Teleteaching with ‘telekikan-shido’: An exploration of how online synchronous supervision of student problem-solving mimics face-to-face pedagogy

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Abstract

Irrespective of the methods used for its delivery, interactions or conversations with an instructor should always be the core of education. This study investigated the feasibility of applying currently evolving communication technologies to facilitate the online mimicking of the student-teacher interactions that have been identified as occurring during the face-to-face supervision of experiential learning, such as laboratory experimentations and/or problem-solving tutorial activities. Students, while performing these learning tasks in face-to-face venues, are supervised by an academic moving through the room observing and then assisting those student(s) who may require some help. Studies, conducted by others in year-eight classrooms, have identified this form of instruction as kikan-shido that, in practice, is often augmented with over-the-shoulder teaching/learning pedagogy. The empirical exploration of student-teacher communication over a local-area network was performed with a commercially available ‘collaborative teaching’ software, that was installed onto the desktop computers within a computer laboratory. This enabled an academic to supervise synchronously online, with a teaching approach that could be described as ‘telekikan-shido’, students who were performing computer-screen-based problem-solving activities. Analyses of the data collected during this trial showed that: (i) software utilities that support network-based audio communication and remote computer-desktop control enable the online mimicking of pedagogy that can be identified during face-to-face supervision of experiential learning; and (ii) post-trial feedback of participants’ perception indicated a reduction in transactional distance and an improvement in transactional presence and telepresence for students while being supervised in real-time over a local-area network. The findings of this research facilitate the implementation of wide-area network-based education platforms that will enable the real-time online supervision of experiential learning. The importance of such applications for distance educators has been articulated by those educationalists who have identified the successful delivery of laboratory content within their science-based curricula as one of the distance education providers’ greatest challenges.
Declaration

This is to certify that

i. the thesis comprises only my original work towards the PhD except where indicated in the Preface,

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.

.................................................................

George Peter Banky

Ethics Approval

This research was approved by the following Ethics clearance:

- University of Melbourne HREC No: 0712820 FHEAG ID: 54/07 28/06/07
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The motivation for this research has been the cross-pollination, over the past 40 years, between my professional practice of digital electronics engineering and tertiary teaching of technical subject matter.

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Chapter 1 - Introduction

The developer of an e-learning system faces several challenges in designing an online laboratory learning environment that ensures strong, effective, accessible, and secure student interaction that best replaces the face-to-face interaction that takes place in on-site laboratories.

(Sivakumar, Robertson, Artimy, & Aslam, 2005: 586)

1.1: Rationale for this study

The teacher-student interaction is the most reliable indicator of the quality of all resultant learning outcomes for online education (Fredericksen, Pickett, Shea, Pelz, & Swan, 2000; Owens, Hardcastle, & Richardson, 2009). It has been argued that irrespective of the methods used for its delivery, the interaction with an instructor should always be the core of education (Feenberg, 1999; Roberts, 2005). Conversely, totally student-centred or student-led online learning, where there is little or no on-going academic supervision of the learner, has been equated with the “dereliction of duty” (Laurillard, 2002: 192) by the education provider. Laurillard (2002) recalls that such approaches were never considered beneficial when only brick-and-mortar libraries and/or laboratories existed, prompting her to ask: “Why should they [the academics] be able to do it with an electronic one?” (Laurillard, 2002: 192).

This study investigates the feasibility of applying some currently evolving communication technologies to enable the online mimicking of the student-teacher interactions that have been identified as occurring during face-to-face supervision of experiential learning, such as laboratory experimentations and/or problem-solving tutorial activities. These pedagogies have been acknowledged as
the integral foundations for all science- and mathematics-based, on-campus, face-to-face education (Babich, et al., 2007; S. A. Brown & Lahoud, 2005; Feisel & Rosa, 2005; Herrington & Nakhleh, 2003; Nickerson, Corter, Esche, & Chassapis, 2007; Scanlon, Cilwell, Cooper, & Di Paolo, 2004; Scanlon, Morris, Di Paolo, & Cooper, 2002; Steidley & Bahnak, 2005; Swamy, Kuljaca, & Lewis, 2002). In practice, teaching in this way is much more teacher-centred than is believed by some experts in the teaching profession (Brusilovsky & Miller, 2001) - especially in the early stages of a course (Horton, 2000). As will be argued, the findings of this research facilitate the implementation of wide-area network-based education platforms that will enable the real-time online supervision of experiential learning. The importance of such applications for distance educators has been articulated by those educationalists who have identified the successful delivery of laboratory content within their science-based curricula as one of the distance education providers’ greatest challenges (Arbaugh & Benbunan-Fich, 2005; Sivakumar, et al., 2005). Additionally, since experiential learning pedagogy has also been progressively incorporated into the teaching of non-scientific subjects, there is an ever-widening pool of academics who potentially could have some interest in this investigation’s outcomes.

As confirmed by this study, students, while performing on-campus laboratory activities and/or problem-solving tutorial exercises, are supervised by an academic moving through the venue observing and then assisting those student(s) who may require some help (Böhne, Faltin, & Wagner, 2004a; Jonassen, Howland, Moore, & Marra, 2003). This form of instruction was widely observed in data collected by the various *Trends in International Mathematics and Science Study* (TIMSS) video recordings taken in secondary school classes around the world (Gonzales, et al., 2000) and subsequently described as kikan-shido (Clarke, 2004). Kikan-shido is a Japanese term that:

> means ‘between desks instruction’ where the teacher walks around the classroom, predominantly monitoring or guiding student activity, and may or may not speak or otherwise interact with the students. (O'Keefe, Xu, & Clarke, 2006: 76)
The study concluded with an empirical exploration of student-teacher interactions over a local-area network while employing a commercially available ‘collaborative teaching’ software, *NetSupport School* (NetSupport Inc., Peterborough, UK), that was installed onto all the desktop computers within a computer laboratory. This software enabled an academic to supervise online, students who were in this laboratory performing computer-screen-based problem-solving activities with a pedagogy that could be described as ‘telekikan-shido’.

Analysis of the resultant data indicated that during the online supervised experiential learning sessions, a number of mimicked face-to-face pedagogies were identifiable. The virtual co-location that resulted from the levels of real-time interactivity and collaboration reduced the participants’ feelings of isolation. Teaching/learning environments where this occurs have been found by other researchers to result in the desired effect of helping students engage in deep approaches to learning (Alavi & Dufner, 2005) hence enabling highly sought-after student academic outcomes and “success in life long learning” (Böhne, et al., 2004a: 317).

**1.2: Background for this study**

The current options for facilitating experimental learning for off-campus students are highlighted by the delivery choices available for laboratory activities that require the learners to:

(i) physically attend designated brick-and-mortar venues where the experimentation, with face-to-face supervision, is compacted into a weekend or at most, a week-long, dedicated programme (Casanova, Civelli, Kimbrough, Heath, & Reeves, 2006; Cooper, Scanlon, & Freake, 2000; de Moraes, Paz, Matuzawa, & Fiuza, 2003; Feisel & Rosa, 2005; Hiltz & Goldman, 2005; Scanlon, et al., 2002; Wong, Ferguson, Florence, Bantwal, & Jones, 1999); and/or

(ii) carry out, on their own at home, typically simple experiments using commercially available materials (Feisel & Rosa, 2005; Hiltz & Goldman, 2005; Scanlon, et al., 2002); and/or
(iii) access and conduct experiments online in either a remote or a virtual laboratory without any real-time (synchronous) supervision (Lindsay, Naidu, & Good, 2007; Scanlon, et al., 2004; Wong, et al., 1999).

Traditionally, off-campus learners have been disadvantaged while participating in these modes of education delivery (S. A. Brown & Lahoud, 2005). The requirement for these students to attend a venue for a fixed period of time, as in option (i), may cause various levels of inconvenience to the students as well as excessive logistic and/or financial burden for the academic institution(s). The lack of real-time supervision, in options (ii) and (iii), can alter the student experience in ways that may result in a “pedagogically different learning experience, and they must be acknowledged as such” (Lindsay, et al., 2007: 772). According to Coates (2006) there is a need for instructor presence even if the online learning is complementary and parallel to on-campus education; and “the key issue for ensuring the presence of the instructor is communication” (B. G. Wilson & Christopher, 2008: 62)

Ramsden (2003) concurs in his observation that asking the students to just ‘do things’ without supervision will most likely result in their inability to understand the underlying process(es) and/or to make the ultimate connection between practice and theoretical knowledge. In such learning environments, where effective instruction is different from that in a classroom, it is the supervising academics’ responsibility to ensure that students (Herrington & Nakhleh, 2003):

- experience more engagement with content,
- participate in more one-to-one communication,
- receive more scaffolding to help them with the explanation of the observed data, and
- be afforded more monitoring of their progress.

Of course, the exact detail of what ultimately occurs in any classroom must depend on the content and the context of that session. The bi-directional nature of teaching/learning is highlighted by both Ramsden (1992) and Laurillard (1993),
who describe teaching as ‘a sort of conversation’, thus clearly identifying on-going participant interaction as the ingredient for the effective instruction of learners, including those who are engaged in distance education (Anderson, 2004).

Distance or off-campus learning, has its foundation in the correspondence education courses that were developed in the United States, France, Germany, and the United Kingdom during the mid 19th century (M. G. Moore & Kearsley, 1996). In Australia, both its geography and the population distribution necessitated the establishment of Correspondence Schools\(^1\) for the education of isolated children. The heavy reliance on print media and the postal system (Owston, 1997) meant that months could elapse before these children received feedback from their teachers, who usually lived in the capital cities of their respective States.

The ‘distance education’ community has always embraced new technologies in order to reach wider audiences and to teach more effectively. In 1925, radio, and then in the 1940s, educational television, added capabilities that enabled the broadcast of live presentations to distant learners (Horton, 2000). In 1951, the world’s first School of the Air was established using the existing shortwave radio network, which was owned and maintained by the Royal Flying Doctor Service of Australia. This technology allowed two-way audio communication with children who were living in the Australian outback. In 1969, Stanford University, using time-sharing computer networks, began delivering mathematics education to low-income students who resided in various parts of the United States (Harasim, Hiltz, Teles, & Turoff, 1995). In the 1980s, teleconferencing\(^2\) over the public telephone network allowed teachers and learners, who were isolated from each other, to talk with each other in real time. In the 1990s, satellite television networks\(^3\) facilitated visual interaction between remotely located pupils and instructors. Internet-based

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1 The ‘Correspondence Model’ is teacher-directed and is an attempt to reproduce classroom teaching with printed material (J. C. Taylor, 1992).
2 Often used to supplement print, audio and video tapes in what was described as the ‘Multimedia Model’ (J. C. Taylor, 1992).
3 The ‘Telelearning Model’ is a return to the teacher-directed model of learning by applying the emerging information and telecommunication technologies (J. C. Taylor, 1992).
teaching is the latest example where technology is being leveraged in an attempt to advance the quality of distance and other off-campus learning (Horton, 2000).

Gilbert (2001) summed up the situation when he declared that:

> the inherited fabric of higher education is under strain around the world. Increasingly pervasive information and communications technologies are enabling people to think differently about the ways in which higher learning is conceptualised, designed, developed and delivered. In particular, the digital revolution is both creating and servicing a demand for virtual learning environments and novel pedagogies that promise to transform both teaching and learning.  

(Gilbert, 2001: 1)

In other words, the application of existing communication technologies already facilitate the delivery of online education over a local-area network of computers and/or a wide-area network, such as the Internet, to students who over time have been described as pursuing ‘distance’, ‘off-campus’ and even ‘on-campus’ education. However, the indiscriminate use of technologies has its own pitfalls. This was clearly articulated in a British Open University publication that recommended the substitution of online learning for traditional lectures only in the early years of a course, because of the then existing inherent technical limitations of real-time interactivity (Toohey, 1999). The report also advocated that in the later stages of a course, conventional tutorials and small classes and/or practical and laboratory sessions should continue to form a significant component of the tuition. This was an attempt to ensure that students worked closely with other students and/or their teachers, thus getting them the “best opportunity to deepen their understanding and make the material their own” (Toohey, 1999: 164).

From a purely pedagogical perspective:

> the traditional model of an instructor and students present in the same time and space, provides the best quality of education because of the almost unbounded modes of communication and interactivity made possible by [their] physical presence.  

(Latchman, Salzmann, Gillet, & Bouzekri, 1999: 247)

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4 Primarily student-paced and has been described as the ‘Flexible Learning Model’ when used to access an ever increasing range of teaching/learning resources (J. C. Taylor, 1992).
This sentiment has been clearly echoed by other researchers who have continued to argue that classroom-like interaction must be emulated for pedagogically sound results in non-face-to-face learning contexts (B. W. Brown & Liedholm, 2002; Dumont, 1996; Feenberg, 1999; Fredericksen, et al., 2000; Horton, 2000; Hughes & Hewson, 1998; Palloff & Pratt, 1999; J. C. Richardson & Swan, 2003; Swan & Shea, 2005; Toohey, 1999); particularly in the higher education sector (Crook, 2005; Toohey, 1999). Recent implementations using the latest available online technologies have resulted in more realistic participant communication, but there still appears to be a difficulty in successfully recreating those aspects of the on-campus face-to-face delivery that are so crucial for the real-time supervision of laboratory and tutorial problem-solving activities (Hiltz & Goldman, 2005).

