing relevant evidence, and considering in some critical detail the methods and procedures which authors have used
to produce empirical data or arrive at theoretical conclusions’ (IBO, 1998, p. 116, 117). It is arguable that students presenting for an EE in Psychology are limited in being creative by the subject criterion guidelines, which restrict the opportunity to do so.

In conclusion, relevant subject area knowledge and skills are seen as essential to creative ideas with support for the view that students in this study depend on subject domain knowledge for the enhancement of knowledge as measured through the H criteria. These data establish a link between student ability to employ their knowledge for academic creativity in the EE.

Another aspect of creativity is the construction of the question or issue for the EE itself. Criterion A requires a focused question or hypothesis. While this aspect has not been considered in this thesis, this study raises the issue on the nature of problem construction in the context of academic creativity. The extent to which students with different mother tongues may construct problems differently is worthy of examination.

8.4 Thinking skills

Broadly interpreted thinking can be thought of as the mental action or ‘... general cognitive processes, such as generating ideas, exploring consequences, reviewing options, monitoring progress and so on’ (Perkins, D., Jay, E. & Tishman, 1993). The term thinking skills is often used synonymously with thinking strategies and can be thought of as ‘... the actions we take whenever we work on ideas. The idea can be an external precept or internally constructed’ (Munro, 1993). These actions include visualising or verbalising an idea, categorising what we know, looking for patterns and affiliations, making inferences and transferring what we know to new situations.

In developing a broader picture of learning, thinking skills are considered in the context of the way in which a student goes about their learning task. Thinking skills are considered in terms of cognitive style and approaches to learning.
8.4.1 Approaches to learning

The Approaches to learning questionnaire (LPQ) was used on the basis of the given explanatory variables. While factor studies of the LPQ have generally supported the factorial validity of the LPQ (Ramsden et. al., 1989; Watkins and Hattie, 1990; Bochner, 1996; Andrews, et. al., 1994; Watkins & Akande, 1994) anomalies have arisen. Within the questionnaire, differentiation occurs between deep and surface factors on the basis of understanding and memorisation or rote learning. It is important to note that a student from an English culture may seek to memorise, an Asian student with a Chinese culture may seek to memorise with understanding (Marton, et. el., 1995).

Approaches to learning are critical determinants of high achievement. A learning approach is a representation of the manner in which a student goes about their learning. This accounts for student intentions regarding the learning task, and activities by which this task is addressed (Entwistle, 1997; Byrne et.el., 2004). The ‘approach’ consists of both student intention and the strategy, toward the task (Ramsden, 1988, p.20).

These findings suggest that surface, deep and achievement motivations play no statistically significant (p < .05) role in the EE and ToK. This interpretation also suggests the use of surface, deep and achieving strategies have no bearing in the EE. While the findings for ToK suggest that for surface motivation and associated surface strategies to learn, the more students wish to retain knowledge for the sake of meeting external criterion, ToK achievement outcomes will fall (p < .05). This finding also suggest the deep and achievement motivations are statistically insignificant (p > .05), and play no role, while deep and achievement strategies play a role in all ToK outcomes.

More specifically the results are disappointing due to the absence of a relationship between the motivations and the use of the 3 strategies in the EE. It is suggested that the absence of balanced use of learning approach beliefs and strategies may be caused by a variety of factors.
While relatively little research has been completed on students at the higher secondary level and in the context of enhancing knowledge, there is general agreement that at the tertiary level students demonstrate varying approaches to learning that are reliant on context, the content and the demands of the of the ‘learning task’ (Marton, et. el., 1984; Richardson, et. el., 1987). Of note is the adoption of a ‘deep approach’ where more abstract learning is required (Svensson, 1977) and greater motivation arising from an alignment between student interest and the relevance of the curriculum to these interests (Fransson, 1977). It is also suggested by Dahlgren and Marton (1978) that, where students are confronted by assessment with a superficial emphasis and engagement with the curriculum to be learnt, a surface approach is adopted, while Ramsden (1977) argues that students adopt a strategic (or achievement) approach if staff provide hints in relation to the assessment schemes to be used.

It should be noted that in none of the above studies was the age of the participants specified, raising the claim that these approaches to learning may be age sensitive and responsive to the differing academic contexts where students may attribute different understandings to the learning in contrasting academic situations (Richardson, 1994). Watkins et. el. (1986) found that as students advance at the secondary level an increase in the use of deep approach strategies occurs. In contrast, (Biggs, 1987; Eklund-Myrskog & Wenestam, 1999) all discovered declining trends in the use of surface and deep approach strategies in Australian and Finnish upper secondary students, regardless of gender (Biggs & Moore, 1993).

It should be noted that conclusions may be difficult to arrive at as the measurable psychological attributes are not stable (Cano, 2005) and may be dependent on the supervisor perception of learning and teaching in the EE processes (Entwistle et. el., 2001; Kember, 2000) and the learner context (Entwistle & Ramsden, 1983). As presented in Chapter 5, little has been written on the approaches to learning and the extent to which these factors influence an enhancement of knowledge. Further research on the relationship between the approaches to learning, the enhancement of knowledge
and understanding knowledge is required before any general conclusions can be reached.

It is also suggested that there may be variation in student learning between the 2 language groups as indicated by the analysis of language effect, where clear differences emerge with Group 1 preferring the use of deep and achievement motivations, while Group 3 has a preference for the use of surface strategies. Second, school may play a role with differences emerging for students from the participating schools showing varying preferences in their use of motivations and strategies. Third, and more significantly in the context of this thesis, these data are consistent with the earlier findings (Chapter 7.2) which suggest the EE is the more demanding task due to its broad and less well defined nature which students have little prior experience and understanding of. The cognitive processes of evaluative thinking, creative thinking, reasoning, problem creating and solving and the use of prior knowledge, all require motivations and the use of strategies in an unfamiliar learning context.

8.4.1.1 School effect

Clear differences emerge between schools for all explanatory variables with significant statistical differences existing between certain schools. This suggests a school effect is present. The elements of individual level and school structural characteristics are the variables that form the school context, acting as predictors of academic achievement (Stewart, 2008). The impact of these individual level and school structural characteristics on student achievement outcomes have long been studied and shown to be linked to academic achievement (Battistich, Solomom, Kim, Watson, & Schaps, 1995; Crosnoe, Johnson, & Elder, 2004; Goldsmith, 2004; Lee & Bryk, 1989; Marsh 1992; Brown & Evans, 2002; Stewart, 2008).

The context of the school and the processes occurring in determining the extent to which individual level predictors, such as student effort, parent child discussions, peer association and parental school involvement (Stewart, 2008), predict academic achievement plays a complex role (Feuerstein, 2000). School characteristics such as
type (public or private), structure, staffing, organisation, resources and climate (Carbonaro, 2005; Parcel & Dufur, 2001) and the impact schools have on student involvement, commitment, and attachment all influence academic development and achievement (Freiberg, 1999). One aspect of school climate is school culture, ‘... the unwritten beliefs, values, attitudes ... among students, teachers and administrators’ (Stewart, 2008), that encourages or discourages student learning and teaching practice (Dupper & Meyer-Adams, 2002; Wang, Haertel & Walberg, 1997; Shields, 1991).

While no conclusions can be drawn above which of these factors cause these differences, it is suggested that the impact of school context, individual level, school structural characteristics and school culture play a role in explaining the variations in achievement which emerge in these findings. This result is consistent with findings that suggest that learning context is significant as to whether students assume a deep or surface approach to learning. Research has identified links between the school environment (Clark & Dart, 1994; Ramsden & Entwistle, 1981; Ramsden et. el., 1989), and the classroom (Dart, 1994; Dart, 1998) and student perception of these contexts, which influences both their approach to learning and student achievement outcomes.

8.4.1.2 Language effect

Indicative trends emerge for these data between the 2 language groupings. For motivation, Group 1 has a higher mean average than Group 3 and statistically significant (p < .05) for surface, deep and achievement motivation. Group 1 students have a greater intrinsic interest in what is being learnt, seeking to develop competence in the subject area in which the EE is being written. This is complemented by surface and achievement motivation where Group 1 students seek to retain knowledge and meet external criterion while achieving a high result relative to other students, gaining self-esteem through competition.

These findings suggest that assuming both language groupings have a similar understanding of the concept of learning (Watkins & Regmi, 1990) students in Group 1
perceive that obtaining a higher level of achievement in the EE and ToK requires the balanced use of all motivations.

In the use of strategies, surface strategy is scored more highly by Group 3 (p < .001), suggesting students in this language group limit their engagement in the EE and ToK seeking to reproduce, learn, memorise and link ideas in an unthinking way. This approach to learning has been associated with traditional approaches to learning where students assume a more passive role (Dart, 1997).

The conclusions that can be drawn from this preliminary exploration of the effect of mother tongue as defined by Language A1 on achievement in the EE and ToK, is first, a reminder of the complexity of the learning process. As has been argued, the ToK and EE are multifarious tasks, designed to give students an understanding of knowledge, and the skills to enhance knowledge and involve complex processes. Second, it must be remembered by teachers that a difference exists between the process and the product. Students use surface strategies and still achieve high outcomes. Third, the data presented is consistent with the view that as the IB expands the level of student outcomes remain at a high level.

8.4.2 Creative thinking

The results in Table 7.16 indicate the association between the use of creative thinking strategies and the EE exist only between Figural abstractness and the SpEE, H criteria and TEE (p < .05). These data suggests that there does not appear to be five distinct creativity traits as measured by the TTCT Figural explanatory variables, but rather one dimension to creativity, Figural elaboration in the context of academic creativity. No association exists between the verbal explanatory variables and the EE.

Associations between creative thinking strategies and the ToK were identified. Of note are the associations between figural abstractness, verbal fluency, flexibility and originality and the ToKE and ToKT. Figural elaboration correlates with the ToKO (p = .02) and Figural resistance to premature closure with the ToKE (p < .05), while these
data suggest strong associations between verbal fluency, flexibility and originality and the ToKE and the ToKT.

There is little research on enhancement of knowledge and creativity in a student academic environment. The definition of creativity (chapter 1.7), as presented in this thesis, is consistent with the cognitive processes as measured in the TTCT. Divergent thinking allows for creative outcomes. The commencement point for creativity is problem sensitivity (Urban, 2000).

These data suggests that figural abstractness plays a significant role in enhancing and understanding knowledge. The learner organises and synthesizes the creative thinking process to distil the information and identify the essence of the problem. These data suggest that this cognitive function may be a more stable psychological trait than the other variables. These findings also suggest that the use of creative thinking skills in the EE is displayed through an understanding of the essence of the problem.

Simonton (1984) has suggested that age may influence the development of creative thinking. This suggests that different periods of development will give differing results for the TTCT and that age may be a factor in understanding and enhancing knowledge. It is possible the other cognitive functions of fluency, flexibility, originality and elaboration are more likely to be found in older participants, rather than students at the higher level of secondary schooling.

The lack of association between fluency, flexibility, originality, elaboration and the EE and ToK achievement outcomes, as suggested by this data raises the question as to whether these patterns are acceptable. If these patterns are acceptable then it is suggested that figural creative thinking is not a required approach to creative thinking in the EE and ToK.

Of note are the associations that emerge between the TTCT Verbal explanatory variables with the ToK achievement outcomes and not with the EE. This result is consistent with the findings and conclusion of Hypothesis 1 that students find the EE
more demanding due to the need to create their own guiding question or hypothesis. This suggests students have difficulty in developing ideas and questions, struggling with the central requirement of the EE, the formulation of a relevant question or hypothesis.

The Figural and Verbal TTCT were administered to the participants according to the instructions contained in the instruction booklet, taking the tasks in their normal classroom environment. There is evidence to suggest that the conditions under which the tests are taken can influence the figural and verbal scores. Where test conditions are varied, Torrance (1988) reported 36 studies, of which 27 had significant differences in scores as a result of the influence of the testing conditions. The extent to which the participants sense encouragement or restraint can have a critical effect on participant performance (Lissitz & Willhoft, 1985). Other influences have been observed to exist: whether students were interrupted from interesting or uninteresting activities (Kirkland, 1974; Kirkland, Kirkland & Barker, 1976), whether the testing environment was test like or game like (Hattie, 1980), and changes in test instructions (Lissitz & Willhoft, 1985). Despite these listed limitations The TTCT is still the most widely used and the standard against which other measures of creativity are appraised (Starko, 2001, p. 388; Almeida, et. el., 2008)).

8.4.2.1 School effect

An ANOVA model was used to examine the relationship between creative thinking skills and schools, with Table 7.18, indicating statistically significant differences (p < .01) between all schools for figural and verbal explanatory variables with the exception of figural fluency and originality.

This researcher was unable to find any investigations on the effect school may play on student creativity. While literature exists on the relationship within business organisational setting and the effect organisational structures can have on individual creativity (Williams and Yang, p.373), these elements of workplace creativity have not been transferred to inform classroom practice (Petrowski, 2000). The role of the school and the potential impact this may have on student creativity have been ignored and are
worthy of examination. Given that this research suggests students find the task of developing a question or issue for the EE as one of the most demanding aspects of their work, and the lack of association between figural and verbal fluency and originality and the EE outcomes, it is suggested that the relationship between the school and student may play a role in fostering student academic creativity. This relationship is worthy of further investigation.

8.4.2.2 Language effect

The effect of language on creative thinking skills suggested clear differences (p < .01) between the two language groups, Group 1 having the higher mean with figural abstractness, and verbal fluency, flexibility and originality. Of note is figural originality (p = .06) and figural resistance to premature closure (p = .07) where the Group 1 mean is higher than the Group 4, these findings approaching statistical significance.

With Figural abstractness, student responses to the Picture Construction and Picture Completion activities suggest Group 1 students are more able to organise their thinking processes and more readily synthesize available information. This measure is based on the notion that creativity requires the learner to know the essence of the problem, to be able to encapsulate the information and represent this level of abstractness in the given title. Davis in Colangelo & Davis, 2003, p. 317 argues that ‘... the figural tests are more culture fair ...’ than the corresponding verbal form.

These results contrast to an earlier study (Torrance, Gowan, Wu & Aliotti, 1970; Gowan & Torrance, 1965) with bilingual children attending schools in Singapore, performing at a statistically significantly lower level on fluency and flexibility and higher on elaboration, with a higher mean for originality. These earlier findings are based on students who at a younger age have gained greater mastery of English than students surveyed in this investigation. Students surveyed in this study are from Asia and began attending English speaking secondary schools, in most cases, in the year before proceeding with the Diploma. The notion of balanced bilingualism, where a
learner accomplishes similar levels of proficiency in at least two languages, is absent from the surveyed population.

This interpretation of the Figural results is reinforced with the Verbal assessment of creativity where Group 1 students have a statistically significant (p < .001) higher mean than Group 4 students. In this survey Group 4 students are from China (13 students), and Indonesia (24 students) having completed their education to Year 10 level and then attend school in the West. This suggests that Group 4 results are mediated by the level of language competence, these students still in the process of becoming fully bilingual. It can be reasonably inferred that these students have not as yet overcome the complexities of learning in a second language. As suggested by Cummins (2001, p. 28), attempts to become bilingual in certain circumstances may in fact negatively affect verbal creativity and ‘... scholastic achievement’. At issue is the variety of bilingual learning situations that arise, the age at which the languages are learned, the separate or simultaneous learning and the context for use at home, school or elsewhere creating particular bilingual learning situations (Cummins, 2001, p. 32).

These findings suggest that students who are in the process of developing their bilingual skills are influenced in their cognitive functioning by the mediating effect of their language competence. The implication of this conclusion is consistent with the findings of Cummins (2001, p.45) that students who do not resolve these issues in managing two levels of language competency will have adverse effects on their cognitive development.

These findings also suggest that students with different mother tongues interpret creativity in different ways. As argued in Chapter 5.10, the notion of language and its relationship to achievement and divergent western and eastern perspectives of creativity may have influenced these results. Further research on the relationship between language and the enhancement of knowledge and understanding knowledge is required before any general conclusions can be reached.
8.4.3 Literacy strategies

While literacy can be viewed as including a wide suite of competencies, this thesis takes the view that literacy is a means of enabling and enhancing creative activity. It can be inferred that literacy is a means of both understanding and enhancing knowledge and it is reasonable to propose that a student’s written ability is essential for the conversion of this information to knowledge.

The results found in Table 7.36 indicate the association between the use of literacy strategies, comprehension, logical relationships and vocabulary, and the ToK achievement outcomes is consistently strong (p < .001), while there were no statistically significant associations found between the literacy explanatory variables and the EE. Little is known about the literacy levels required for the EE and ToK.

These results suggest that reading comprehension is poor, and good reading skills are lacking in the context of the EE. This may be the case where ‘... one of the greatest demands on students attending post-secondary institutions is the comprehension of many different and difficult texts’ (Hart & Speece, 1998, p. 670). Students are required to think deeply about the ideas in their subject domain and move beyond surface knowledge, to an integration of this information into new knowledge. These results suggest that students may not see the connection between reading comprehension and achievement in the EE (Butler & Winne, 1995); they may have little prior knowledge in relation to their chosen subject domain and research question (Carpenter & Just, 1986); students may not be aware of appropriate strategies to employ for such a task; and they may not be focused on acquiring knowledge (Mayer, 1996). This interpretation would suggest that reading comprehension strategies should be taught to improve learning for the enhancement of knowledge.

The ability to recognise connections between ideas and the principles of organisation in a text, allows for the communication of these ideas in a particular sequence emphasising their relative importance within and between sentences. While words might be defined
in isolation, logical relationships will be inadequate unless words can be understood in a context. These results suggest that in the context of the EE, students are unable, or find it difficult, to assign meaning to these words, resulting in a weak sense of logical relationships. This would indicate that students find difficulty in identifying the mutual dependence of ideas within a sentence and between sentences, finding it problematical to comprehend the meaning of the text. This interpretation again raises questions as to the breadth of the EE task and the student ability to transfer these ideas to the question or issue of the EE. For the EE it is suggested that logical relationships need to be taught in a systematic way.

These results further suggest that knowledge of vocabulary does not contribute to achievement in the EE. This result differs with previous research that suggests a strong relationship between vocabulary knowledge and achievement outcomes (Conroy & Plant, 1965).

The above situation is further compounded for students in the Group 3 category where statistically significant (p < .001) differences exist between Group 3 and Group 1, for all literacy measures. Group 1 has the higher means. An understanding of language requires command of vocabulary, logical relationships and reading comprehension. For a student who falls into the Group 3 category, and presents for the Diploma in English, acquiring proficiency in English as the language of instruction and the use of texts and the requisite literacy skills for the EE and ToK tasks, involves significant adjustment and intercultural learning. This suggests an explicit literacy strategy is required to assist learners, particularly in writing of their EE.