While observing the various sessions of supervised experiential learning for this study, over-the-shoulder teaching/learning was consistently identified as a constituent in the practice of kikan-shido. One description for over-the-shoulder teaching/learning simply depicts it as ‘teaching by example’ that for a long time has been and still is successfully used, in industry, for on-the-job training (J. S. Olson, Covi, Rocco, Miller, & Allie, 1998; Twidale, 1999). Since it is basically a form of one-to-one tutoring (Twidale, 1999) that inherently facilitates interaction and collaboration (Gibbs, 1992; Palloff & Pratt, 2005), it is a pedagogy that has been linked to deep approaches to learning by the student(s) (Biggs, 1999; Laurillard, 2002). The vital importance of this outcome is highlighted by Marton and Säljö (1984: 46) in their conclusion that the “deep/holistic approach is the best, indeed the only, way to understand [sic] learning materials”. Biggs (1999), Toohey (1999) and Ramsden (2003) have even argued that the definition of good teaching is to engage students in ways that will facilitate deep approaches to learning.

A major disadvantage of entirely online education delivery is the strong sense of total isolation felt by some students who, upon finding difficulty with the
presented material, tended to settle for ‘surface’⁵ rather than ‘deep’⁶ approaches to learning (Toohey, 1999). In general, the need for student support has “even more importance in distance learning and in flexible education because of the need to compensate for the students’ remoteness” (Gillett, Crisalle, & Latchman, 2002: 68). The usual trade-off between flexible online access to laboratory experiments and real-time assistance has been identified as having a significant negative effect on the learning experience, further supporting the argument that the presence of an expert mentor is particularly critical while the student(s) is(are) participating in highly desirable hands-on activities (Lindsay & Good, 2005). The importance of the type of available help is further illustrated by the fact that the absence of real-time supervision for students has been shown (i) to produce unmotivated learners, (ii) to be a highly likely catalyst for the abandonment of their studies (Böhne, Rütters, & Wagner, 2004b), and/or (iii) provoke highly damming student feedback (Lindsay & Good, 2007) – all extremely undesirable consequences.

That said, the currently available forms of online education have potentially enriched the learning experiences of many. In particular:

for developed nations, online learning was claimed to provide the answer to dealing with the growth of post-secondary education, in terms of better pedagogy and the prospect of reduced costs. It was also thought to offer increased flexibility in meeting the needs of students for learning, independent of time, place or circumstances, and to be a solution for the increasing demand for lifelong learning. ... For developing nations, online learning was to provide learning to improve basic literacy, numeracy and skills acquisition, lessening the need for expensive bricks-and-mortar infrastructure.

(Bell, Bush, Nicholson, O'Brien, & Tran, 2002: 1)

In fact, throughout its evolution the two most consistently cited shortcomings for off-campus education delivery have been:

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⁵ “Surface learning processing … [is] primary absorption of new information and understanding it at a simple level, does not change the student’s engraved thinking processes.” (Offir, Lev, & Bezalel, 2008: 1172)

⁶ “Deep learning processing … is a process that takes place when students translate new information into engraved concepts and relate it to their life experience. Existing thinking schemes change during this process and the learned material is assimilated within the student’s perceptions web.” (Offir, et al., 2008: 1172)
• limited support for real-time collaboration between participants (Berge, 2000; Hughes & Hewson, 1998; Lindsay & Good, 2005; Marques & Hsu, 1999; Regalbuto, 1999), and
• the varying levels of isolation perceived by the participants (Palloff & Pratt, 2005; Rovai, 2002c; Thurmond, Wambach, Connors, & Frey, 2002; Williams, 2007).

The increased demand for distance education has prompted many institutions to investigate new delivery methods that could minimise the above-mentioned limitations and consequently result in deep approaches to learning by off-campus students (Steidley & Bachnak, 2005). Both the recent growth of the so-called ‘digital economy’ and the rapid developments in communication technologies, particularly those associated with the Internet, have “been accompanied worldwide by the promise of improved education and training through the development of online learning” (Bell, et al., 2002: 1). From a Government perspective, the resultant flexible delivery is seen as providing educational opportunities without the need for additional infrastructure investment for campus-based amenities (Toohey, 1999). Fuelling this are predictions such as, by 2010 there will be over:

100 million people in the world, all fully qualified to proceed from secondary to tertiary education, for whom there will be no room on any campus anywhere. (Gilbert, 2001: 2)

Additionally, the significant increases in income that are generated by this type of course delivery have become a crucial financial lifeline for some Australian academic institutions; and in the current economic climate, should continue for the foreseeable future. Figures released in 2005 showed that student enrolments for online education have increased by more than 25 per cent at Australia’s Open Universities, which is a collective of seven tertiary institutions set up in 1993 for the sole purpose of offering the flexible delivery of post-secondary education (Beauchamp, 2005). In the United States of America, a nationwide survey of colleges and universities found that in September 2007, about 3.94 million students were enrolled in at least one online subject (Allen & Seaman, 2008).
Annual enrolments have been increasing at an average of almost 20% for the past 6 years, resulting in more than 20 to 25% of all tertiary students in that country undertaking at least one subject offered through distance education (Mayadas, Bourne, & Bacsich, 2009).

The necessary features of an Internet-based software platform that facilitates real-time online supervision may be deduced from observing the participant interactions during face-to-face experiential learning that is supervised by kikan-shido with the pedagogically appropriate application of over-the-shoulder teaching/learning. In essence, such a platform must enable the remote viewing of each student’s activities and, if necessary, the demonstration with real-time communication of any recommended next step(s) for reaching the desired solution (Böhne, et al., 2004b). In technical terms, for the supervision of students who are engaged in computer desktop-based activities, as a minimum the system should support:

- ‘remote monitoring of multiple desktops’ that facilitates a form of telekikan-shido where the supervisor is ‘cyber walking’ between the students’ computer desktops;
- bidirectional audio communication between participants even though it has an obvious shortfall with its inability to inherently transmit the often critical non-verbal cues that are part of all face-to-face interactions, such as “facial expressions, direction of gaze, posture, dress and [interpersonal] physical distance” (Short, Williams, & Christie, 1976: 44); and
- ‘remote desktop control’ that effectively connects two personal computers in a way that any application software running on one computer is controllable with the keyboard and mouse of the other computer.

These three features are present in the software that was chosen for the trial conducted for this study. Subsequent analyses of the collected data established that:

- students while engaged in experiential learning, such as ‘learning-by-doing’ or ‘problem-solving’, in tertiary institutions (typically performed in
laboratory classes and/or tutorials) were supervised by context-dependent kikan-shido in conjunction with appropriate over-the-shoulder teaching/learning pedagogy;

- software utilities that support network-based audio communication and remote computer desktop control enable the online mimicking of some face-to-face pedagogy;
- post-event feedback of participant perception indicated a reduction in transactional distance and an improvement in transactional presence and telepresence for students who were engaged in some computer-based learning-by-doing while being supervised in real-time over a local-area network.

It will also be argued in this thesis that the findings of this research should motivate others to further investigate the development and deployment of Internet-based platforms that directly support the practice of real-time over-the-shoulder teaching/learning pedagogy for the online supervision of all forms of computer-screen-based teaching/learning. The technical capabilities of both desktop-sharing and bidirectional audio communication inherently facilitate various levels of teacher-student collaborations and interactions, or telekikan-shido that could be described as an online adaptation of kikan-shido with over-the-shoulder teaching/learning, thus mimicking some of the pedagogy practiced during face-to-face supervised laboratory and problem-solving tutorial sessions.

Independent of any educational context, students tend to learn in many different ways (Kolb, 1976; Oblinger & Oblinger, 2005), so it is imperative that teachers, at all times, try different teaching techniques in an attempt to match their students’ learning styles. Incompatible styles usually result in poor student performance, academic frustration and the ultimate loss to society of possible graduates (Felder & Silverman, 1988). The findings of this research will add to the repertoire of online teaching options. This has the potential to enhance quality educational outcomes (Britain, 2004; Hughes & Hewson, 1998), particularly for online-delivered distance education (Newlin & Wang, 2002).
1.3: The structure of this study

As stated earlier, other researchers have established that kikan-shido is the ‘pedagogy of choice’ employed for the supervision of students who are engaged in problem-solving exercises in mathematics classes in secondary schools (Clarke, 2004), and similarly, over-the-shoulder learning/teaching in industry for training and technical support (Twidale, 1999). As seen in Figure 1.1, ‘Phase One’ of this study commenced with the observation of a number of face-to-face laboratory and tutorial classes in order to gain a better understanding of the teaching styles applied during the supervision of such learning sessions in tertiary institutions. Each one of these lessons was recorded and then analysed for any identifiable presence of both kikan-shido and over-the-shoulder teaching/learning elements.

![Figure 1.1: Research framework for ‘Phase One’.

Then, for the duration of one academic semester, the students of two tutorial groups, who were engaged in computer-screen-based experiential learning, were
supervised by the researcher either face-to-face or online over a local-area network. All these sessions were recorded and the collected data was subsequently analysed for the presence of both kikan-shido and over-the-shoulder teaching/learning elements, in particular to see if any element was identifiable as having been mimicked online. Post-trial surveys afforded another perspective on both the ‘academic-student interactions’ and the ‘student activities’ as perceived by the participating students while experiencing the two modes of supervision. Finally, transcripts of focus groups provided further feedback on the students’ perceptions of the completed research exercise.

As indicated in Figure 1.2, in ‘Phase Two’ of this study the students’ perceptions of the online interaction were investigated using some established online communication metrics, such as telepresence (Shin, 2003), social presence (Wheeler, 2005) and transactional distance (M. G. Moore, 1993).
For all components of this research, the selection of the supervising academic and the student participants was pseudo-random. Where applicable, the processing of the collected data utilised a three-layered interpretive model\(^7\) for media-rich research into social interaction, attributed to Wortham and Derry (2006), which ensured a traceable path from the analysed data, through any intervening depiction(s), back to the recorded data. One of the benefits of the technique is an implied link between the various data forms and the raw data. Additionally, this procedure allowed the researcher and/or any other expert(s) and/or interested parties to repeatedly review the behaviour of an academic or a group of students, in order to code or recode it anytime (Fraenkel & Wallen, 2006). Following the transcription of each session recording, and by adopting the recommendations of Miles and Huberman (1994), at least the first few pages of each transcription were independently coded on at least two occasions several days apart in order to ensure internal code-recode reliability, which was found to be above 95\% in all cases.

It has to be acknowledged that while both recordings and any observer’s recollections of events can only manage to capture certain aspects of what occurred, such recordings, unlike recollections, are permanently and reliably available for later analysis and scrutiny (Polgar & Thomas, 1995).

1.4: The research questions

The key research questions examined in this study were:

**Q1:** Which kikan-shido activities and over-the-shoulder teaching/learning pedagogies were observable in face-to-face supervised laboratory experimentation?

**Q2:** Which kikan-shido activities and over-the-shoulder teaching/learning pedagogies were observable in face-to-face supervised problem-solving tutorial classes?

\(^7\) “The first interpretive layer of our model is the ‘raw data’ layer, which most often takes the form of digital video recordings of social interaction, … the end-product of [the second] layer is a document that re-renders what we as observers ‘see’ in a selected segment of raw data, … [the third] layer is where analytic (if probabilistically hedged) statements are made regarding what has happened in the event stream”. (Wortham & Derry, 2006:846 - 849)
Q3: Which kikan-shido activities and over-the-shoulder teaching/learning pedagogies were observable in face-to-face and online-supervised, computer-screen-based, problem-solving tutorial sessions?

Q3.1: How successful was the online student supervision of active learning?

Q3.1.1: What were the participants’ perceptions of being there (telepresence)?

Q3.1.2: What were the participants’ perceptions of being separated from the others (transactional distance)?

Q3.1.3: What were the participants’ perceptions of other participants’ availability (transactional presence)?

1.5: The thesis structure

The structure of this thesis and the relationship between its chapters are shown in Figure 1.3. The core of the research was a field trial that was constructed on a foundation comprising the relevant aspects of three much wider concepts, namely pedagogy, technology and practice. Following the discussions of the trial results, in order to further utilise the outcomes, recommendations for future directions for the implementation of Internet-based education platforms to enable the real-time online supervision of experiential learning are overviewed.

In Chapter 2 some of the relevant pedagogy is reviewed. This is the appropriate starting point, since pedagogy rather than technology should always be the driver of any proposals for the improvements to educational quality (Bernard, et al., 2004; Dumont, 1996; Holmes, 1999; Laurillard, 2009; Ramsden, 2003). In this chapter ‘surface and deep approaches to learning’, ‘face-to-face delivery’, ‘collaborative learning’, ‘experiential learning’, kikan-shido and ‘over-the-shoulder teaching/learning’ are discussed. The first four topics set the groundwork for the research by highlighting a number of established teaching/learning styles, while the last two topics, as will be seen in the later chapters are vitally relevant to the analyses of the collected data.
As stated already, new technology should never be the catalyst for educational innovation. However, it ultimately does become the limiting factor in any implementation. In Chapter 3 the applications of computer technology to the delivery of distance or off-campus education are overviewed. An early example - the ‘virtual classroom’ - is detailed and is used as a vehicle to introduce, within an educational context, both ‘synchronous’ and ‘asynchronous’ communication. With the ubiquitous accessibility of wide-area networks, a number of ‘computer mediated communication’ systems, including the ‘asynchronous learning network’ and some other Internet-based distance education platforms are discussed.