It should be noted that in the school data set, School 90 consists primarily of students from Group 3 resulting in a school effect where school 90 has lower means for all explanatory variables that is a statistically significant (p < .01).

In the ToK, these literacy results suggest clear associations exist between the explanatory variables and the ToK achievement outcomes. If a student wishes to improve their ToK outcomes, then improvement must occur in their ability to
understand the main ideas, discriminate between essential information from supporting ideas, their ability to recognise relationships between concepts and draw analogies while recognising the principles of organisation in the text, logical relationships and their word knowledge. These observations suggest a clear action path to improve learner use of literacy strategies presents itself.

8.5 Motivations

Motivation as conceptualised in this thesis has three components: mastery and performance belief (Pintrich and Schrauben, 1992) self-regulation (Deci and Ryan, 2000), and student beliefs about whether they can learn or achieve (self-efficacy). For supervisors to motivate students and achieve optimally in the EE, and for teachers in the ToK, a knowledge of all three motivations is required.

8.5.1 Mastery and performance

In this thesis, the explanatory variable, ‘Intrinsic motivation’ is consistent with the characterisation of academic intrinsic motivation in the literature, as showing ‘... curiosity; persistence; task endogeny; and the learning of challenging, difficult and novel tasks’, of Gottfried (1985) and Gottfried et. al. (2001). The information supports the view of Deci & Ryan (1985), Gottfried (1985) and Lloyd & Barenblatt (1984), that a positive relationship between intrinsic motivation and academic achievement for secondary level students exists. This result suggests that this relationship exists for the EE and ToK. Moreover, the results suggest that students view their success in these tasks as depending on the handling of their learning rather than on the supervisors or teachers, with a preference for the completion of a challenging and difficult task. This is consistent with the argument that intrinsic motivation is also associated with student learning goals that emphasize the mastery of challenging tasks (Dweck & Leggett, 1988) and that more effective strategies are used when approaching these tasks (Elliott &Dweck, 1988).
These findings also propose that explanatory variable 4, ‘External influences’, plays a noteworthy role in student academic success. The external factors’ over which the learner has no control is perceived by students as determining success in these tasks. This factor reflects student perception of the significant role of the supervisor and teacher, with lack of success the result of poor teaching. Students also perceive intelligence as playing a role in successful achievement, with the suggestion that regardless of their efforts, learning will not get any better if intelligence is lacking. This result is consistent with the view of Dweck (1986) that learners in setting performance goals desire to avoid harmful judgements of their ability or gain approving judgements, implying the setting of performance goals.

These results suggest that students approach the EE with two goal orientations. First, successful achievement in this task is dependent on their engagement of learning as a fulfilment of their learning goals, enjoying the challenge and difficulty of the EE task, but second, also concerned about their result and the influence of their supervisor over whom they have little control. It would be reasonable to propose that students in adopting an intrinsic motivation approach, embrace deeper levels of cognitive engagement, but this interacts with external influences that facilitate achievement in the EE.

Of note are the associations between these two explanatory variables and the H criteria. Evidence exists that intrinsic motivation encourages creativity (Amabile, 1979, 1985; Amabile & Gitomer, 1984; Amabile, Goldfarb, & Brackfield, 1990; Amabile, Hill, Hennessey, & Tighe, 1994; Ruscio, Whitney & Amabile, 1998; Mumford, 2003), which is confirmed by the association between ‘My approach to learning’ and the H criteria (r = .14, p = .016). This suggests that students are focused on their subject matter and persevere due to the intrinsic rewards arising from the task. These findings also suggest that extrinsic motivation plays a role. It is unclear whether extrinsic motivation plays a negative or positive role in relation to the H criteria.

For the ToK, it is suggested that students adopt multiple goal orientations, not only intrinsic and external motivations, as argued above, but ‘mastery learning’ and ‘use of
time’, which play roles in the ToK achievement outcomes. This suggests that students do seek clarity in their learning when understanding and constructing knowledge and, while focusing on the examinable tasks, are happy to think about ideas not directly related to the ToK. It should be noted that studies have shown a positive association between mastery learning and use of time (Pintrich, 1989; Pintrich, et al., 1993), an aspect of self regulation.

In summary, these findings suggest that students will adopt intrinsic goal motivations using dispositions and behaviours that lead to deeper cognitive engagement and interacting with extrinsic orientations for successful achievement in the EE task. In the ToK task, students adopt multiple goal orientations, a balanced use of ‘intrinsic motivations’, ‘external influences’, with ‘mastery learning’ and the explanatory variable, ‘use of time’, in their learning.

8.5.1.1 School

The school results (Table 7.30) indicate that a school effect is present, for explanatory variables ‘intrinsic motivation’, ‘mastery learning’, ‘external influences’ and ‘use of time during learning’ (p < .01). This suggests that some schools are more likely to encourage intrinsic motivation (schools, 10, 20), mastery learning (schools 20, 30), external influences (schools, 10, 20), and use of time (schools 20, 30). School 50 has the lowest mean score for intrinsic motivation, mastery learning, use of time during learning, and is fourth lowest for external influences.

The pattern that emerges is that school 20 encourages a balanced use of intrinsic motivation, mastery learning, with external influences, and the use of time, as multiple goal orientations for success in the EE and ToK achievement outcomes. At the other extreme school 50 is least encouraging of intrinsic motivation, mastery learning and use of time during learning, with external influences playing a smaller role.

While research has examined the influence of classroom on the two general goal orientations (Pintrich & Schrauben, 1992), little has been studied on the influence of
school on motivational beliefs and cognitive engagement. These results are consistent with the work of Dweck & Leggett (1988) where students in mastery environments usually achieve higher outcomes in the classroom.

8.5.1.2 Language

These findings indicate no statistically significant differences exist between Group 1 and Group 4 for the BHTL explanatory variables. This suggests that student motivations for the EE and ToK are similar over both language groupings. A statistically significant difference emerges between Group 1 and Group 3 for the variable use of time during learning. This suggests that Group 3 students are more likely to focus on the use of time in completing their work while thinking beyond the immediate task.

8.5.2 Motivation self – regulation

Intrinsic motivation assumes active engagement with tasks that students find interesting and when assisted by conditions that encourage ‘psychological need satisfaction,’ lead to self-regulated or autonomous motivation behaviours. Student perception of having command of their own destiny leads to greatest motivation when students make choices about how to learn and the direction of that learning perceiving an internal or locus of control over their achievement outcomes.

This study suggests that the ‘Intrinsic valuing of research’ is associated with the ToK outcomes, suggesting that students believe they have some control over their learning across domains. Student choice about how to learn motivates students to put in the necessary effort. This association is not found with the EE, suggesting a lack of autonomy or sense of control (personal agency) with the tasks and activities associated with the EE. A perceived locus of causality is absent.

The explanatory variable amotivation, suggests that student behaviours are neither intrinsically nor extrinsically motivated, but rather, students view the EE and ToK as
serving no purpose. The existence of amotivation suggests students are unable to regulate themselves in terms of the required behaviours to effectively complete the EE and ToK, leading to a lack of self determination. These findings suggest that students recognise that amotivation leads to a fall in achievement outcomes and the more amotivated they are the lower their outcomes. Also to be noted is that external regulation results suggest that behaviours engaged in to obtain external rewards and introjected regulation, where the behaviours have not been assimilated to self and are so not self determined (Deci & Ryan, 2000), all lead to a fall in achievement outcomes. While these patterns clearly emerge, they are not balanced by free student engagement in the EE because of interest and enjoyment. This suggests that the conditions are absent to encourage intrinsic motivation and the possibility arises of the undermining of psychological need satisfaction evident in intrinsic motivation.

These findings suggest that students do not have the intention to question or research and therefore lack motivation or self determination in relation to these tasks. According to Deci & Ryan (2000), students are amotivated if there is an absence of self-efficacy or lack of control in terms of the desired behavioural outcomes, questioning and researching. This result is consistent with the self-efficacy outcomes where no association has been found between SEEE (Table 7.42) and SEToK (Table 7.46) outcomes.

It should be observed that the ToK has statistically significant relationships (p < .05) with identified regulation and intrinsic motivations. This suggests that students have identified with the underlying behaviours required for success in the ToK outcomes. This regulation, due to the self sanctioning of these learning behaviours, correlates with greater commitment to the task and higher levels of performance.

8.5.2.1 School

The results for schools suggests that statistically significant differences emerge between schools for amotivation (p < .001), introjected regulation (p = .05), identified regulation (p < .001) and intrinsic motivation (p < .001). It can also be observed that no clear
pattern emerges in student preferences for self determined behavioural regulation between schools.

8.5.2.2 Language

These findings suggest that differences do exist in self-regulated motivational behaviours between the 2 defined language groups. This result suggests that students whose native tongue is Chinese have a higher intrinsic valuing of research than students whose native language is English. While studies have examined cultural differences in self-regulated motivation behaviours, little has been done to examine motivation self–regulation and academic achievement in the context of understanding and enhancing knowledge from the perspective of the spoken language.

The results of this study lead us to believe that Group 3 students have a higher level of self-regulation than Group 1 and are more intrinsically motivated (p = .001), balanced with a higher level of introjected (p = .02) and identified (p = .02) regulation. Evidence of self imposed sanctions directing behaviours with achievement in the EE is balanced with the student goal of free engagement because of interest and enjoyment. This suggests Group 3 students are more strongly motivated.

8.5.3 Learning self – regulation

The EE achievement outcomes were not predicted by autonomous regulation. This supports the view that students do not view the EE task as an enjoyable and interesting one, and student involvement does not result in a free commitment formed from personal interest. This is consistent with the analysis in this thesis that the EE is a broad task that requires the use of a range of learning skills for successful completion. Student perception of this task suggests it is not viewed as enabling neither the exercising of self control over their learning nor setting limits to self-direction. This observation highlights the point that students require training to improve skills in self regulation strategies. Such strategies would encompass self-reflection on goal setting, the use of learning strategies, self-evaluation, information seeking, motivation, the use
of heuristic methods in problem solving and an understanding of volitional problems that may arise. These volitional problems would include procrastination, concentration and motivational issues. It is suggested that this approach has the potential to improve student self-efficacy. Further, training in the problem creation process in the context of an ill-defined problem is required as well as the ability to set a question or hypothesis and the skills needed to set about answering their question, or solving the problem.

The results for controlled regulation show an association between this explanatory variable and the EE achievement outcomes. This suggests that the context in which the student learns as well as teacher and supervisor comments, influence learner behaviours. It should also be noted that social context plays a role, with the perception of others of the student learning behaviours and the need to achieve highly to be seen as a worthy person, also influences student approaches to the EE.

8.5.3.1 School

These findings suggest a school effect is present with both explanatory variables. It can be observed that schools 10 and 60 have the highest mean scores for both explanatory variables, suggesting that both schools encourage the use of autonomous and controlled regulation. School 50 has the lowest mean score for both variables. The implication for schools is that they can act as purposeful agents in encouraging a balanced use of autonomous and controlled regulation in students. These findings also suggest that schools can encourage the use of appropriate strategies to enhance student choice and control of approaches and methods to meet their learning goals.

8.5.3.2 Language

Of note are these findings which suggest that no significant statistical difference exists between the 2 defined cultural groups for learning self-regulation. Autonomous regulation approaches statistical significance (p = .06) with Group 3 having the higher mean. As argued in Chapter 5.10, language shapes thought (Whorf, 1956) which influences the approaches to learning and the conceptualisation of creativity. In contrast
are these findings that suggest there is little difference in the use of self regulation in the pursuit of achievement between these 2 language groupings. The implication of this is the tentative conclusion that students from both language groupings can be made more aware of the importance of self-regulation strategies and trained in the same way.

8.5.4 Self-efficacy and the EE

The lack of correlation levels between the SEEE questionnaire and EE achievement outcomes are difficult to assess. It would appear reasonable to suggest that students struggle to understand the meaning and application of EE criteria and consequently do not feel confident about the processes related to the EE. This preliminary examination of the influence of self-efficacy in a creative context has focused on problem construction, researching and writing the EE. Bandura (1997) claimed that multiple kinds of self-efficacy are required for performance in a domain. In this investigation the notion and measurement of self-efficacy has been shaped to the idea of creativity within the EE. While self-efficacy requires a belief in one’s capacity to accomplish the creative task, creativity also requires domain expertise and knowledge and a set of skills to ensure the creation of a novel question, the transfer of established concepts and the re-prioritisation of ideas. Complexity in the EE arises through the necessary beliefs about one’s capacity to accomplish the task, student domain knowledge of the topic area the EE is written, and the level of skill for creative processes to occur. No statistically significant correlations (p > .05) exist between the 2 explanatory variables and the EE outcomes (Table 7.40). These data suggest that student capacity to think creatively about the EE, the re-organisation, re-prioritising and transfer of ideas are cognitive strategies which have not influenced the EE achievement outcomes. It is plausible that a student can complete the EE, but perceive themselves as lacking creativity in this task.

This result, as suggested above, also raises questions about the use of criteria on assessment in student learning through the EE. Evidence suggests that deficiencies in the writing of undergraduate essays lie more with the critical analysis of information and development of arguments rather than with the basic skills (Nightingale, 1988;
Taylor & Nightingale, 1990). The use of criteria should convey an explicit statement to students of the implied or stated learning behaviours for each achievement outcome.

Possible reasons for this result may be that:

- different understandings of the meaning of specific learning criteria and its relationship to standards and the level of achievement exist
- the use of taxonomies such as Bloom et al., (1956) to target particular learning skills which do not prescribe the appropriate learning level of use for these skills
- a lack of shared understanding of criteria between staff/supervisors and staff/supervisors and students
- lack of clarity of criteria
- criterion referenced assessment depends on subjective professional judgement where various interpretations by staff and students may exist
- authentic assessment aligns with ill defined problems and is holistic in nature, suggesting a degree of subjectivity when measuring the achievement outcomes to the stated criteria

It is argued that these possible causes impact on the interpretation and use of criteria for supervisors, teachers and students in both the EE and ToK. Effective use of the criteria will validate the quality of student learning.

Criteria in the EE requires ‘effective analysis/interpretation ... with understanding’ (Criteria C); ‘A convincing argument which addresses the research question that is well developed and organised, clearly expressed and lends itself to evaluation’ (Criteria D). The H criterion allows for differences in creativity and acts as a measure of creative qualities such as ‘... personal engagement, initiative, depth of understanding, insight, inventiveness and flair’, as learning outcomes (The EE, 1998). These examples imply the use of particular skills without prescribing the learning level, the possibility of confusion as to the interpretation and meaning of criteria between assessors and supervisors, and supervisors and students; and the clarification of criteria where subjective professional judgement is needed and various interpretations exist.
Comment should be made at this stage that, in addition to student perception of the relative difficulty (Chapter 7.2.1), arguably the EE is the more demanding task in relation to the ToK. Consideration must be given to the EE as a supervised task with a recommended 4 to 6 hours of supervision, while the ToK has a suggested minimum of 100 hours of class tuition. The higher order thinking skills required in the EE are not directly supported as the EE is treated as an independent learning task. The EE requires a conclusion, based on the question, research, and the arguments presented which are critically analysed and evaluated. In comparison, the ToK higher order thinking skills are supported through class tuition, modelling and teaching, up to the point of essay choice and writing. In the ToK students are not judged on a conclusion but rather on the recognition of the knowledge issue(s) (Criterion A), the quality of analysis (Criterion B), breadth and links (Criterion C), structure, clarity and logical coherence (Criterion D), the use of examples (Criterion E) and factual accuracy and reliability (Criterion F). ToK supports, through an understanding and integration of the 6 Diploma subject groups, the higher level skill development.

Self-efficacy is cited as a necessary condition for creativity and the construction of knowledge (Bandura, 1997), influencing the ability to engage in these particular behaviours (Bandura, 1977). It is suggested that students have difficulty in understanding the meaning and application of the EE criteria and consequently do not feel confident about their EE. This view supports the suggestion that supervisors and students need to be more informed about the nature, interpretation, and use of criteria.

8.5.4.1 The influence of school and language on SEEE

The school results (Table 7.41) indicate that a school effect is present, with some schools more likely to foster the creative aspect of self-efficacy in the EE. The explanatory variables, creative aspect of the EE (p = .007) are statistically significant, and the use of ideas is approaching significance (p = .05). While little research exists on the role school may have on creativity, this result is significant as it suggests there is a clear school impact which warrants further research. The effect of language on SEEE would suggest that no influence exists (Table 7.42).
8.5.5 Self-efficacy and the ToK

A similar issue exists for SEToK where it is difficult to assess the lack of association between SEToK and the achievement outcomes for ToK. Critical to a student’s understanding of knowledge are their underlying epistemic beliefs. As argued in Chapter 3, students through the ToK develop a view of knowledge as an outcome of ongoing reasonable inquiry. The different assumptions students make about knowledge lead to students exploring the nature of the problem and available solutions in different ways. The self-efficacy questionnaire, based on the ToK criteria, suggests that students have difficulty in interpreting the criteria, with little association between the SEToK and the ToK achievement outcomes (Table 7.44). This may reflect the evolving epistemological beliefs of students and a disparity with the requirements of the ToK criteria which necessitates a conclusion based on reasonable evidence for both ToK tasks.

As argued in 8.5.4, the development of higher level thinking skills for ToKO and ToKE occurs in the context of ToK class tuition and the subjects learnt. The explanatory variables, an understanding of knowledge ($p = .9$) being creative about knowledge ($p = .3$) and use of argument ($p = .3$) show no significant association with the ToK achievement outcomes. While writing the EE is perceived as a more complex knowledge organisation task, and cognitively demanding when compared to ToK, these results suggest that students in this group have little knowledge of thinking skills and their application to the ToK outcomes. A more likely interpretation is that students do possess, at least to some degree, the required thinking skills, but in the context of the ToK tasks, find difficulty in applying them. The difficulty in applying these thinking skills is due to a lack of clarity in the criteria themselves which do not lend themselves to easy interpretation and application with the ToKO and ToKE.
8.5.5.1 The influence of school and language on SEToK

No statistically significant results (p < .05) exist between schools or cultures for the relationship between self-efficacy and the ToK achievement outcomes. This suggests that schools and culture have little influence on SEToK.

8.6 Language

The IB Diploma model of learning was created in a western humanistic tradition (Peterson, 1987) not only for the attainment of knowledge and acquisition of skills, but also for the development of attitudes and values (Hill, 2007). A key issue for learning is the extent to which different languages influence the range of factors that affect an understanding and enhancement of knowledge and the relevant achievement outcomes. For students with varying language backgrounds, the achievement of learning goals can be an overly complex task, depending on teacher encouragement of student independence and responsibility for their own learning or dependence on the teacher’s knowledge and proficiency.