Chapter 4 documents the observed pedagogy practiced in face-to-face experiential learning, such as laboratory experimentations and problem-solving tutorial sessions, in on-campus venues at a tertiary institution. For comparison, the pedagogy of asynchronously supervised online learning is also deduced from the analysis of interviews with academics involved in devising and/or delivering
the curricula. Finally, the collected data are used to pinpoint the pedagogy that is practiced during face-to-face and online supervised problem-solving tutorials. The resultant framework consisted of the already identified kikan-shido activities (Clarke, 2004) and elements of over-the-shoulder teaching/learning pedagogy.

Chapter 5 details a trial that involved the researcher supervising, either face-to-face or online over a local-area network, a number of tutorial sessions where students were participating in experiential learning. The data were collected from session recordings, the supervisor’s post-event reflective journal, and post-trial surveys and focus groups with the participating students.

In Chapter 6 the data collected during the trial described in Chapter 5 are analysed for the presence of both kikan-shido and over-the-shoulder teaching/learning pedagogy. In the subsequent discussion of the results the face-to-face and the online supervised sessions are compared for indications on the success of mimicking elements of the former during the latter. Additionally, post-trial feedback of participants’ perceptions are analysed for any effect on transactional distance, transactional presence and telepresence while being supervised in real-time over a local-area network.

Chapter 7 examines the potential of extending the findings of Chapter 6 to facilitate synchronous online supervision of off-campus experiential learning via a wide-area network such as the Internet. Of particular interest are those students who are performing remote laboratory experimentation with either simulated equipment or physical equipment that has been modified to have a computer interface. In conclusion, a distance education platform that is an application of commercially available communication software to facilitate participant supervision with telekikan-shido is offered in order to assist decision makers in tertiary institutions.
Chapter 2 - Learning and teaching concepts

*I hear and I forget. I see and I remember. I do and I understand.*
- ancient Chinese proverb (as cited in Centra, 1993: 24)

2.1: Overview

Common educational views of learning have been represented as falling into two categories (Benbunan-Fich, Hiltz, & Harasim, 2005). The first is the ‘constructivist theory’ that entails the discovery, construction, practice and validation of knowledge by each learner, particularly in science education (Driver, Asoko, Leach, Mortimer, & Scott, 1994; Matthews, 2000). The other is known as the ‘objectivist model’ where the goal is to identify a single objective reality, called knowledge, exclusively through the senses. In practice there are a variety of learning approaches and pedagogies, which include:

- traditional instruction, demonstration with running commentary, apprenticeship, creation and use of microworlds, practice sessions, legitimate peripheral participation, use of external representations, competition, scaffolding, handicapping, grandstanding, vicarious learning, help suggestions called out in real time, story-telling away from actual use, and post action reflection and discussion. (Twidale, Wang, & Hinn, 2005: 690)

One common method of implementing constructivist learning is the use of collaboration or group learning that is, the use of learning networks. Toohey (1999), with help from his colleagues, developed a simple model of the learning process. The resultant five stages and their relationship to each other are shown in *Figure 2.1*. Both in the ‘trying out’ stage, where students frequently identify the gaps in their knowledge, and in the ‘reflect and adjust’ stage, where students consider the feedback they have received in order to decide how to adapt their
understanding. In this model students need interaction with teachers and other students (Sherin, 2007). In fact, the collaborative active involvement of both learner and academic staff assists students to attain the very desirable intellectual skills of application, evaluation, analysis and synthesis (Centra, 1993).

![Figure 2.1: A simple model of the learning process (Toohey, 1999: 154).](image)

In this chapter the topics of surface and deep approaches to learning are reviewed. Past research has identified experiential learning as an activity during which students have the opportunity to achieve the highly preferable deep approaches to learning (Alavi & Dufner, 2005; Banky & Wong, 2003, 2007; Larreamendy-Joerns & Leinhardt, 2006) and “typically involves significant amounts of self-directed learning on the part of the students” (Prince, 2004: 223). While performing such activities, students are traditionally supervised by the academic walking amongst them and observing their activities, then stopping to probe and/or help whenever that is needed. This form of pedagogy has been branded as ‘kikan-shido’ with over-the-shoulder teaching/learning a frequently identifiable component in its practice.
2.2: Surface and deep approaches to learning

Biggs (1999) described a student’s approach to learning as either ‘surface’ or ‘deep’. He found that low levels of student engagement result in surface approaches to learning and often meaningless outcomes. In contrast, high levels of engagement result in deep approaches to learning and outcomes with construed meanings. In summary, “high-quality learning requires a deep approach” (Clow, 1998: 22). The hundreds of studies that were carried out in Europe and Australia furthermore confirmed that:

students who take a deep approach retain knowledge longer, have better understanding, produce logical and coherent work, and can make more connections between different topics.

(Toohey, 1999: 11)

Ramsden (2003) identified the ‘deep approach’ as a highly satisfying form of studying as well as the quintessence of the style of learning that is expected from tertiary students. He concluded that the graduate attributes that need to be developed by higher education, for example “imaginative, flexible and adaptive skills” (Ramsden, 2003: 60), are only attainable in this way. He made his message on good teaching loud and clear by defining it as the engagement of “students in ways that are appropriate to the deployment of deep approaches” (Ramsden, 2003: 60).

Laurillard (2005) established that any form of active learning is a major facilitator for the achievement of deep approaches to learning. Furthermore, for her as for Biggs (1999), the focus of this educational process should be on the student’s rather than on the teacher’s actions. However, she does caution against giving the student total autonomy with her assertion that any form of learning “without feedback is completely unproductive for a learner” (Laurillard, 2002: 55). By applying Pask’s (1976) formalised ideas on education, she describes this as the conversational nature of the teaching-learning process (Laurillard, 1993).

Some examples where experiential learning may be delivered include “seminars, recitations, laboratories, case studies, simulations, games, debates, role playing,
cooperative learning, [and] collaborative learning” (Centra, 1993: 27). Kochhar-Lindgren (2001) concluded that for this style of learning to occur there is a prerequisite for “creative activity, the freedom of appropriation, and … a knack for opening the ‘open’ through language” (Kochhar-Lindgren, 2001: 412). Chickering and Gamson (1987) identified laboratory sessions as the best venue for the students to attain the cognitive levels of Bloom’s Taxonomy (Bloom, 1956); those that embrace the most important attributes for graduates of most professional tertiary courses.

The guarantee of attaining deep approaches to learning by students who construct their own study programmes has been described by Toohey (1999) as “too simplistic” (Toohey, 1999: 128). He pointed out that while this may work for some students who know what they want, it was a highly unlikely outcome for “entry-level students who are still learning about their own interests and the possibilities within their … [chosen] profession” (Toohey, 1999: 128).

So, how can academics in practice expedite deep approaches to learning? Activities that are typically characterised by ‘reciprocal transactions’, such as collaboration and interaction (Krathwohl, Bloom, & Masia, 1964), have strongly influenced students towards deeper processing and active engagement (Palloff & Pratt, 2005; Sitzmann, Ely, & Wisher, 2008), but there is no single teaching method that will create the necessary learning environment – “different students will be attracted by and learn most effectively from different learning styles” (Clow, 1998: 22). After all, the best learning can only occur when a range of teaching “methods are available to engage learners in constructing and reflecting knowledge” (Goldman & Hiltz, 2005: 266). The ‘one style fits all’ teaching approach has been discredited by researchers (Goldman & Hiltz, 2005; Hughes & Hewson, 1998; Oblinger & Oblinger, 2005) who advocated that since students have different learning preferences, the delivery of content must be varied in an attempt to match the styles of as many members of the student group as possible. For engineering students in particular, a mismatch between teaching and learning styles has been identified as the reason for “poor student performance,
professorial frustration and a loss to society of potentially excellent engineers” (Felder & Silverman, 1988: 680). The rectification of such issues is an important educational maxim that has to be appreciated as a fundamental design principle when applying emerging media and technologies in higher education (Lindsay & Good, 2007; Lizzio, Wilson, & Simons, 2002).

2.3: Face-to-face teaching

Jovett (1953) retold a quote that he attributed to the fifth century BCE/BC Greek philosopher Socrates highlighting an obvious shortfall of books - namely their inability to immediately and interactively provide additional explanations to any questions that may arise in the reader’s mind. This criticism is equally valid for any form of communication that is characterised by delayed response times. If required, face-to-face communication can afford instantaneous feedback (Daft & Lengel, 1986). Additionally, instructor interaction is crucial when learners feel unsure and perhaps helpless, while attempting to apply new knowledge (Roberts, 2005). Even the teacher’s nonverbal behaviours have been found to significantly affect the quality of learning (Alibali & Natan, 2007; Gorham, 1988).

The core element of the teaching process has been identified as the didactic conversation that is the interaction between the teachers and their learners (Newlin & Wang, 2002). In some detail, this involves the instructor:

- constantly observing student activities, with an eye for the individual student who is struggling or for the group that is stuck or engaged in dysfunctional processes. Teachers pay attention to content, reasoning, and outcomes, but also to attitudes, group chemistry, and mutual support of team members.

(Jonassen, et al., 2003: 91)

Ramsden (2003) described teaching not only as a conversation with talking and listening but also ensuring that the students feel vital components of the resultant interactions. It is in these surroundings that the students’ understanding is continually challenged in ways that is clearly unachievable in isolation (Toohey, 1999). Finally, in order to support, encourage and motivate the students the instructor in a face-to-face setting is able to adapt the:
teaching to the cognitive needs of individual students - that is, the crafting of learning opportunities (for example problem sets, explanations, feedback) vis-à-vis the students’ prior knowledge and history of performance.

(Larreamendy-Joerns & Leinhardt, 2006: 588)

Collaborative learning, where students work together to achieve a common group objective (So & Kim, 2005), is typically conducted by means of a series of face-to-face meetings (Ocker & Yaverbaum, 1999). Several studies have established that face-to-face “collaborative learning is more effective than individualistic instructional strategies in terms of student achievement, attitudes towards their learning experience, [and] motivation to learn“ (Alavi & Dufner, 2005: 192-193). Analysis of student feedback surveys have also shown “that classroom settings are associated with greater student satisfaction with collaborative learning approaches” (Arbaugh & Benbunan-Fich, 2005: 123). In many instances just the simple activity of people coming together can accentuate community membership and even reinvigorate the participants’ focus (Rosenberg, 2001).

In practical terms, tutorials and/or laboratory classes, where students work closely with other students and/or their teachers, provide the students with the best environment for deepening their knowledge in order to gain ownership of the presented material (Toohey, 1999). Traditionally, students, while performing on-campus laboratory activities and/or problem-solving tutorial exercises, are supervised by the academic moving through the venue observing, and then assisting those student(s) who may require some help (Jonassen, et al., 2003). In these environments students not only receive information, as important as that is, but are also able to develop critical thinking skills (Regalbuto, 1999) and social skills (Horton, 2000) through face-to-face communication. In the past, distance educators, irrespective of the technology that they decided to employ, tended to ignore the requirement for the support of these important interactions (Geyer & Effelsberg, 1998). In fact, one of them even postulated that “no amount of electronic gadgetry [could] replace that broader meaning of traditional education” (Dumont, 1996: 200).
Audible cues such as voice tone and message content (Daft & Lengel, 1986), as well as visual cues such as facial expressions and body language contribute to the richness of face-to-face interactions, thus creating a compelling educational environment (Hollan & Stornetta, 1992; Ishii, Kobayashi, & Grudin, 1993). The ability to inherently and immediately share materials, figures, diagrams and/or objects under discussion, in face-to-face settings (Toohey, 1999) further assists the delivery of higher quality learning/teaching (Gorham, 1988; Pinsky & Wipf, 2000). An important societal trait is the demonstration of ‘power’ that is usually communicated nonverbally through ‘physical size’, ‘elegance’, ‘exerting active control’, ‘body language’ (Mehrabian, 1981) or verbally by the amount of ‘talking’ (Sorrentino & Boutillier, 1975; Stang, 1973). For instance, those who talk more are automatically perceived as being more dominant and powerful.

Although there is a technology-facilitated increase in the frequency of interactions between teachers and students in distance learning courses (Yacci, 2000), the currently implemented teleteaching applications are still unable to successfully afford all of the communication channels that are inherently available to the traditional face-to-face instructor. Research of distributed group members who were working on an intellectual task has confirmed that they obtained no advantage from seeing each other via video, as long as they had high quality audio communication (G. M. Olson & Olson, 1997). However, if the joint activity between remote participants requires ‘highlighting’, ‘pointing’, ‘doing rather than verbally explaining’, that is "clarifying information through hand gestures" (Veinott, Olson, Olson, & Fu, 1999: 307), then a video link will be of a substantial benefit.