The findings of this research suggest that while Group 3 students have higher mean scores than Group 1 (p < .05) for the EE, when size effect is considered using Cohen’s d, it can be inferred that this difference is small. It was also argued that Group 3 students completed the EE in the subject of their strength thus enabling the effective use of their established learning skills (Table 7.49). This result is consistent with Bond (1992) who argued that Chinese students, when attending overseas universities, were more likely to choose subjects that utilised existing learning skills rather than selecting subject areas that would challenge and extend these skills. Chan (1999) observed that the Chinese classroom tended to ignore problem solving skills and suggested that Chinese students were more practical when evaluating ideas. It was further argued that the discouragement of critical inquiry and creativity occurred where the exploration of new ideas and alternative directions are needed.
When ToK achievement outcomes are considered, Group 1 students have higher mean scores \((p < .001)\) than Group 3, Cohen’s \(d\) suggests the effect size for each ToK achievement outcome is moderate and positive. This finding is consistent with the views expressed by Chan (1999) where student behaviours conform to society’s expectations of their role. This conformity to societal expectations discourages open discussion until individual relationships within a group have been clearly defined. Until these relationships are well defined, difficulties with discussion groups exist and the prospective learning possibilities associated with group work and questioning are limited (Yau, 1994). This is the antithesis of ToK which relies on questioning and class discussion to enable an understanding of knowledge.

### 8.7 Limitations of the present study

The study is limited by a number of factors. First, over twenty schools offered to participate in allowing students to complete the questionnaires. Of these twelve schools eventually participated, eight drawn from the Southern hemisphere presenting for examinations in the November examination session. Four schools from the Northern hemisphere participated and were May examination schools. Future research would benefit from drawing on more schools from the Northern hemisphere.

With the exception of the questionnaire on student perception of which task was the more demanding, administered when students had completed both the EE and ToK tasks, the questionnaires were distributed to students at the end of year 11, part way through the Diploma programme. The timing of the administration of the questionnaire and student perception of the Diploma programme offers a particular outlook that is influenced by a range of factors that over time can change.

A potentially mediating effect of language on the study sample of participating students who were non native English speakers may exist. While all students were taught in English future research would benefit from examining whether the language groupings result in different learner factors that influence the achievement outcomes.
Nevertheless, the value of these findings are not diminished by the fact they are based on student perception of the cognitive complexity, the participating students coming from two main language groupings. From the standpoint of student understanding and enhancement of knowledge in a constructivist framework, student perceptions of their learning experiences should receive more attention when evaluating their learning.

8.9 Chapter summary

This chapter has examined the comparative difficulties for students presenting for the EE and ToK and the influence that thinking skills and motivations has brought to the learning process. The influence of school and language on the achievement outcomes has also been examined. The interpretation of the results for the comparative difficulty of the EE and ToK indicate that students perceive the EE as more cognitively demanding than the ToK. Students have limited prior experiences in understanding the nature of an academic essay. The teaching of academic creativity through the EE, the development of a novel research question, the transfer of established concepts, the reprioritisation of ideas and creative processes, generate complex knowledge. These results show that students have greater relative difficulty with the cognitive processes associated with the enhancing of knowledge and the thinking and motivations needed for successful completion of the EE relative to the ToK. It is also shown that schools and languages influence the achievement outcomes of the EE and ToK.

In conclusion, relevant subject area knowledge and skills are seen as essential to creative ideas which supports the view that students in this study depend on subject domain knowledge for the enhancement of knowledge as measured through the H criteria.
Chapter 9
Implications for International education

9.1 Overview

A unique feature of the IB Diploma is the ToK and EE and the role they play in developing an explicit awareness of an understanding of knowledge and knowledge enhancement and innovation. This exploratory study examines the extent to which learner variables predict achievement in the EE and ToK.

The Diploma evolved in the 1960’s with specific cultural teaching methodologies and pedagogical expectations which have now spread to other areas of the world where ‘... different economic, political and cultural conditions exist’ (Walker and Dimmock, 2002). This research raises significant questions for international education about the role of language and thinking skills and motivations, in enhancing knowledge through the EE and understanding knowledge through the ToK. It also raises important questions about the role of schools and its impact on achievement in the EE and ToK.

9.2 ‘International education’ defined

There are varied definitions of what constitutes an international education and a lack of consensus on the characteristics of an international school. Further it is difficult to clarify the relationship between an international education and international school (Heyward, 2002). There is a growing consensus for the re conceptualisation of international schools as intercultural with intercultural literacy being the means for structuring the schools and the curriculum, for ‘... effective teaching and learning in a cross cultural or pluralistic setting’ (Heyward, 2002).

The IBO has chosen to define international education (Appendix 9.1) according to 8 criteria. Of relevance to this thesis are the first criteria, ‘developing citizens of the world in relation to culture, language ...’, the fifth criteria, ‘equipping students with the skills to learn and acquire knowledge, individually or collaboratively, and to apply these skills and knowledge accordingly across a broad range of areas’, the seventh criteria, ‘encouraging diversity and
flexibility in teaching methods’ and the eighth criteria, ‘providing appropriate forms of assessment and international benchmarking’ (IBO, 2005-2010a)

Reflecting the origins of the IB, that a student must first relate to their own language and culture, and then ‘... not to include a second language in an international course seemed unacceptable’ (Peterson, 1987, p. 57), signals the importance of intercultural understanding. Of relevance to this thesis is the relationship of the cognitive domain to the curriculum, as reflected in the above criteria. It should be noted strongly that the IBO views an international education as means to an experience that is an inherent part of the curriculum, one of developing both attitudes and values (Hill, 2007, p. 32).

Of relevance here is the embodiment of the notion of individual and cooperative learning, critical reflection, subject area knowledge, thinking and creative thinking skills, motivations, life-long learning, and learning how to learn. Additionally there is diversity in teaching methods and appropriate assessment to measure the learning outcomes.

### 9.3 Learning in an international context

This thesis raises questions about the assumptions made regarding teaching and learning in English for students with differing mother tongue languages in the classroom. It also raises issues about the role of subject knowledge, thinking skills and motivations involved in the learning process. Learning in an international context is shaped by the spoken languages and the school environment, these variables requiring explicit acknowledgement in an international education. Learners, classroom practitioners and school organisations need to be informed. This suggests that an explicit understanding of learning in an international context is required.

International learning must take account of the differences in language and conceptual knowledge, as well as the influences on creative thinking skills, the ability to convert written information to knowledge, approaches to learning, and the role of motivations. These findings suggest that students with different mother tongues think differently with diverse motivations to learn and beliefs about how to learn. These findings also suggest that school level processes influence learning and that clear differences emerge.
Schools provide the context and culture in which students learn and can facilitate or inhibit student learning (Shields, 1991). Schools offering the Diploma range in type from so called national schools to international schools. A national school will offer the prescribed local programme and certificate, may be public or private, and the main student body is relatively homogenous, coming from the same country. An international school will have a culturally diverse body of students with no one culture dominating, be private and independent, and offer an international education programme. Within these 2 broad categories is a multiple of complex variations, affected by the external cultural context that the school exists in (Hill, 2006). As argued by Hill (2006), the distinction between national and international schools is no longer reliable, ‘... the boundaries ... so blurred that the usefulness of these terms has diminished’ (Hill, 2006). However it can be reasonably assumed that a school subscribing to an international education develops values and attitudes associated with the notion of ‘international mindedness’.

As acknowledged by Walker (2004, p. 51), ‘The IBO mission statement, for example, refers to ‘individual talents’, ‘responsible citizenship’, ‘critical thinkers’ and ‘informed participants’, ... objective of international education is to encourage its students to appreciate the diversity of modes of learning, of which the western humanism is one’.

This thesis is a preliminary examination of the relationships between the named learner variables and the cognitive processes that influence these achievement outcomes. These findings suggest both a strong language and school influence is present, and that further research is required to understand the relationship between language and learning. This thesis argues there are differences in student thinking and motivation between the two language groupings, native English speakers and native Chinese speakers. Of note are the clear differences which emerge between the language groupings and thinking skills and the implications of this for the understanding and enhancement of knowledge. This has implications for learning in an international context.
9.4 Language

The IBO recognises the origins of the Diploma are from a western humanist tradition, the assumptions underpinning learning and the associated teaching practices, with the inculcation of humanitarian values (Hill, p. 25; Seefried, M., 2008), promoting through the mission statement, ‘... ‘individual talents’, ‘responsible citizenship’, ‘critical thinkers’ and ‘informed participants’, all key phrases from the handbook of humanist education’ (Walker, 2004, p. 51).

Monique Conn, Academic Director IBO, has explicitly recognised the importance of culture, stating that:

Developing an understanding of culture is critical to promoting and understanding of others and an ability to relate cooperatively to them. This is what each individual programme and sequence of programmes is designed to achieve.

(Conn, 2002, p.6)

Further, she argues for a pedagogical approach that ‘...stimulates curiosity, inquiry, reflection and critical thinking’ (Conn, 2002, p.1), and the encouragement of a ‘... creative, independent approach to inquiry and learning (Conn, 2002, p. 10).