Early implementations of computer-based educational tools tended to ignore the social protocols, such as raising hands, giving rights to talk or to write on the blackboard, setting up work groups and reference pointing that are employed by teachers to control the interaction and the flow of instruction in a classroom (Geyer & Effelsberg, 1998). Since classroom-like interactions are vital components of learning, the on-going exploration of emulating them in online
delivery is essential (Woodley, 2001). Garrison and Anderson (2003) voiced their fear that if e-learning becomes a simulation of face-to-face pedagogy, potential improvements may be lost; an obviously false conclusion since there is no logical reason why new technologies could not be used for both.

On the other hand, just being in a face-to-face venue does not guarantee genuine interaction between participants or even a conversational approach since:

the atmosphere within the classroom or lecture hall obviously has an effect on [student] motivation. An alienating climate where students feel that no one knows or cares who they are and whether they attend or not will undermine motivation and willingness to persevere with difficult material.

(Toohey, 1999: 17)

Swan and Shea (2005) have also identified that there is a positive relationship between the teachers’ immediacy behaviours and student learning. ‘Immediacy’ has been defined as actions that minimise the ‘psychological distance’ between the communicators (Weiner & Mehrabian, 1968). In a face-to-face context this can be verbal (that is giving praise, seeking viewpoints, joking, or offering insight), or non-verbal (that is, physical distance, touch, eye contact, facial expressions or some other forms of body language).

2.4: Kikan-shido: ‘Walking between desks’

Students at all educational levels typically participate in some forms of experiential learning, such as problem-solving tutorials and/or laboratory experimentation, in order to attain deep levels of understanding. Comparative analysis of mathematics and science classroom pedagogy, as practiced in a variety of countries and examples of which are available from the data collected by the various Trends in International Mathematics and Science Study (TIMSS 1995, 1997) video recordings (Gonzales, et al., 2000), has confirmed the existence of culturally-specific teaching practices (Stigler & Hiebert, 1999), that are embodied in lesson events that “offer a more fruitful vehicle for both characterisation and comparison” (Mesiti, Clarke, & Lobato, 2003: 17). During, the Learner’s Perspective Study (LPS 2002), which is an international research consortium
studying the practices in well-taught mathematics classrooms worldwide, the following lesson events were identified: “Beginning the Lesson, Learning Tasks, Student at the Front, Guided Development, Setting the Task, Walking Between Desks, and Summing Up” (Clarke, 2004: 5). Each of these events has an easily and reliably identifiable form that enabled its subsequent classification in the data which were collected from the countries that participated in the Learner’s Perspective Study.

‘Kikan-shido’ is a Japanese term which literally means ‘between desks instruction’ where the students work at their desks, either individually, in pairs, or in small groups, while their teacher circulates around the classroom, predominantly monitoring, then if necessary, interacting and/or guiding the students’ activities (Hiebert, et al., 2003; O’Keefe, et al., 2006). Clarke (2004), in order to compare the classroom practices in several countries, applied the participation patterns of ‘Walking Between Desks’ or kikan-shido, to obtain evidence for the co-constructed nature of what was observed during such learning/teaching activities. As an integral part of his study that focused on eighteen year-eight mathematics classrooms which were located in five countries around the world, the principal functions of kikan-shido were also identified. With reference to the definitions shown in Table 2.1, these were: monitoring student activity, guiding student activity, organisational and, occasionally, social talk. Later, in order to employ the enacted patterns of kikan-shido as a measure in their international comparative research, O’Keefe, et al. (2006) expanded the four principal functions into sixteen activity code definitions as shown in Table 2.2. The value of breaking down kikan-shido in this way is highlighted in the fact that “they are mutually exclusive and in combination, account for all documented activities” (O’Keefe, et al., 2006: 78).

The research established that the observed patterns depended on (Clarke, 2004; O’Keefe, et al., 2006):

- class sizes;
- the difficulty of the presented subject matter;
• the levels of student comprehension and student willingness to learn; and
• the students’ perception of the amount of support that kikan-shido could afford them.

<table>
<thead>
<tr>
<th>Kikan-Shido</th>
<th>Monitoring Student Activity</th>
<th>Guiding Student Activity</th>
<th>Organisational</th>
<th>Social Talk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between desks instruction in which the teacher walks around the classroom, predominantly monitoring or guiding student activity and may or may not speak or otherwise interact with the students.</td>
<td>The process by which the teacher observes the progress of on-task activities and homework, ascertains student understanding, or selects student work, with intent to keep track of student progress, question student comprehension and record student achievement.</td>
<td>The process by which the teacher gives information, elicits student response in order to promote reflection, or facilitates engagement in classroom activity, with intent to actively scaffold the development of student participation and comprehension of subject matter.</td>
<td>The process by which the teacher distributes and collects materials, or organises the physical setting in the classroom, with intent to support interactions among students and facilitate student engagement in learning activities.</td>
<td>The teacher engages with student(s) in conversations not related to the subject matter or current on-task activity.</td>
</tr>
</tbody>
</table>

*Table 2.1: Kikan-shido principal function definitions (O'Keefe, et al., 2006: 76).*

While the formal identification of kikan-shido activity has thus far been limited to secondary school mathematics classrooms, it is the contention of this researcher that the supervision of students who are engaged in ‘learning-by-doing’ or ‘practice-based learning’ activities, even in tertiary institutions, are commonly monitored and guided by this style of pedagogy (Banky, 2007). In a tertiary setting, such student activities are typically performed in laboratory and/or tutorial venues.

In order to investigate the use of new technologies for teaching in a higher education context, Clow (1998), as shown in *Figure 2.2*, adapted Laurillard’s (1993: 103) Conversational Framework diagram to argue that:

> the framework requires interaction at two levels: that of actions, and that of descriptions. Interaction at the level of actions concerns direct, experiential learning. … Interactions at the level of descriptions concerns adaptation and reflection: conversation about the world. … A teaching exercise can be examined to see how it supports the activities of the Laurillard model: does it allow conversation between teacher and student at the level of descriptions … and at the level of actions? (Clow, 1998: 25)
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>Selecting Work</td>
</tr>
<tr>
<td></td>
<td>Students are chosen to share their work, methods or thinking with the whole class. This may occur immediately or later in the lesson.</td>
</tr>
<tr>
<td>M2</td>
<td>Monitoring Progress</td>
</tr>
<tr>
<td></td>
<td>Teacher walks around the classroom observing student progress of on-task activity.</td>
</tr>
<tr>
<td>M3</td>
<td>Questioning Student</td>
</tr>
<tr>
<td></td>
<td>An expression of inquiry that invites or calls for a reply from a student that may or may not be related to the current on-task activity.</td>
</tr>
<tr>
<td>M4</td>
<td>Monitoring Homework Completion</td>
</tr>
<tr>
<td></td>
<td>While students are engaged in on-task activity, the teacher observes the completion of homework and may note student achievement or understanding of subject matter.</td>
</tr>
<tr>
<td>G1</td>
<td>Encouraging Student</td>
</tr>
<tr>
<td></td>
<td>Activity pursued by the teacher intended to motivate, provide support and feedback to individuals or groups of students.</td>
</tr>
<tr>
<td>G2</td>
<td>Giving Instruction / Advice at Desk</td>
</tr>
<tr>
<td></td>
<td>Teacher scaffolds the development of students’ understanding by providing information, instruction or advice, focusing on the development of a concept that addresses meaning, reasoning, relationships and connections among ideas or representations, or the demonstration of a procedure.</td>
</tr>
<tr>
<td>G3</td>
<td>Guiding Through Questioning</td>
</tr>
<tr>
<td></td>
<td>A series of specific teacher questions intended to scaffold the development of student understanding of a procedure or concept during the on-task activity.</td>
</tr>
<tr>
<td>G4</td>
<td>Re-directing Student</td>
</tr>
<tr>
<td></td>
<td>Activities pursued by the teacher to regulate the behaviour of student(s) who are perceived not to be paying attention to the current activity, and to support students’ on-going engagement during the lesson.</td>
</tr>
<tr>
<td>G5</td>
<td>Answering a Question</td>
</tr>
<tr>
<td></td>
<td>Information given by the teacher when requested by a student.</td>
</tr>
<tr>
<td>G6</td>
<td>Giving Advice at Board</td>
</tr>
<tr>
<td></td>
<td>Instruction or advice given while an individual or group of students work at the board. The instruction or advice may be intended for those students working at the board or may be intended for the whole class.</td>
</tr>
<tr>
<td>G7</td>
<td>Guiding Whole Class</td>
</tr>
<tr>
<td></td>
<td>Teacher walks around the classroom and provides information, instruction or advice intended for the whole class.</td>
</tr>
<tr>
<td>O1</td>
<td>Handout Materials</td>
</tr>
<tr>
<td></td>
<td>Teacher walks around the classroom distributing materials related to on-task activity.</td>
</tr>
<tr>
<td>O2</td>
<td>Collect Materials</td>
</tr>
<tr>
<td></td>
<td>Teacher walks around the classroom and collects materials from students.</td>
</tr>
<tr>
<td>O3</td>
<td>Arranging Room</td>
</tr>
<tr>
<td></td>
<td>Teacher repositions furniture to enable independent, paired, group or board work.</td>
</tr>
<tr>
<td>S1</td>
<td>School Related</td>
</tr>
<tr>
<td></td>
<td>Teacher engages in conversation related to school activities or curriculum.</td>
</tr>
<tr>
<td>S2</td>
<td>Non-School Related</td>
</tr>
<tr>
<td></td>
<td>Teacher engages in conversations of a social nature not related to the subject matter or on-task activity.</td>
</tr>
</tbody>
</table>

Table 2.2: Kikan-shido activity code definitions for M1 - M4, G1 - G7, O1 - O3 and S1 - S2 (O'Keefe, et al., 2006: 77).

In essence Clow has managed to identify those teacher-student interactions that are visible to any third party who may be present in a learning environment. Therefore ‘descriptions’ (numbered 1, 2, 3, and 4 in Figure 2.2) and ‘actions’ (numbered 6, 7, 8 and 9 in Figure 2.2) are external, as compared to the internal
ones (numbered 5, 12, 10 and 11 in Figure 2.2), shown in Laurillard’s diagrammatic representation of her Conversational Framework.

![Figure 2.2: Adapted version of Laurillard’s Conversational Framework (Clow, 1998: 26).](image)

**Figure 2.2**: Adapted version of Laurillard’s Conversational Framework (Clow, 1998: 26).

**Figure 2.3** details how the kikan-shido activities (as defined in Table 2.2) can be deployed or mapped to accomplish the necessary processes within the Conversational Framework in an experiential learning context. For example, the Conversational Framework’s Process 3 (*T redescribes conception in light of S’s conception or action*) could be achieved with the kikan-shido activities M3 (Questioning Students), G2 (Giving Instruction/Advice at Desk), G4 (Re-directing Students), G5 (Answering Questions) and/or G6 (Giving Advice at Board).
Process 7 (S acts to achieve task goal) is attainable with kikan-shido activities M2 (Monitoring Progress) and/or M4 (Monitoring Homework Completion); and so on for the other processes, namely Processes 1, 2, 3, 4, 6 and 9, as shown in Figure 2.3.

![Diagram of the Conversational Framework]

**Figure 2.3**: Implementing the Conversational Framework (shown in Figure 2.2) with kikan-shido activities as defined in Table 2.2.

Good teaching has been described as an interactive engagement with the students (Chickering & Gamson, 1987; Lizzio, et al., 2002; Newlin & Wang, 2002) that also results in the greatest student satisfaction (Arbaugh & Benbunan-Fich, 2005; Daft & Lengel, 1986). Furthermore, the learners’ experiences may be enhanced...
by the application of new technologies, including video, DVD, web resources and simulations. Laurillard (2002) highlighted this by adapting her original Conversational Framework to accommodate the benefits offered by the use of these on-going developments.

2.5: Over-the-shoulder teaching/learning

Good teachers “think carefully about their students’ understanding of the subject matter” (Ramsden, 2003: 233) so that they can modify their teaching strategies in order to address the learning problems that they have managed to identify. The use of kikan-shido, during the supervision of experiential learning, facilitates the collection of the necessary information, while over-the-shoulder teaching/learning enables the on-going refinement of this data. Over-the-shoulder teaching/learning assists any teacher to further monitor, structure and consolidate the material that was delivered elsewhere, for example in the lectures (Biggs, 2003).

One view of over-the-shoulder teaching/learning described it as ‘teaching by example’ that has been, and still is, used successfully in industry for on-the-job training (J. S. Olson, et al., 1998; Twidale, 1999). Dramatised instructional videos or DVDs (Pinsky & Wipf, 2000), and even telephone-accessed computer help-desks (Pentland, 1992) are just two very common examples of over-the-shoulder teaching/learning-like incarnations using new technologies. Twidale (2000) concluded, after analysing the findings from one of his earlier research studies on the help received by the users of a library’s computerised catalogue system, that a considerable amount of learning occurred just from observing what other users were doing. Bannon (1986) is credited with coining the term ‘over-the-shoulder’ in his description of the informal learning that a new employee may receive while sharing an office with a more experienced colleague. A typical scenario could involve a novice computer user who, while trying to use a computer, benefits from the assistance received from a more computer-skilled co-worker (Twidale, 2005). Learning in this way is analogous to being an apprentice, which is one of the oldest and probably the most natural way of acquiring an education (Collins, Brown, & Holum, 1991). Its underpinning real-
time, human-to-human contact, has been acknowledged as crucial for the successful application of this pedagogy (Twidale, 2005; Veerman, Andriessen, & Kanselaar, 2000), which “can vary unpredictably between teaching, collaborative problem solving, and co-discovery” (Twidale, 2010: 86)

The two most important academic benefits of this form of education have been identified as:

- the helper’s ability to pitch examples and explanations at a level that is based on the recipient’s prior experience and expertise (Marton & Booth, 1997; Twidale, 2000); and
- just the helper’s presence encourages “risk-taking, exploration and experimentation, and consequently [deep approaches to] learning” (Twidale, 2005: 525) by the recipient(s), as has been corroborated by one of the outcomes of an early kikan-shido investigation (Clarke, 2004).