The development of the IB in the context of western thought and culture and the inclusion of other language groupings in the IB community raises the issue as to the extent that learning actions in understanding and enhancing knowledge differ between the various mother tongue speakers. The findings in this thesis suggest different approaches in the use of thinking skills and motivations do exist between the two examined language groupings. As noted in Chapter 5, the process of converting information to knowledge and enhancing knowledge involves generic processes while the language in which students learns provides the means and helps determine what is learnt as well as influencing how and when it is learnt. Through language a learner gains information and knowledge, and the provision of the processes and tools for their thinking, as well as the motivations that underpin these learning tasks. This research raises questions about the extent to which different mother tongue speakers have diverse understandings of knowledge, and the extent to which ToK is constructed from a western cultural perspective.
The notion of academic creativity, as outlined in Chapter 1.7, is the generation of outcomes that would not have been taught or expected to be learnt by students. It can be displayed through the development of a novel research question, the transfer of an established concept, innovative operation or processes, and re-prioritisation of ideas. This research suggests that the measure of creativity used, the H criteria, is robust across subjects (Chapter 7.3.11) while differences emerge between the language variables for creative thinking skills, (Chapter 7.4.7), learning self regulation (7.5.2), motivation self regulation (7.6.2); approaches to learning (7.8.2), literacy (7.9.2), and achievement outcomes for the EE and ToK (7.12).

The Extended Essay also developed in a western educational context and understood as a means for enhancing knowledge, raises the issue as to whether different language groups construct problems or questions in the same or alternative ways and the extent to which these problems or questions are solved differently. Creativity from a western perspective is usually viewed as the production of novel ideas, useful and appropriate to the situation (Amabile, ’1983b; Lubart, 1994). The Chinese conception of creativity suggests a shared core view with a western understanding, but with a greater moral component (Yang & Sternberg, 1997), while aesthetic appreciation is more highly valued in the western view (Rudowicz & Yue, 2000).

9.5 The influence of the mother tongue on learning

While the IBO considers international education has ‘come of age’ (IBO, 1999) one aspect of international education that needs further examination is the influence of the mother tongue language on learning. This research suggests that clear differences emerge between the language groupings and the use of thinking skills and influence on motivation.

Of particular significance are the literacy correlations where clear differences emerge between Groups 1 and Group 3 for all literacy factors (p < .001). These findings suggest that Group 1 students are more able to construct an understanding of knowledge in their mother tongue, English, than are Group 3, native Chinese speakers. Statistically significant differences also emerge for the TTCT with figural abstractness and figural resistance to premature closure (p = .01) with Group 1 having the higher mean when compared to Group 3 (native Chinese speakers). Similar language grouping effects emerge for the TTCT with
Figural abstractness (p < .001) and approaching statistical significance for figural originality (p = .06) and figural resistance to premature closure (p = .07) with Group 1 having the higher means when compared to Group 4 (native Chinese and Indonesian speakers). All verbal explanatory variables are statistical significant (p < .001) with Group 1 having the higher mean. With the Approaches to Learning statistically significant results emerge for surface, deep and achievement motivation (p < .01), Group 1 having the higher mean, while Group 3 emerged with a higher mean for surface strategy (p < .001).

These findings indicate a tension exists between the language groups with the teaching of thinking skills in the Diploma. While the IBO has valued disciplinary knowledge in teaching an understanding of knowledge through the ToK and the enhancement of knowledge through the EE, the significance of ToK as a means of explaining the methodologies and assumptions of domain knowledge as an essential part of learning occurs in the context of the western humanistic tradition (Peterson, 1972). The implication for international education is as the IB continues to expand language issues will gain in significance and if the IB is not to limit the discussion on the meaning and representation of an understanding and enhancement of knowledge, language issues will need to be more explicitly considered.

This research suggests that differences emerge between the language groupings with the use of motivations. These data for learning self regulation suggest that a statistically significant difference emerges between languages (p < .05) for autonomous regulation with Group 3 having the higher mean. For motivation self regulation factors, statistically significant differences emerge for introjected regulation (p = .02), identified regulation (p = .02) and intrinsic motivation (p = .001), with Group 3 having the higher mean for each factor. A language grouping differences emerges in the BHTL questionnaire with the factor ‘use of time during learning’ (p = .03) with Group 3 students having the higher mean. These data for SEEE and SEToK suggest no differences between the two used language groupings exist. These findings suggest that differences in motivations between language groups do exist, but the strength of this difference is unclear from this research. No clear implications arise from these findings.

In comparing the mean scores for extended essay and ToK achievement outcomes along language groupings, (Group 1 and Group 3), statistically significant (p < .05) differences were found to exist for all achievement outcomes. Using Cohen’s d to estimate the size
effect of the sample population it emerges that while the extended essay outcomes have higher means for Group 3, it can be inferred that these differences are small due to the size effect of the sample population. Group 1 has higher levels of achievement in the ToK than Group 3 and, using Cohen’s d, the effect size for each ToK achievement outcome is moderate and positive.

It must be noted that a difference exists between the process, the development of thinking skills and motivations, and the product, the EE and ToK achievement outcomes. These findings suggest that differences arise between these two language groups. To manage these emerging differences in learning, a model for multiple ways of learning to take account of these language differences will need to be developed. This will further, enrich an understanding of the IBO mission statement, which aims ‘... to develop inquiring, knowledgeable and caring young people (IBO, 2005 – 2010b).

9.6 Implications for schools

The implications for schools are less clear. While statistically significant differences occur for all explanatory variables associated with thinking skills and motivations, the emerging patterns are less consistent.

For TTCT, statistically significant differences emerge for Figural elaboration, abstractness and resistance to premature closure and for all verbal explanatory variables (Table 7.18 and 7.19). With the exception of figural elaboration, School 20 has the highest mean score for all explanatory variables, while school 55 has the lowest mean score for all the listed variables. This suggests that School 20 has a culture that encourages these variables while school 55 is least successful in encouraging these aspects of creative thinking.

With the approaches to learning (Table 7.36) School 50 has the highest mean score for surface motivation, and the second lowest mean score for deep motivation. In contrast, School 20 has the second lowest means score for surface motivation, the highest for deep motivation and the highest mean score for the use of deep and achievement strategies and the lowest mean score for the use of surface strategies. School 30 has the lowest mean score for the use of all motivations and deep strategy use and the highest mean score for the use of surface strategies. With the use of literacy skills (Table 7.39), School 10 has the highest
mean score for comprehension and logical relationships with the second highest mean score for vocabulary, while school 90 has the lowest mean score for all literacy explanatory variables.

The extent to which a school may influence motivational behaviour is suggested by the following patterns that emerge. With the BHTL (Table 7.31) the explanatory variables intrinsic and mastery motivations and use of time (p < .05), school 20 has the highest mean score, while for external influences school 20 has the second highest mean score. School 50 has the lowest mean score for all BHTL explanatory variables. With learning self-regulation (Table 7.24) School 60 has the highest mean scores and School 50 the lowest mean score for autonomous and controlled regulation. The results from motivation self-regulation (Table 7.27) indicate that school 50 has the highest mean score for amotivation and intrinsic motivation and the lowest mean score for identified regulation, while School 10 has the lowest mean scores for all motivations with the exception of identified regulation where it has the second lowest mean score. For self-efficacy, a statistically significant difference arose between schools (p = .007) with the explanatory variable ‘Creative aspect of the EE’, for SEEE.

In conclusion, while these observations are limited by the number of schools and the number of questionnaires to which student participants from each school responded, patterns emerge. It is suggested that School 20 is effective in influencing creative thinking skills, encouraging the use of deep motivation and deep strategies (approaches to learning), while encouraging intrinsic and mastery motivations with effective use of time (BHTL). In contrast School 55 would appear to be least successful in encouraging creative thinking among its students. School 50 would also appear to be least successful in encouraging motivation (BHTL) and self-regulation. These findings suggest that schools can implement strategies to be more effective in the encouragement of thinking skills and motivations.

9.7 Chapter summary

The above discussion suggests that an international education must be informed by an explicit understanding of ‘international learning’. The findings of this thesis suggest that the learning context and influence of mother tongue play an important role in influencing the achievement outcomes in the ToK and EE. These results suggest that learning in a cross
cultural context requires multiple ways of learning and must take into account different ways of thinking and motivations. More explicitly, there are alternative international perspectives on how knowledge is understood and enhanced. This further suggests that these learning factors need to be explicitly understood by classroom practitioners, EE supervisors and the school organisation.
Chapter 10

Future directions and conclusions

10.1 Overview

This exploratory study examined the extent to which learner variables, including beliefs about knowledge, predict achievement in the Extended Essay and Theory of Knowledge. The development of an awareness of knowledge and its enhancement are seen as key outcomes of education in contemporary knowledge based societies. The context for this study has been two essential elements in the IB Diploma, the ToK and Extended Essay which have the potential to develop an explicit awareness of an understanding of knowledge, and knowledge enhancement and innovation.

The first aim was to identify and rate student beliefs as to which task was the more cognitively demanding. The second and more important aim of this study was to examine why these relative trends in difficulty occurred as students seek to improve their understanding of knowledge through the ToK, and to research, organise and enhance knowledge through the extended essay. The findings and conclusion of this study lead to key recommendations that are aimed at supporting the extended essay as a means of enhancing knowledge and the ToK as a means of understanding knowledge.

10.2 Future directions

Recommendations are recorded with reference to each hypothesis, some of which are supplemented with suggestions to provide ideas for teachers, professional development and the IBO.
10.2.1 Relative difficulty of the EE and ToK

Hypothesis 1 findings indicate that students perceive the EE as more demanding than the ToK.