Underpinning the successful over-the-shoulder teaching/learning pedagogy is the real-time conversation that increases the students’ involvement in their learning; after all, ‘help giving’ is a collaborative interaction initiated by the helper in order to try to solve a problem (Twidale & Ruhleder, 2004). Learning processes are greatly affected by “the various elements that define the learning environment, one of the most important being the opportunity to interact with others” (Cobb, 1994: 243; as cited in Bernard & Lundgren-Cayrol, 2001). The prospect of being able to share one's own ideas while responding to the reactions of others enhances the thinking process and deepens understanding (Alavi, 1994; Chickering & Gamson, 1987). In other words, “collaboration results in a level of knowledge within the group that is greater than the sum of the knowledge of the individual participants” (Whipple, 1987: 5).

The second-best method of teaching occurs when students teach other students (McKeachie, Pintrich, Lin, & Smith, 1986). Peer teaching, as this is known, is a powerful pedagogy that is largely underexploited even though participation in this
form of collaborative learning has significant academic benefits for both the tutor and tutee (Biggs, 2003).

A diagram by Ling (2006), and shown in Figure 2.4, is an adaptation of Laurillard's (2002) Conversational Framework to account for the interactions that occur during peer teaching. Conceptually students can use elements of over-the-shoulder teaching/learning pedagogy in order to achieve this. All educators were students at some time, and this experience influences the types of pedagogy they practice as teachers of others (Roehrig, Luft, Kurdziel, & Turner, 2003).

![Figure 2.4](image-url)

*Figure 2.4: Conversational Framework adapted for peer teaching based on Figure 2.2 (Ling, 2006).*

Irrespective of who performs the teaching role, and since students have a wide range of learning preferences (Britain, 2004; Oblinger & Oblinger, 2005), any narrowly targeted pedagogy, as already stated, is unlikely to result in universally satisfactory learning outcomes and therefore a variety of strategies tends to be the practiced teaching paradigm. Extensive participant interaction, as may be observed during this form of experiential learning supervision (Zhang, 2005), facilitate valuable feedback on the progress of each student - thus providing an on-going indication on the success of any of the applied teaching techniques.
2.6: Kikan-shido and over-the-shoulder teaching/learning

Over-the-shoulder teaching/learning pedagogy is a sub-component of some kikan-shido activities. This relationship is illustrated in Figure 2.5. The following examples detail how such overlaps between kikan-shido and over-the-shoulder teaching/learning may occur in practice:

- (M1) Students are chosen to share their work, methods or thinking with the whole class that is watching over the shoulders of the selected students;
- (M2) Teacher walks around the classroom observing student progress of on-task activity by watching over the student’s shoulders;
- (M4) The teacher observes the completion of homework by watching over the student’s shoulders;
- (G1) Activity pursued by the teacher intended to motivate, provide support and feedback to individuals or groups of students by illustrating issue(s) graphically while student(s) watch this over the teacher’s shoulders;
- (G2) Teacher scaffolds the development of students’ understanding by providing information, instruction or advice, focusing on the development of a concept that addresses meaning, reasoning, relationships and connections among ideas or representations, or the demonstration of a procedure by illustrating issue(s) graphically while student(s) watch this over the teacher’s shoulders;
- (G4) A series of specific teacher questions intended to scaffold the development of student understanding of a procedure or concept during the on-task activity by illustrating issue(s) graphically while student(s) watch this over the teacher’s shoulders;
- (G6) Instruction or advice given while an individual or group of students work at the board that could include demonstration of the process that is watched over the teacher’s shoulders.
In practice there are a variety of ways of achieving the necessary classroom interactions, which, as proposed by Clarke (2003b), are in the main driven by the syllabus, the delivery mode and the resultant student activity. In order to characterise teacher practices Mesiti, Clarke et al. (2003) adopted qualitative comparisons at the level of these ‘lesson events’ that were also used to investigate the characteristics of the pedagogy that occurred during the various tutorial sessions that comprised the trial detailed in Chapter 5. The analysis of the obtained data involved the identification of kikan-shido with over-the-shoulder learning/teaching activities during face-to-face or online supervised learner problem-solving that has been shown to support the deep approaches to learning by the participating students (Banky & Wong, 2007).
Chapter 3 - Computer-based distance education

*Are we grafting the age-old way of teaching Biology101 onto the Internet, or are we using the native capabilities of the technology to change Biology101 for the better?* (Twigg, 2004: 112)

3.1: Overview

In 1977, as a student attending her final postgraduate seminar on the topic of designing an ‘ideal classroom’ for the 21st century, Professor Starr Roxanne Hiltz devised the Virtual Classroom (VC)\(^8\). Years later she recalled her moment of revelation with these words:

> In this imagined learning environment there was a multimedia lecture hall, where the Professor pronounces words of Truth and Knowledge, and the students try to absorb this and take notes. In a sumptuously finished circular ‘conversation pit’ with leather couches and marble coffee tables, the Professor as Discussion Leader and Socrates would conduct seminar type sessions, moderating discussions and presentations in which the majority of the talking was done by students. There was also a ‘learning resources’ area, with reference materials, computer hardware and software, and perhaps laboratory equipment, where individuals and small groups of students might do research and prepare their assignments. ... Suddenly it came to me. A teaching and learning environment did not have to be built of bricks and boards. It could be constructed in software.  
> (Hiltz, 1994: 5)

In the above description Hiltz appears to be ignoring the fact that the participant interactions in the traditional classroom are much more than just ‘speaking and listening’. It also appears that she has disregarded the very important pedagogical benefits provided by non-verbal communication like body language that is clearly missing from this depiction of her vision. To be fair the successful online

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\(^8\) The Virtual Classroom is a registered trademark of New Jersey Institute of Technology.
transmission of which is highly problematic even with existing technologies (Brooke, 2008; Shea & Bidjerano, 2009). The opportunity for the participants to give and/or receive real-time assistance and prompt feedback has also been ignored. Even the concept of the ‘leaning resources’ area” is of questionable value since it appears to put “the learner directly in touch with the source material, …[but] without the teacher … to recommend one book over another or show where to find it” (Murison-Bowie, 1999: 148). While the popular justification for this style of pedagogy is the rhetoric of ‘giving students control over their learning’, to Laurillard (2002) this is simply an example of negligent behaviour on the part of the academic. She supported her viewpoint by stating that such pedagogy would never be condoned within brick-and-mortar libraries and/or laboratories; and she questioned its acceptance with electronic ones. The issue was succinctly summed up by the suggestion that:

> teacher presence is a necessary part in both formal and non-formal learning contexts. There is always a need for a teacher or a facilitator to structure, shape, and assess the learning experience if it is to be more than fortuitous learning.

(Garrison & Anderson, 2003: 75)

New online communication technologies support new pedagogies with the application of their ‘interactive potential’ for the encouragement of deep approaches to learning (Biggs, 2003) and by providing “access to critical communities of learners [and] not simply access to information” (Garrison & Anderson, 1999: 51). However, Ritter and Lemke (2000) were critical of just adding ‘interactivity’ to online education venues, by asserting that experiential learning by students is not achieved by them pointing and clicking their way through web pages.

Both the notion that a student is not someone who must study full time at a brick-and-mortar institution (Shuffler & Goodwin, 2008) and the well-acknowledged necessity for ‘lifelong learning’ (Toohey, 1999) fuel the need for flexibility in education, which in turn has been one of the major driving forces for the adoption of new technologies by distance educators (Johnston, Killion, & Oomen, 2005). In general:
distance education includes the various forms of study at all levels which are not under the continuous, immediate supervision of tutors present with their students in lecture rooms or on the same premises, but which, nevertheless, benefit from the planning, guidance and tuition of a tutorial organization [sic].

(B. Holmberg, 1986: 26)

Since students are seen more and more as ‘clients’ or ‘customers’ of tertiary institutions, their engagement with their studies, independent of the delivery mode, should be the focus of higher education (Coates, 2006).

In this chapter, three issues that are related to computer-based distance education are discussed. Firstly, two common communication modes, ‘synchronous’ and ‘asynchronous’, are defined within an educational context. Next, computer-mediated communication is introduced as the enabler for the pioneering implementations of Hiltz’s visionary virtual classroom. Her work in this area established a new approach to the delivery of distance education, known as the asynchronous learning network. Finally, the Internet’s support for higher levels of participant interaction and collaboration is presented as a possible solution for the delivery of higher quality distance education.

3.2: Synchronous vs. asynchronous communication

There are many definitions of the terms ‘synchronous’ and ‘asynchronous’ in an educational context (Tu, 2000a; Vat, 2001). The following is one example with a distance education focus:

Distance learning is the exchange of curricular materials between a teacher and students located at distant sites, with some form of two-way communication between them. The learning can be synchronous - in real time, with simultaneous participation by students and teachers - or asynchronous, with the students choosing when they will participate. Correspondence courses are an early example of asynchronous distance learning.

(Ginsberg & Foster, 1998: 48)

Rosenberg (2001) concluded that synchronous and asynchronous learning are not mutually exclusive but they are points on a continuum of “interdependence between the expertise (instructor or content) and independence (e.g. individual’s
control) in learning” (Rosenberg, 2001: 143). As summarised in Table 3.1, Horton (2006) identified some of the learning situations where one or the other communication mode has been found to be more suitable for the task at hand. While his focus appears to be on learner-learner communication, these are equally valid for any teacher-learner contact. Examination of the effects of the communication medium on learning has found better outcomes when synchronous, rather than asynchronous, modes were employed in distance education (Sitzmann, et al., 2008). However, experience suggests that a combination of both these delivery modes should be considered for most curricula (Berge, 2000; Larreamendy-Joerns & Leinhardt, 2006). Instruction on such hybrid networks:

fulfills the ideal of interactive distance learning … [by]
break[ing] the isolation of distance learners and introduce[ing]
the fluidity of discourse into the landscape of distance
education. (Larreamendy-Joerns & Leinhardt, 2006: 583)

<table>
<thead>
<tr>
<th>Choose synchronous activities when ...</th>
<th>Choose asynchronous activities when ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>▶ Learners need to discuss issues with other learners at length.</td>
<td>▶ Learners are from a wide span of time zones and countries.</td>
</tr>
<tr>
<td>▶ Learners need the motivation of scheduled events reinforced by peer pressure.</td>
<td>▶ Learners have inflexible or unpredictable work schedules.</td>
</tr>
<tr>
<td>▶ Most learners share the same needs and have the same questions.</td>
<td>▶ Learners cannot wait for a class to form.</td>
</tr>
<tr>
<td>▶ Learners have unique individual needs.</td>
<td>▶ Learners have unique individual needs.</td>
</tr>
</tbody>
</table>

Table 3.1: Recommendations for choosing synchronous or asynchronous activities (Horton, 2006: 364).

Technically, communication via online platforms can be either synchronous or asynchronous. However, “the widespread application of … [synchronous communication] technology is … hampered by the relatively slow speed of most Internet connections” (Owston, 1997: 30). Undaunted by these technical limitations, pioneering educationalists, such Fetterman (1996; cited in Owston 1997), used the then available commercial software utilities to deliver online instruction, supplement their consultation hours, provide downloads for students, and collaborate with others as required. The overall data speed across the Internet
is limited by the minimum speed of any of the hardware and software components that comprise the end-to-end pathway of the transmitted digital information. The future availability of inexpensive high-speed components that enable the transmission of high-quality ‘streaming audio’ and high-definition full-motion video, may possibly make off-campus education equivalent to that practiced in the physical classroom (Arbaugh, 2000b).

Twidale (1999) concluded that cost savings for the help-giver rather than outcome quality has been the driver for the popularity of asynchronous, when compared to synchronous, remote assistance. The subtleties of implementing these two communication modes are highlighted by Motteram (2001) who while recognising that synchronous communication results in “more immediate social bonding” (Motteram, 2001: 149), suggested ‘e-mail’, a typically asynchronous method (Cotlar & Shimabukuro, 1995; Toohey, 1999; Yukseltunk & Cagiltay, 2008), as an example for achieving it. E-mail, that removes the control of the conversation from the initiator (Wheeler, 2005), was subsequently established to be a highly inappropriate solution for such tasks (Barile & Durso, 2002). Even the use of computer chatrooms, a recent online implementation of synchronous written forums, have been unpopular with students who felt that because their typing speeds were not fast enough they would have preferred an audio-based alternative (Stodel, Thompson, & MacDonald, 2006). Although these cyber facilities are often described as ‘real-time’, users regularly experience significant time delays in the flow of any dialogue that is caused by the typing of a posting, checking it on one’s screen, reading the response(s) from others and then repeating this cycle over and over as required (Anagnostopoulos, Basmadjian, & McCrory, 2005).