At issue is the challenge of creating a learning environment that provides students with an understanding of knowledge and allowing for the teaching of academic creativity through the creating of a question or hypothesis in the context of an ill defined problem. The facilitation of a student understanding of the knowledge structures assist’s in the creation of a solution through researching and writing up of the essay in an academic context. This develops learner expertise in the enhancement of knowledge. The use of effective strategies combined with domain specific knowledge and skills for problem creating and problem solving are required.

As noted in Chapter 7.2, students construct a guiding question, ranking this as the third most demanding task, behind the writing up of the question and the continuous nature and writing up over a period of time. Following the construction of the guiding question, in rank order is the development of a plan of action, the steps to be taken and the collection of relevant information.

The reasons given in Chapter 7.2 suggest students have little prior knowledge of the relevant strategies to effectively employ in the EE. This indicates the EE is a new and unfamiliar task for higher level secondary students’ that requires the integration of heuristic strategies into problem representation and problem solving.

In the EE task a student contends with more non – automated cognitive processes, with greater time required to understand and apply these processes. If a poorly defined question is constructed, the task is less clearly defined, with poorer goals structure, requiring further non – automated cognitive processes.

Students have difficulty in being able to construct a question and an image of what the EE final product should look like, and to then match the required processes to the intention of the original concept or question.
The relevant learning activities are highlighted by the key learning behaviours for students:

- To structure or create a question;
- Develop an awareness of the goal and final outcome;
- Develop a learning pathway;
- Link ideas with and use existing subject knowledge;
- Identify the learning strategies used;
- Monitor their learning;
- Automatise what has been learnt;
- Organise the new learning in terms of the criteria by which the essay is assessed;

It is recommended that students be:

- systematically exposed to research skills. Research skills are understood as:
  - determining the information needed to answer the research question;
  - able to locate the sources containing the information. This requires access skills involving information and communication technologies;
  - selecting appropriate information;
  - critical and evaluative skills that create an awareness of the authority and currency of information sourced from the internet, the values and biases of information, the influence of cultural context;
  - synthesising this information into an appropriate presentation format;
  - acknowledging the sources used in approved referencing and bibliographic style;
- taught to recognise the research need/issue and in so doing trained in problem identification and construction of a clear problem statement;
- taught to formulate sub questions to support the main thesis or question;
- work on questions outside the set curriculum;
- prepared to collect relevant information to answer the questions and sub questions and resolve the main issue or problem;
- instructed on the use and management of time for researching, drafting and refining the topic/question;
- knowledge;
• better informed as to the purpose of the extended essay to answer a question/issue/hypothesis with research based evidence.

It is recommended that an explicit learning approach be taken at workshops to inform teachers/supervisors/coordinators on:

• research methodology;
• the difficulties in problem recognition and construction of a clear problem statement (issue/question), with supporting sub-questions;
• guiding students who work on questions outside their subject domain;
• student use and management of time for researching, drafting and refining the topic/question;
• the advise to be provided in the development of an action plan, and the monitoring and revising of this action plan;
• the importance of encouraging students to reflect, analyse and evaluate the process of converting information to knowledge;
• in providing feedback make written and spoken comments that are positive and supportive.

These recommendations enable students to be better able to engage in ‘personal research’, to formulate a question, to research and communicate their findings in a coherent manner through writing. These recommendations enable the supervisor to more effectively offer support and direction to students, guidance in the skills of undertaking research and support in the construction of a clear problem statement.

It should also be noted that in recommending the above strategies the role of the supervisor continues as per the EE Guide (1998) which includes assistance with:

• defining a suitable topic;
• formulating a precise research question;
• access to appropriate resources (such as people, a library, a laboratory);
• techniques of gathering and analysing information/evidence/data;
• documentation methods of acknowledging sources
• writing an abstract.
The above recommendations supplement and scaffold the role of the supervisor as per the EE Guide (1998) and the EE Guide (2007, p. 8, 9).

10.2.2 Subject area knowledge

Hypothesis 2 Achievement in the EE, but not in the Theory of Knowledge, is predicted by student ability to recall and apply relevant subject area knowledge.

The framework for this thesis is that ToK is understood as a comparatively ‘domain general’ subject while the EE is seen as domain specific. What and how learners know is the basis for student thinking strategies, their capacity to organise and make relationships between ideas, the conversion of information to knowledge and the displaying of this knowledge.

The development of a knowledge base runs in parallel with the construction and writing of the EE. A knowledge base allows for achievement and creativity. Students are developing a declarative and procedural knowledge base through the EE subject domain. Students beginning their EE half way through Year 11 may have limited prior subject knowledge that limits the formulation of a question, the integration of heuristic strategies into problem representation and initial solution in the extended essay process. The argument presented here is that while students may possess a range of ideas, they do not have the developed skills to match these ideas to the construction of a question and the complexity of the final extended essay product. With the gaining of a broader knowledge base and greater depth of understanding in a subject specific area, students should realistically be able to construct and research a manageable question or issue. This understanding will enable supervisors to guide students in question construction and be prepared to modify their ideas and questions. It should also be noted that time is required for the creation and implementation of innovative ideas in problem conception, formulation and solving. This may be an issue for some students.

It is recommended that for the extended essay:

- teacher/supervisors be informed on the importance of subject area knowledge for the enhancing of knowledge and the use and understanding of knowledge in academic creative ways;
• schools establish a set of protocols to guide students in the subject choice and knowledge area in which to write their extended essay.

These findings suggest a knowledge base informs ToK, and it is recommended that:
• teachers be informed about the importance of ToK as a means of integrating subject domain knowledge, research methodological knowledge, its use in understanding of knowledge and the making of informed decisions and judgements about knowledge.

10.2.3 Thinking skills

Hypothesis 3d A balanced use of deep, achieving and surface learning approach beliefs and strategies are associated with achievement in the extended essay and ToK.

Approaches’ to learning encapsulates the notion of intention and strategy and is the relationship between the student and the task (Ramsden, 1988, p. 20, Biggs, 1993), expressing the way a student goes about their learning task. These findings suggest that motivations play no role in achievement in the extended essay and ToK, while the use of achievement and deep strategies are an important influence on all achievement outcomes in the ToK.

The EE and ToK are complex pieces of work designed to give students an understanding of knowledge and the ability to enhance knowledge. It should be acknowledged that in this thesis the same measures for learning, and explanatory variables for the models for thinking and motivations have been used for all language groups, in particular Group 1 and Group 3. As argued, factor analysis for the models of thinking and motivation, should be further investigated to determine whether different explanatory variables emerge that align to different language groupings.

It is argued that differences arise between the language groupings and their conception of learning (Marton et el., 1995) and the use of thinking skills. It is recommended that:
• future studies might seek to further examine whether different Principal Component solutions arise for different languages in the context of the extended essay and ToK using the Learning Process Questionnaire.
Hypothesis 3a The ease of use of creative thinking strategies predict achievement in the extended essay and ToK.

The TTCT is a measure of an individual’s ability to generate ideas in response to figural and verbal stimuli. A student in constructing a question, researching and generating a solution for which there is no learned outcome requires creativity. An essential part of writing the extended essay is the ability to be creative, to draw on this creativity in enhancing knowledge, with the ToK enabling an understanding of knowledge. These results suggest there is one dimension to creativity for the EE, figural abstractness that predicts achievement. It is recommended that:

- The influence of creativity on problem creating and problem solving in the context of the EE is further examined.

As argued in Chapter 8, the role of the school and the potential impact this may have on student creativity has been ignored and worthy of examination. This research suggests students find the task of developing a question or issue for the extended essay as one of the most demanding aspects of their work. The lack of association between the explanatory variables figural fluency and originality, and verbal fluency and originality with the extended essay outcomes, suggests a relationship between the school and student may play a role in fostering student academic creativity. This relationship is worthy of further investigation. It is recommended that:

- the relationship between school and student may play a role in fostering student academic creativity and this relationship should be investigated;
- techniques and strategies for the teaching of academic creativity be explored.

It is also recommended that:

- the role of language in encouraging academic creativity, differences in the conception of creativity and the impact this may have on the assessment criteria be explored.
**Hypothesis 3e**  
Student ability to convert written information to knowledge is associated with extended essay and ToK achievement.

The EE involves various literacy skills, comprehension, logical relationships and vocabulary, but no indication exists for possible recommendations. For ToK, if students wish to achieve more highly, then an improvement in literacy is required.

The significance of this literacy outcome for ToK is the increasing extent of cross disciplinary studies at university requiring the transfer of skills between academic domains or contexts. Changes in the higher education sector enable students to combine subject disciplines from different faculties requiring the development of transferable skills articulated in course outcomes (North, 2005). Of note is the increasing emphasis on essential skills, including communication (Gibbs, 1987; Mayer, 1992; Kearney, 1996; MCEETYA, 2002) which is among the national goals for schooling (MCEETYA, 2002). Of interest is the extent to which the ToK prepares students in developing cross disciplinary written skills for academic writing and the effect student conceptions of knowledge may have on this writing. It is recommended:

- to examine the mediating influence of ToK in developing cross disciplinary academic writing skills in preparing students for university level studies, and the influence student conceptions of knowledge have on this writing.

Little research has been completed on the literacy levels required for the EE and the relationship between writing and the enhancement of knowledge. The EE involves various literacy skills, reading comprehension to extract and construct meaning from a text, logical relationships to recognise connections between concepts and the use of vocabulary. It is suggested that the nature of writing in the EE draws on prior relevant knowledge, that students write to consolidate new information, and writing occurs to extend and reformulate this knowledge. It is recommended that the:

- literacy levels required for successful completion of the EE be examined;
extent to which students from different language groupings may be influenced when drawing on past and relevant knowledge, writing to consolidate new information and writing to extend and reformulate this knowledge be investigated.