Asynchronous communication is typically “in a narrow bandwidth … called writing” (Feenberg, 1999) that inherently affords students with ample time for reflection before having to respond or contribute (Berge, 2000; Garrison & Anderson, 2003; Guan, Tsai, & Hwang, 2006; Hmelo-Silver, Derry, Woods, DelMarcelle, & Chernobilsky, 2005; Larreamendy-Joerns & Leinhardt, 2006; Ligorio, 2001; J. C. Taylor, 2001a; Williams, 2007), and its ongoing practice is
ultimately beneficial for the improvement of all associated skills (Lewis, Whitaker, & Julian, 1995). Even in face-to-face environments it has an established presence as an adjunct communication medium (Garrison, Anderson, & Archer, 1999).

The delays within asynchronous systems inhibit spontaneity, thus potentially allowing the student to progress significantly down the ‘wrong path’ before being corrected by colleagues and/or an academic (Cheaney & Ingebritsen, 2005). On the other hand because this form of communication has an inherent democratic nature, the students tend to complete all their set tasks and subsequently make the resultant contributions permanently accessible to all participants (Kuriloff, 2005; Williams, 2007). Additionally, since written communication tends to hide the author’s social role, rank and/or status this:

medium affords those with physical limitations or personal reticence the possibility of participating fully and equally in communicative activities within a mainstream environment. (Berge & Collins, 1995b: 4)

Harasim, et al. (1995) and Mason (1991; as cited in Berge, 2000) identified a number of other educational benefits of asynchronous online instruction, namely:

• increased interaction in quantity and intensity;
• lends itself to situated learning;
• better access to group knowledge and support;
• convenience of access;
• increased motivation;
• more cost-effective technology.

Disregarding the logistics of scheduling synchronous meetings (Cheaney & Ingebritsen, 2005), Mason (1991; as cited in Berge, 2000) concluded that all forms of synchronous systems offer a number of equally compelling advantages, namely:

• more motivating;
• helps to develop a sense of ‘social presence’ and group cohesion;
• provides quick feedback on ideas;
• supports consensus and decision making;
• encourage students to keep up-to-date on assigned work;
• provides structure and discipline.

The on-going support for asynchronous delivery principally results from its inherent ‘any time any place’ convenience (Berge, 2000; Biggs, 2003; Finkelstein, 2006; Hiltz & Goldman, 2005; J. C. Richardson & Swan, 2003). However, on the downside, the feedback from students who were enrolled into asynchronously delivered distance courses identified feeling isolated (Dumont, 1996; Finkelstein, 2006), as well as experiencing:

- information overload, communication anxiety in relation to delayed responses, … increased work and responsibility,
- difficulty in navigating online and following discussion threads,
- loss of visual cues, and concerns about health issues related to computer use. (Harasim, et al., 1995: 15)

Wainfan and Davis (2004) reported that ‘deindividuation’, a state related to ‘depersonalisation’ of an individual who is submerged into a group (Festinger, Pepitone, & Newcomb, 1952), may also increase due to this type of online communication, with negative impact on the student outcomes. In general it has also been found to be less dynamic than traditional interactions (Nowak, et al., 2004) and problematic for the establishment of the participants’ social presence since this form of communication has a marked deficiency of 'immediacy' (Garrison & Anderson, 2003). On occasions users have ended up getting access to a block of messages, each of which could have arrived at different times and probably unrelated to the ones preceding it, causing ‘space-time dislocation’ (Pincas, 1998). Then again, users do accept what they have as long as they are not given another alternative for the task-at-hand (Nowak, et al., 2004).

Asynchronous online learning sometimes encouraged the students to make arrangements for synchronous communication such as “informal face-to-face, telephone, … or conference interactions with other students” (Levin, Levin, & Chandler, 2001). So, was the resultant learning style still an example of asynchronous distance education or of some new hybrid implementation?
Some educators have claimed that synchronous distance education results in better student achievements (Sitzmann, et al., 2008) if “deployed when synchronous learning is uniquely suited” (Finkelstein, 2006: 5). Others recommend asynchronous delivery for better learning outcomes and more positive student attitudes, although it usually has lower retention rates than synchronously delivered courses. In part, the answer for this lies in the fact that students who dropped out before the end of the course were not included in the collected data; thus the better performers were the ones who managed to ‘survive’ the process (Bernard, et al., 2004). For educational platforms that support both communication modes:

synchronous learning is more effective among students with a high cognitive ability than among those with a low cognitive ability. This can be explained by the fact that the inflexible nature of the teaching and the few and poor quality interactions increase the transactional distance and the gaps in communication and create a psychological void which can potentially lead to misunderstandings between the teacher and the students, resulting in a decrease in the quality of learning. (Offir, et al., 2008: 1181)

Over 350 studies, dating back to 1928 (Russell, 1999), that compared the overall learning effectiveness of distance and face-to-face learning, established the ‘no significant difference’ phenomenon. Alavi and Duffner (2005) cite a number of highly targeted studies that compared asynchronous and face-to-face education that also confirmed these findings. The ensuing conclusions asserted that ‘instructional methods’ rather than the ‘delivery medium’ affected the pedagogical outcomes, placing the onus onto the course designers to “choose instructional methods that will maximize [sic] learning outcomes” (Sitzmann, et al., 2008: 4). One research exercise compared live classroom delivery with distance education where the same material was presented synchronously via closed circuit television to students who were at a different campus (Bernard, et al., 2004). Another, involved college students who were randomly selected to receive the same lecture material in one of three instructional formats - namely: conventional lecture,
synchronous web-based, and asynchronous web-based modes (Newlin, Lavooy, & Wang, 2005).

Following their publications, the ‘no significant difference’ conclusions were harshly criticised for many reasons, including: “focusing on the wrong factor, methodologically flawed, biased sampling, … being pseudoscientific” (Zhao, Lei, Yan, Lai, & Tan, 2005: 1837), and using the incorrect measures for obtaining the outcomes (Clow, 1998; R. D. Garrison & Anderson, 2003; Zhao, et al., 2005). Most comparative studies of web-based systems tended to ignore the fact that “writing is not a poor substitute for physical presence and speech, but another fundamental medium of expression with its own properties and powers” (Feenberg, 1999), hence totally disregarding the possibility that the written word may have some inherent compensating characteristics that could skew any subsequent conclusions. Lastly, since all the above-mentioned studies involved the didactic delivery of lecture material only, the obtained results have extremely narrow educational relevance.

Logically, both synchronous and asynchronous distance education require the academic to acquire new and “different sets of technical and pedagogical competencies to engage in superior teaching practices” (Bernard, et al., 2004: 36). In telecommunication terminology the face-to-face or ‘in-class’ model has been described as a ‘synchronous learning network’ (Latchman, et al., 1999; Ng, 2007), perhaps providing a hint on how such a learning environment could be successfully re-created online for distance students.

3.3: Computer-Mediated Communication and the Asynchronous Learning Network

All human communication that occurs via a network of computer-based wired or wireless technologies is commonly referred to as ‘computer-mediated communication’. When applied to distance education the resultant ‘computer-mediated collaborative learning’ differs from the traditional teaching methods in five respects: “(a) text-based and computer-mediated interaction, (b) many-to-
many communication, (c) time- and place-independence (d) long distance exchanges, and (e) hypermedia links” (Warschauer, 1997: 470). This form of teaching/learning represents a departure from traditional methods\(^9\) and therefore there is a need for an adequate period of prior familiarisation by the instructor in order to attain positive educational outcomes (Alavi, 1994). Hiltz (1994) implemented her virtual classroom using a computer-mediated communication system that was a centrally-located mainframe computer running a time-share operating system, thus creating a fundamentally asynchronous learning platform. She defended her choice of technology by stating that:

asynchronicity \([sic]\), which may at first seem to be a disadvantage, is the single most important factor in creating a collaborative teaching and learning environment … [where] both teachers and students are active participants in the shared task of seeking to understand and apply the concepts and techniques that characterize \([sic]\) the subject area. … Round-the-clock access to a common communication and work space is crucial for facilitating group or collaborative projects.

(Hiltz, 1994: 6 & 9)

Interestingly, there is no claim by Hiltz (1994) that this may be the best implementation of the virtual classroom. After all synchronous learning systems can ultimately also deliver the above-stated aims - and perhaps much more. Asynchronous, collaborative learning requires different levels of commitment than those found in face-to-face venues, in particular the requirement for prompt replies by all who participate in this process (Chernobilsky, Nagarajan, & Hmelo-Silver, 2005). Recent research findings highly recommend the incorporation of synchronous communication opportunities in order to allow collaborating students to (i) organise workloads, (ii) clarify difficult concepts/ideas, (iii) embrace social awareness (Dimitracopoulou, 2005), and (iv) build group identity and cohesiveness among members (So & Kim, 2005) during otherwise asynchronously proposed delivery.

In the late 1970s, e-mail, installed on timesharing mainframe computers, was first adopted for instructional activities, namely to expand the opportunities for

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\(^9\) “The fundamental goal … is to remove the barriers of time and place in the facilitation of learning” (Elbeck & Mandernach, 2009: 3).
discussion outside the traditional classroom (Harasim, et al., 1995). Later, chatrooms were used for text-based tutor-learner contact, such as pedagogical support, assignment submission, and feedback (Harasim, et al., 1995). Some educationalists argued that the pedagogy practiced in successful classrooms should be the starting point for the design of new online educational environments (Hughes & Hewson, 1998), while others “challenged the classroom as a standard of quality by focusing on features or contexts that make distance instruction … uniquely appropriate” (Larreamendy-Joerns & Leinhardt, 2006: 580). The ongoing advances in technology continue to support the development of new platforms for facilitating off-campus group work and collaborative learning (Toohey, 1999) thus validating the claim of enthusiastic proponents of online distance education that almost all subject matter can be successfully communicated electronically (Phipps & Merisotis, 1999).

Holmes (1999) was adamant that “educators are the key professionals in improving the education of our children” (Holmes, 1999: 42) and definitely not computing professionals, since “a computer is not a solution to any problem; it is a tool for solving problems” (Holmes, 1999: 42). Hiltz (1994) attempted to defend any potential shortfalls by declaring that:

> whenever one tries to emulate and support non-computerized [sic] processes within a software environment, fundamental changes occur in both the processes and the outcomes - some things are lost and some are gained. (Hiltz, 1994: 6)

An exploration of the literature for the best teaching/learning processes and methodologies consistently identified those that ultimately resulted in deep approaches to learning by the students (Biggs, 1989; Laurillard, 1993; Marton & Säljö, 1984; Ramsden, 1992). In order to encourage this, similar to a brick-and-mortar classroom, a cyber amenity has to facilitate for the learner an:

active engagement with content, interaction with other learners, a well-structured knowledge base and clear motivation by and interaction with the teacher, and opportunities for individual reflection on the experience.

(Gibbs, 1992; as cited in Hughes & Hewson, 1998: 4)
Other studies have also confirmed that the students’ satisfaction with distance education was clearly influenced by their perceived distance from the course provider (Arbaugh, 2001; Thurmond, et al., 2002). Consequently, in order to achieve a successful learning process, a sense of community must be established amongst the participants (Palloff & Pratt, 1999). Particularly, for distance education, this should lessen the “feelings of disconnectedness, isolation, distraction, and lack of personal attention, that could affect student persistence in distance education courses or programs” (Rovai, 2002b: 198). Rovai (2002c) listed both transactional distance and social presence as two of the seven factors that correlate positively to a sense of community. Lowe, et al. (2007) summed up transactional distance as the “learner’s perception of … communication gaps as caused by a physical separation from instructor and other learners” (Lowe, et al., 2007: 30). In fact, the presence of the instructor “who should be actively seen as stimulating, providing material for and guiding students’ collaborative interactions” (Coates, 2006: 158) has been identified as the fundamental differentiator between distance and conventional education (Bright, Lindsay, Lowe, Murray, & Liu, 2008).

MacFarland (2001) and Cavanaugh (2002) identified an ‘age bias’ with their findings of mature-aged distance learners being more satisfied with their courses and performed better in them than members of campus-based younger cohorts. Moore and Kearsley (1996), examined various distance learning courses and hypothesised that an increase in the transactional distance required an increase in student autonomy (as cited in Offir, et al., 2008: 1172).

A reduction in the perceived transactional distance may be achieved by facilitating high bandwidth communication in order to enable ongoing real-time guidance which is adaptable to the recipients’ needs (Gillet, et al., 2002; Hill, Wiley, Nelson, & Han, 2004; Lowe, et al., 2007; M. G. Moore & Kearsley, 1996; Stein & Wanstreet, 2003; Wheeler, 2005). The importance of bandwidth was also highlighted by Martarazzo and Sellen (2000) who found that speed rather than quality of synchronous communication resulted in both more efficiency and
satisfaction in collaboration between non-proximal participants. Communication systems with delays of greater than 500ms have been found to severely disrupt their users’ conversational flow (G. M. Olson & Olson, 2000).

From a student’s perspective this was reinterpreted by Cohen and Ellis (2004) who confirmed Hiltz’s (1994) earlier findings that ease of access to the teacher is a quality indicator for online courses. Instructor availability and student responses in real-time have been traditional key ingredients of tertiary education (McNeely, 2005) which have been ignored by the advocates for distance delivery via non-interactive electronic means. Investigations into the application of interactive electronic media have shown that synchronous rather than asynchronous communication resembles face-to-face environments (Walther, 1993), providing a level of affirmation for the technologies selected for the trial. Irrespective of how this is argued, the ultimate benefit has been identified by Gillet, et al. (2002) as little or no loss in the motivation of the learners.

Both the perception of continual tutor presence (Tagg & Dickinson, 1995) and the participants’ levels of interaction (Roblyer & Wienceke, 2003) as evidenced by both the promptness and the frequency of responses, ultimately has a beneficial effect on learner performance in online contexts (Oblinger & Oblinger, 2005). Thurmond, et al. (2002) found that students equated feeling connected with their instructor(s) with getting adequate assessment.

A number of studies also confirmed that learning effectiveness correlates with the student’s perceptions of social presence (J. C. Moore, 2005; Palloff & Pratt, 2005; J. C. Richardson & Swan, 2003; Stein & Wanstree, 2003), principally the perceived teacher-student immediacy (S. A. Brown & Lahoud, 2005; Weaver & Albion, 2005). In a sense both these terms depict:

the degree to which a distance student perceives the availability of, and connectedness with, people in his/her educational setting. ‘Availability’ implies that what is needed or desired is obtainable upon his request, involving the responsiveness of interpersonal relationships. ‘Connectedness’ indicates the belief or feeling that a reciprocal relationship exists between two or
more parties, involving an individual's subjective judgment upon the extent of the [individual’s] engagement in relationship with others. (Shin, 2003: 71)

Another widely identified shortcoming of distance education is the negative effect that it often has on student motivation, which is ultimately reflected in the student dropout rates (Harasim, et al., 1995). A common reason that has been offered for both high dropout rates from, and student dissatisfaction with, distance delivered courses is an absence of community (Hill, 2001; Hill, et al., 2004). A variety of remedies have been proposed by many researchers in an attempt to minimise this critically important issue. These include:

- managing a positive social dynamic (Woods & Ebersole, 2003);
- supporting a student-centred approach to learning (Knowlton, 2000);
- the inclusion of timely teacher-to-student feedback (Cavanaugh, 2002);
- developing a sense of community among the participants (Hiltz, 1994; Levin, et al., 2001; Rovai, 2002c);
- building and sustaining a cooperative learning group (Hiltz, 1995);
- increasing the social presence (Newlin & Wang, 2002);
- encouraging nonverbal and verbal immediacy (Arbaugh, 2001).

The virtual classroom and its various derivatives became the foundations of the ‘asynchronous learning network’ that used computer-mediated communication for ‘anywhere, anytime’ collaborative learning (Baker & Lund, 1997; Harasim, et al., 1995; Hiltz & Goldman, 2005). A key characteristic of asynchronous learning networks as a form of teaching and learning is that they facilitate learning by students in a cooperative or collaborative way that results in the establishment of a ‘learning community’ or a ‘learning network’ (Hiltz & Goldman, 2005). Interestingly, there is no reference to the fact that synchronous communication is also available for participation from anywhere, and ignoring time-zone issues, it is more logical for classroom-like cooperative or collaborative learning. Rovai’s (2002c) later research findings confirmed that the ‘community’ in asynchronous learning networks is more important than in traditionally delivered courses because the communication modes in the latter are more natural than the text-
based interaction that occurs in the former. His conclusions still have validity even though the ubiquitous use of the various forms of ‘texting’ by the younger generations make written communication more acceptable, it is still hardly definable as ‘normal’.

As technology continued to improve, collaboration between participants was more easily supported and computer networks became global learning networks where a remote student could get a “master's degree in almost any engineering field and select courses [sic] from MIT, Cal Tech, and Dartmouth, among others” (Harasim, et al., 1995: 244). Via the Internet, a selection of standard, full-credit undergraduate and graduate programmes were on offer, with the stated aim of creating:

a distance learning environment that rivals the traditional classroom environment in the quality and content of the learning experience ... [in order] to encourage a new educational paradigm in which the instructor is no longer regarded as the sole source of all knowledge. (Owston, 1997: 28)

3.4: Internet-based distance education

The Internet, which was conceived well before any of today’s computer technologies, was envisaged to support online collaboration with both file and resource sharing (Leiner, et al., 2003; Schoech, 2000). The significance of the potential benefits that this could offer the education community was encapsulated in a statement that compared it to other historical events that had an effect on learning opportunities, including:

the land-grant movement in the Nineteenth Century [that] brought access to higher education to the middle class; the community college movement of the Twentieth Century [that] brought universal access to higher education; [and] the technology revolution of the Twenty-first Century [that] can bring access to all beyond the bounds of time and place. (Stukel, 1997 cited in Regalbuto 1999: 5)

Early adopters were warned that Internet-based online teaching is not just a matter of uploading one’s class notes or a video of a lecture for others to access, but requires new paradigms for content delivery (Feenberg, 1999; Horton, 2000;
Johnston, et al., 2005). Biggs (2003) cautioned that if this or any other technology is not used appropriately then it becomes just as ineffective as any other inferior way of teaching. Laurillard (2009) affirmed the recommendations of others (Ashcraft & Treadwell, 2008; Holmes, 1999; Newlin & Wang, 2002; Sitzmann, et al., 2008) that online course design should never be driven by technology - rather it should be by pedagogy. Online education has been identified as “a multidisciplinary problem” (Levert & Pierre, 2000: 557) that “lies at the junction of distance education, human-computer interaction, instructional technology, and cognitive science” (Larreamendy-Joerns & Leinhardt, 2006: 569), and therefore should ideally be tackled by a team consisting of both engineers and educators. Furthermore, it is imperative that issues such as ‘what should students learn?’ and ‘how can this be expressed to the students?’ are resolved before addressing “problems such as how to present a lecture, manage a tutorial or use information and communication technology” (Ramsden, 2003: 122).

The availability of ‘networking technologies’, which are integral components of the Internet (Phipps & Merisotis, 1999), encouraged distance education designers to pioneer the previously difficult-to-achieve, face-to-face pedagogy of collaboration between participants (Benigno & Trentin, 2000; Finkelstein, 2006; Harasim, et al., 1995). This was an attempt to try and address those who:

often point to this lack of interaction as one of distance learning's major flaws. They assert that learning is passive and that for high-quality education the face-to-face give-and-take of ‘traditional’ classrooms is a necessity. (Dumont, 1996: 192)

Many researchers in distance education have supported the proposal that the incorporation of as many elements of face-to-face teaching as possible will improve the quality of the learning experience (Berge, 2000; Finkelstein, 2006; Hughes & Hewson, 1998; Regalbuto, 1999). Examples of such elements of classroom instruction include: “social interaction, prompt feedback, engaging activities, instructional flexibility, the dynamism of a knowledgeable scholar, and adaptation to individual needs” (Larreamendy-Joerns & Leinhardt, 2006: 579-580). In general the ease with which students can interact with faculty and other students has been acknowledged as the most critical characteristic of Internet-
based education (Phipps & Merisotis, 2000; Sitzmann, et al., 2008), that must be a fundamental consideration during any course design and its subsequent implementation (Mandernach, Gonzales, & Garrett, 2006).

The ever-improving access to the Internet, and hence to Internet-based learning, made it the convenient alternative for distance learners (Hill, et al., 2004; G. M. Olson & Olson, 2000; Shank, 2008b). Over the years, in an attempt to improve on the levels of participant interaction, collaboration and perceived immediacy, the capabilities of videoconferencing (Fetterman, 1996; Toohey, 1999), audioconferencing (Laurillard, 2002; Toohey, 1999), chatrooms (Harasim, 1999; Hiltz, 1994), bulletin boards (Hiltz, 1994; Toohey, 1999) and/or e-mails (Hiltz, 1994; Toohey, 1999) have been exploited in the many available delivery platforms. The hope was that, if used appropriately over an Internet connection, these technologies would facilitate “the indispensable principle of learning and teaching as a conversation” (Ramsden, 2003: 161) in a distance education context. While, the interactions between students and teachers have been identified as the key to successful online learning (Bright, et al., 2008; Roberts, 2005) “they should not be construed as inevitably conducive to learning solely because … [they may] take place” (Larreamendy-Joerns & Leinhardt, 2006: 591).

Since the above-listed technologies were found to be “useful for subjects without a strong practical component” (Guzmán, Berenguel, Rodríguez, & Dormido, 2005: 112), the successful online delivery of experiential content - particularly in science courses – remained a great challenge (Arbaugh & Benbunan-Fich, 2005; Sivakumar, et al., 2005). This constituent of the curriculum tended to be “handled with [unsupervised] online simulations, home experimental kits, or intensive … laboratory weeks on campus” (Hiltz & Goldman, 2005: 12) or at other suitably located physical venues (Casanova, et al., 2006; de Moraes, et al., 2003). Technologists have predicted that the evolving trends, as tabulated in Table 3.2, will enable the future implementations of higher quality delivery platforms for such course content.
<table>
<thead>
<tr>
<th>Moving from:</th>
<th>Moving to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrowband</td>
<td>Broadband</td>
</tr>
<tr>
<td>Plain, single mode (e.g. text or speech)</td>
<td>Multimodal rich</td>
</tr>
<tr>
<td>Tethered (wired) access</td>
<td>Untethered (wireless) access</td>
</tr>
<tr>
<td>Users adapting to technology</td>
<td>The technology adapting to user.</td>
</tr>
</tbody>
</table>

Table 3.2: Evolving trends in Internet technologies (Jonassen, et al., 2003: 35)

While there is an on-going lack of empirical research into the value of web-based instruction (Newlin, et al., 2005) the speculation is that there is “no other area of study [that] will have a greater impact on the future of distance education” (Garrison, Anderson, & Archer, 2003: 125).

On a positive note, Harasim, et al. (1995), concluded that the teaching of all subject matter should benefit from the inclusion of some levels of online delivery. Horton (2000) identified over 30 features of web-based technologies, which in his opinion, will result in better learning experiences than those in a classroom. This list included:

- exposure to real-world data;
- development of better thinking skills;
- time for reflection before response;
- just-in-time training
- equitable access to assistance;
- expert instruction from anywhere;
- dynamic syllabi; and
- organisational flexibility and integration of work and training.

No wonder then, that the ultimate world-wide demise of all but five brick-and-mortar universities was predicted in an Oxford University study (Holmes, 1999). Coincidentally, ‘five’ was also the prediction by Thomas J. Watson Snr., IBM’s CEO in the 1940’s, as the number of mainframe computers that will ever be needed globally (Maney, 2003). The absurdity of both of these predictions has been clearly vindicated with the hindsight of time.
Chapter 4 - Investigation of face-to-face and online teaching/learning

The principles of good teaching do not alter when information technology is appropriately used to help make learning possible. (Ramsden, 2003: 172)

4.1: Overview

This chapter details the process of, and the ensuing results from, the observations of a number of face-to-face experiential learning activities, such as problem-solving tutorial and laboratory experimentation sessions in a tertiary institution, in order to identify the pedagogy practiced by the participating students’ supervisors. Additionally, for off-campus experiential learning, the transcripts of interviews with the supervising academics were analysed, so as to identify the pedagogy they perceived to have practiced in this context.

Subsequent analyses of the collected data established that:

• students while engaged in experiential learning, such as ‘learning-by-doing’ or ‘problem-solving exercises’, in tertiary institutions (typically performed in laboratory classes and/or tutorials) were supervised by context-dependent kikan-shido in conjunction with appropriate over-the-shoulder teaching/learning pedagogy.

The ubiquitous accessibility of the Internet has resulted in various levels of participant interaction, collaboration and perceived immediacy in the delivery of distance education. Emerging technologies such as “multimedia tools, hypertext systems, interactive systems, information exchange between teacher and student
through [the] internet [sic], information access from any part of the world” (Guzmán, et al., 2005: 112) have impacted the development of new teaching methods, predominantly, “for subjects without a strong practical component” (Guzmán, et al., 2005: 112). The online delivery of hands-on content, particularly in science courses, still offers a great challenge (Arbaugh & Benbunan-Fich, 2005; Sivakumar, et al., 2005) and tends to be “handled with [unsupervised] online simulations, home experimental kits, or intensive … laboratory weeks on campus” (Hiltz & Goldman, 2005: 12) or at other suitably located physical venues (Casanova, et al., 2006; de Moraes, et al., 2003). The academics interviewed for this investigation opted for asynchronously supervising their students who were conducting virtual laboratory experiments off-campus.

The data collection and analyses instruments that were used included:

- audio recordings of observed tutorials and laboratory sessions;
- audio recordings of interviews with academics who practiced online teaching;
- transcription of audio recordings into ‘storyboards’ or text;
- binary coding of identifiable participant interactions;
- cross-tabulation of coded data;
- application of appropriate statistical analysis tools to the cross-tabulations.

### 4.2: Observing face-to-face experiential learning sessions

#### 4.2.1: Research details

Ten laboratory sessions and four tutorial sessions were selected for observation in order to investigate the pedagogy practiced in the supervision of students who were participating in experiential learning activities in a tertiary institution.