For bilingual students, it is recommended that:

- a set of explicit literacy procedures and strategies that EE supervisors and ToK teachers can use to improve reading comprehension, vocabulary and logical relationships for use in researching and writing the EE, and more generally for the ToK.

10.2.4 Motivation

Hypothesis 3c: That a balanced use of intrinsic and extrinsic motivations to learn are associated with achievement in the extended essay and ToK.

These results suggest a balanced use of intrinsic and extrinsic motivations to learn is required. In the context of the EE and ToK the creation of a learning environment by supervisors and teachers that motivates students is recommended. Various instructional strategies associated with setting achievement goals to encourage mastery of a challenging task are required. This would give confidence, enjoyment and an inherent satisfaction of the EE learning task for its own sake.

It is recommended that:

- Students continue to be given choices as to the EE question/issue/hypothesis as to satisfying their interest, enjoyment and the organising of their learning;
- Supervisors provide feedback as to the attainment and progress in achieving the set goals for the EE. The student in setting goals will find this a motivating factor, giving them greater interest in the EE task, but require affirmation and advice as the attainability of these goals;
- Supervisors encourage intrinsic motivation attributions through deeper involvement in the question/issue/hypothesis when searching for a problem solution that encourages a potentially more creative outcome;
• EE supervisors encourage students to see that attribution factors such as effort play a role in achievement success in the EE. Students in seeing this connection are more likely to persist when faced with difficulties;
• That the value of the EE learning task be explained and understood by students;
• EE supervisors raise student expectations about their ability to succeed and meet their learning goals and in so doing increase student self-efficacy;
• Students in being given choice about their EE learning goals and the use of strategies for achieving these goals will encourage self-determination.

These identified variables will create a learning environment will enhance intrinsic and extrinsic motivations to succeed.

Hypothesis 3b, a preference for autonomous or self-determined regulation behaviours for motivation and learning predict achievement in the extended essay and ToK

Motivations self regulation

Strong correlations exist with identified regulation and intrinsic motivation with achievement in ToK. Identified regulation consciously values the ToK tasks with learning behaviours that because of interest and enjoyment gained. No correlations exist with external regulation. It is suggested that ToK is taught in a more contained and manageable classroom environment. Consequently it is easier for students to demonstrate intrinsic and identified regulation.

With the EE, negative correlations exist between amotivation and external regulation and the EE achievement outcome, with no statistically significant relationships emerging for identified regulation and intrinsic motivation. This suggests a low degree of self regulation.

It should be recognised that teachers are not prepared or trained to direct students into self-regulated learning behaviours. Teachers in the classroom environment are directing students through the learning process rather than directing students towards self regulation in motivation and learning (Boekaerts, 1997). The EE task is a broader task with many sub processes, providing a powerful learning environment to develop self regulated motivational and learning skills. It is recommended that:
A learning model is developed to enable students to activate the cognitive skills and behaviours in ill defined problem solving to achieve a successful EE outcome. This learning model should be inclusive of cognitive strategies and the associated motivational self regulation strategies modelled in the context of domain knowledge and account for emerging differences in culture.

Learning self – regulation

The controlled regulation associations with the achievement outcomes suggest these behaviours are supported by social context and learner perception of how their behaviours are recognised. These learner perceptions are dependent on supervisor comments and the belief that a worthy person will achieve a high grade. Controlled regulation requires a balance with autonomous regulation to encourage free student engagement with the EE where increased self-management and self-direction becomes apparent. It is recommended that consideration be given to increasing autonomous regulation through the use of learning strategies that encourage greater control over learning when engaging in the EE task. Further, it is suggested that the use of these learning strategies be further explored as to their use in the context of the EE and the ToK. These learning strategies would include goal setting, planning and organisation, development and managing of the extended essay and ToK tasks through an action plan, information gathering, self-monitoring and revision of the action plan, self-evaluation, seeking assistance and envisaging the final outcome.

It is also recommended that the relationship between student conception of knowledge and learning outcomes in the EE and ToK be examined on the assumption that knowledge beliefs are part of the underlying meta-cognitive processes, and that for some students learning can be challenging because of their epistemological beliefs.

Further, it is recommended that the beliefs about learning and self regulated behaviours for students from various language groupings in the IBD programme be investigated as to the similarities of the suggested learning self strategies above, and the use of learning strategies to achieve successful outcomes in the EE and ToK.
Hypothesis 3f, that the degree of student self efficacy to learn or achieve is associated with achievement in the extended essay and ToK

It is imperative that the learning outcomes, and the nature and use of the criteria for the EE and ToK, are explicitly communicated to students at the commencement of the learning and teaching process for both tasks. Assessment design encourages student learning, and for this students require clarity in the expectations, meaning and interpretation of the relevant criteria. This will affirm student motivation and learning in these two tasks, and increase student confidence in their belief they are able to effectively complete both tasks.

It is recommended that:

- The nature and interpretation of the criteria be explained to students as a first step in the introduction of the EE task to students;

- An explicit learning approach be taken at workshops to inform teacher supervisors on the interpretation and application of the criteria;

- IB coordinators be informed on the importance of collecting sample work and provide opportunity for students to discuss these works according to the set criteria.

As argued in 8.5.3 and 8.5.5 students have difficulty in interpreting and understanding the EE and ToK criteria. The role of criterion referencing in an international context is a description of attainment for an achievement task that enables measurement of that outcome across schools and cultures. The criteria for the EE and ToK are designed to describe levels of achievement in each task that enables teachers and supervisors to guide and assess student learning and ensure clarity in the marking of these tasks. These findings suggest the criteria are complex at the expense of clarity. Criteria need to be accessible to teachers, supervisors and students.

While it might be assumed that explicit criteria is required to eliminate ambiguity, the learning behaviours implied at each level of achievement indicate the performance level of skills required by a student. This suggests a level of uncertainty in the nature of the criteria.
and the interpretation of these criteria requiring a professional judgement as to the acceptable learning achievement outcomes. It is suggested that assessors should be experts in their respective domains or knowledge of interdisciplinary issues. The application of criteria may be applied differently due to the complexity of the criteria reflecting the complexity of the underlying tasks. Teacher and supervisor understanding of the EE and ToK tasks is dependent on an understanding of the skills and constructs required for achievement in these tasks.

It is recommended that:

- The IBO validate the use of criteria for the EE and ToK. In particular the construct validity as a measure of the traits underlying achievement in the EE and ToK

10.2.5 Language

Hypothesis 4: The association between the above learning influences on achievement outcomes is influenced by the student mother tongue

The findings of this thesis suggest a clear language influence on learning. The EE and ToK are complex pieces of work designed to give students an understanding of knowledge and the ability to enhance knowledge. It should be acknowledged that in this thesis the same measures for learning, and explanatory variables for the models for thinking and motivations have been used for all language groups, in particular Group 1 and Group 3. As argued, factor analysis for the models of thinking and motivation, should be further investigated to determine whether different explanatory variables emerge aligned to the different languages. It is hypothesised that for different language groupings alternative factors or explanatory variables for the various cognitive processes will emerge for thinking skills and motivations. It is recommended that:

- Factor analysis along language groupings be investigated to determine whether different explanatory variables emerge for thinking skills and motivations;
- Multiple ways of learning are investigated.

The results in Chapter 7.12, the influence of language on achievement and creativity, suggest statistically significant differences emerge for the ToK. Given that the ToK can be viewed as a means of teaching an understanding of knowledge, these results suggest that students from
language Groups 1 and Group 3 have different conceptions and understandings of knowledge. As argued in Chapter 3.2 and 9.4 that ToK is a Western construct, then it is recommended that it be investigated as to:

- The extent to which an understanding of knowledge in ToK is consistent with an understanding of knowledge in other cultures;

It is also recommended that teachers be informed on developing an awareness and the use of strategies to draw on the learner’s prior understandings, and to develop tasks that will build on this prior knowledge to more effectively allow for new learning in another language.

10.3 Conclusion

Recently, educational researchers have called for the development of an awareness of knowledge and its enhancement as key outcomes for education in contemporary knowledge based societies. The capacity to convert information to knowledge, to change and enhance it (Singer & Lythcott, 2002; Sternberg, 2002), use and display the knowledge in a range of ways (Munro, 2002) is a key component of a knowledge based society. This knowledge based society requires the development of new and complex skills (Murtonen & Lehtinen, 2003). Munro (2002), Lehtinen (2002), Murtinen et. al. (2001), Haggis & Pouget (2002) and Yip & Chung (2005), believe we have little knowledge on how upper secondary students conceptualise the converting of information to knowledge and enhance this knowledge.

The emphasis of this study has been to examine the complex influence of learner factors on the level of achievement in the EE and ToK. The results of this study have important practical implications for research, supervision of extended essays and teacher education programs. While significant relationships have been shown to exist, further developments within the Diploma, and research is required to increase our understanding of how knowledge can be understood and enhanced. It is this understanding of what knowledge is and the ability to create new knowledge from information that enables students to be life - long learners.
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Title:
The influence of learner factors on the level of achievement in the extended essay (EE) and the theory of knowledge (ToK)

Date:
2010

Citation:

Publication Status:
Unpublished

Persistent Link:
http://hdl.handle.net/11343/35815

File Description:
Thesis

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