The researcher’s availability during a two week period in the last weeks of the semester determined which laboratory classes were to be observed. These sessions involved six academics supervising six student groups of various sizes. The students either worked alone or in groups of two or three. The combination of academics and student groups included:
• the academic with the same student group in sequential sessions;
• the academic with different student groups repeating the material of earlier sessions; and
• a second academic assisting different academics and different student groups.

All of these sessions formed parts of the curriculum in one of three subjects, each of which was part of the degree courses in either *Electronic and Computer Systems Engineering*, or *Telecommunications Engineering*, or *Multimedia* taught at Swinburne University of Technology.

While the chosen tutorial classes, which were to be presented by the researcher, were selected from his normal teaching load. These sessions consisted of revision exercises in digital and analogue electronics, offered to science students in the final year of their degree courses, also at Swinburne University of Technology.

Common to both laboratory and tutorial activities was the requirement that the students worked with a personal computer. Additionally, in three of the laboratory sessions, the learners also had to experiment with some electronic hardware modules. The ‘software-only’ classes were held in computer laboratories consisting of local-area networks of between twelve and thirty desktop machines. In each venue, one computer was also connected to a data projector, thus enabling its screen’s image to be projected onto a nearby wall. The ‘software-and-hardware’ sessions were held in a science laboratory that had twelve student workstations, each consisting of a number of electronic test instruments as well as a networked personal computer. A number of white boards were also installed around the walls of this latter venue, and if required, the academic had access to an overhead projector. As noted by Anagnostopoulos, et al. (2005), the academic’s physical presence enabled the direct monitoring and controlling of all student activities within each of the venues.
All the participants, both the academics and the students, were pre-selected in a pseudo-random way. By the time this research commenced, the selected academics were already timetabled with their teaching loads, and all the students had already chosen their laboratory or tutorial groups, without any of them being aware of the possibility of their future involvement with this study. Although the students were only observed and their anonymity strictly ensured, appropriate ethics approval was acquired before starting the investigation. While conducting the laboratory or tutorial session, the supervising academic was supplied with a lapel microphone that was plugged into an audio recording device, thus facilitating the creation of an audio record of the ensuing teacher-student interactions for later analysis.

4.2.2: Research method
The data collection process involved a three-layered interpretive model recommended by Wortham and Derry (2006) for media-rich research into social interaction. Their proposal is underpinned by the ‘event matrix’ and consists of three interpretive levels: the ‘raw data layer’, the ‘observed events layer’ and the ‘analysis layer’.

For this part of the study, the participants’ audible interactions (the ‘event matrix’) were recorded by the use of a portable audio recorder (the ‘raw data layer’). While the resultant data only managed to capture certain aspects of the corresponding events, unlike an observer’s recollections, it is fixed and reliably available for later analyses and scrutiny (Polgar & Thomas, 1995). In any case, observers often fail to notice activities that may have had a critical influence on some final conclusions without the ability to rectify this situation after the event. Additionally, if that observer is also the researcher then a bias must be introduced into the collected data by his/her personal experiences (Goldman, 2007).

The recordings from the observed laboratory sessions were transcribed into a hardcopy form (the ‘observed events layer’). Each recording of the observed tutorial sessions was then transferred into ‘storyboards’ (the ‘observed events
layer’) using the process shown in Figure 4.1 with the subsequent addition of time stamps and the corresponding images from the Microsoft® PowerPoint® slide shows that were used to pace the students’ activities during each tutorial class. All the resultant documents were analysed for any identifiable kikan-shido (O’Keefe, et al., 2006) and/or over-the-shoulder-learning/teaching activities by referencing both the descriptors identified in Chapter 2 (the ‘analysis layer’) and the researcher’s 40 years of teaching experience. As recommended by Miles and Huberman (1994), the first few pages of each transcript and storyboard were coded on at least two occasions several days apart in order to ensure internal code-recode reliability, which was found to be above 95% in each case.

Figure 4.1: The ‘storyboard’ creation process (Banky, 2007: 4).

One of the benefits of this three-layered technique is the implied link between the various data forms and the raw data. This documented linkage may be extremely valuable, since:

by explicitly naming layers of the model, by concretizing [sic] interpretive processes, and by demanding that interpretations must “link down” to raw data, the model can illuminate opaque
connections among categories and codes used in research, empirical data, and analysis. (Wortham & Derry, 2006: 850)

Further, this complete process allowed the researcher, any other expert(s) and/or other interested parties to repeatedly review the behaviour of an observed academic and/or a group of students in order to code or recode it anytime (Fraenkel & Wallen, 2006). **Table 4.1** and **Table 4.2** summarise the identified teaching/learning elements that occurred in each of the fourteen recorded sessions.

**4.2.3: Analyses of the results**

A visual comparison between the contents of **Table 4.1** and **Table 4.2** revealed a number of often-repeated exchanges between the participants. The pedagogies practiced in face-to-face learning environments, which result in “real-time interactions [that] offer immediacy, personal contact, and community” (Kuriloff, 2005: 1), were easily observable in all the laboratory and the tutorial sessions.

Accordant with Shimizu (2002) the supervising academic accomplished these by:

walking among the students’ desks, [while] looking at their work, giving some feedback [or] hints, [asking] questions for evaluation, deciding an order of responses for discussion, [and if required] selecting students for the whole class discussion.

(Shimizu, 2002: 3)

This pedagogy, identified as kikan-shido (O’Keefe, et al., 2006), has been vital in the tuition of mathematics, physics, chemistry, general sciences, reading, writing and history (V. Richardson, 2003), therefore detecting it in the collected data, even in a tertiary context, is hardly surprising (Banky, 2007).

During each session, components of constructivist learning\textsuperscript{10} were visible to the observer. The ensuing participation in active learning has been identified as the foundation of most science-based courses (Clow, 1998; Herrington & Nakhleh, 2003; Pickering, 1988), even if the laboratory experiment is simulated on a computer (Pickering, 1988; Wiesner & Lan, 2004), suggesting that ultimately, it is

\textsuperscript{10} “An engaged learner, hands-on interaction with the materials of the task, an authentic problem-solving context, and human interactions during the process” (Gance, 2002).
<table>
<thead>
<tr>
<th>Observed Tutorial Sessions</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venue type</td>
<td>F2F</td>
<td>F2F</td>
<td>F2F</td>
<td>F2F</td>
</tr>
<tr>
<td>Academic id</td>
<td>K</td>
<td>K</td>
<td>K</td>
<td>K</td>
</tr>
<tr>
<td>Student Group id</td>
<td>k</td>
<td>k</td>
<td>k</td>
<td>k</td>
</tr>
<tr>
<td>Computer based</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Hardware based</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of students</td>
<td>10</td>
<td>7</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Students/Computer</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Data projector &amp; screen</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Whiteboard</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**OBSERVED KIKAN-SHIDO ACTIVITIES**

<table>
<thead>
<tr>
<th>Activity</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1 - Selecting Work</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student(s) demonstrate work to all</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic watches students' activity</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic demonstrates using data projector to all</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>M2 - Monitoring Progress</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic watches students' activity one-to-one</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>M3 - Questioning Students</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic watches students' activity one-to-one</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>M4 - Monitoring Homework Completion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic watches students' activity one-to-one</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>G1 - Encouraging Students</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic encouraging students one-to-one</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>G2 - Giving Instruction/Advice at Desk</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic advises using student's computer one-to-one</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Academic uses artefacts to illustrate one-to-one</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G3 - Guiding Through Questioning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic advises using student's computer one-to-one</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Academic uses artefacts to illustrate one-to-one</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>G4 - Re-directing Students</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student uses artefacts to illustrate one-to-one</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>G5 - Answering Questions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic advises using academic's computer one-to-one</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>G6 - Giving Advice at Board</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic using data projector one-to-one</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>G7 - Guiding Whole Class</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic advises using whiteboard one-to-one</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

**PRACTICED OTSI/L PEDAGOGY**

- Table 4.1: Observed participant interaction in face-to-face (F2F) supervised tutorial classes.
Table 4.2: Observed participant interaction in face-to-face (F2F) supervised laboratory classes
the activity and not the context nor the venue that contributes to the achieved highly-desirable student outcomes.

The entries in *Tables 4.1* and *4.2* effectively contain binary data; that is an ‘X’ in a cell indicates the presence of the corresponding item, while an empty cell represents its absence. There is no attempt to quantify the intensity and/or quality of those identified in this way. A cross-tabulation is conventionally performed in order to explore the relationship between two categorical variables that result from binomially-classified objects (Francis, 2007). Since the sample size in this case was small (n=14), the practical significance of any obtained statistical result has to be limited (J. Cohen, 1988). In an attempt to minimise this potential drawback, *Fisher's Exact Test (2-sided)* was identified as the most appropriate statistic for tables with such small frequencies.

The significance probability \( p \) value for *Fisher’s Exact Test (2-sided)* is the probability of obtaining, by chance, an observed difference (in either direction) that is the same as or more extreme than actually observed in the data which has no real or underlying difference. Thus, the smaller the \( p \) value, the more convincing is the evidence of this difference. The tests were carried out at the 0.05 level, meaning that the conclusion of a real difference may only be drawn if the obtained \( p \) value is less than 0.05. It is worth noting that this test does not indicate the magnitude, the importance or the significance (in the common meaning of this word) of the difference between the compared data. The statistical software *SPSS Statistics 17 for Windows* (SPSS Inc. Chicago, IL.) was used to generate the cross-tabulations and to calculate the respective probabilities that are summarised in *Table 4.3*.

A visual inspection of the right-most column of *Table 4.3* (headed ‘Obs’ and obtained for *Tables 4.1* and *4.2*) indicates a calculated \( p > 0.05 \) for all but three cases. These are:

- ‘*Academic demonstrates using data projector to all*’ (\( p=0.001 \));
- ‘*Questioning Students*’ while monitoring their progress (\( p=0.015 \));
• ‘Non-School Related’ socialising ($p = 0.015$).

These results indicate a statistical difference between the observed supervisory practices for the three activities/pedagogies listed above. An explanation for the first is that the contexts were different – unlike the laboratory classes, each tutorial had a mini-lecture format where at the start of that session the theorems relevant to the subsequent problem-solving were reviewed by the supervisor. The second difference was caused by the fact that the syllabus for the totally software-based laboratory exercises were easily completed by the participating students with little or no supervisory intervention. The third difference may be a reflection of the personalities of the participants involved in each of the sessions.

<table>
<thead>
<tr>
<th>OBSERVED KIKAN SHIDO ACTIVITIES</th>
<th>PRACTICED QTST/4 PEDAGOGY</th>
<th>Obs</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1 - Selecting Work</td>
<td>Students demonstrate work to all</td>
<td>0.176</td>
</tr>
<tr>
<td></td>
<td>Academic watches students’ activity</td>
<td>0.176</td>
</tr>
<tr>
<td></td>
<td>Academic demonstrates using data projector to all</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Academic demonstrates using whiteboard to all</td>
<td>1</td>
</tr>
<tr>
<td>M2 - Monitoring Progress</td>
<td>Academic watches students’ activity one-to-one</td>
<td>1</td>
</tr>
<tr>
<td>M3 - Questioning Students</td>
<td></td>
<td>0.015</td>
</tr>
<tr>
<td>M4 - Monitoring Homework Completion</td>
<td>Academic watches students’ activity one-to-one</td>
<td>0.505</td>
</tr>
<tr>
<td>G1 - Encouraging Students</td>
<td>Academic encouraging students one-to-one</td>
<td>0.286</td>
</tr>
<tr>
<td>G2 - Giving Instruction/Advice at Desk</td>
<td>Academic advises using student’s computer one-to-one</td>
<td>0.286</td>
</tr>
<tr>
<td></td>
<td>Academic uses artefacts to illustrate one-to-one</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Academic watches students’ activity one-to-one</td>
<td>0.286</td>
</tr>
<tr>
<td>G3 - Guiding Through Questioning</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>G4 - Redirecting Students</td>
<td>Academic advises using student’s computer one-to-one</td>
<td>0.286</td>
</tr>
<tr>
<td></td>
<td>Academic uses artefacts to illustrate one-to-one</td>
<td>0.245</td>
</tr>
<tr>
<td></td>
<td>Student uses artefacts to illustrate one-to-one</td>
<td>0.505</td>
</tr>
<tr>
<td></td>
<td>Academic watches students’ activity one-to-one</td>
<td>1</td>
</tr>
<tr>
<td>G5 - Answering Questions</td>
<td></td>
<td>0.068</td>
</tr>
<tr>
<td>G6 - Giving Advice at Board</td>
<td>Academic advises using academic’s computer one-to-one</td>
<td>0.505</td>
</tr>
<tr>
<td></td>
<td>Academic using data projector one-to-one</td>
<td>0.57</td>
</tr>
<tr>
<td></td>
<td>Academic advises using whiteboard one-to-one</td>
<td>0.505</td>
</tr>
<tr>
<td>G7 - Guiding Whole Class</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>01 - Handout Material</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>02 - Collect Material</td>
<td></td>
<td>0.505</td>
</tr>
<tr>
<td>03 - Arranging Room</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>S1 - School Related</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>S2 - Non School Related</td>
<td></td>
<td>0.015</td>
</tr>
</tbody>
</table>

*Table 4.3:* Summary of the probabilities ($p$), as calculated by *Fisher’s Exact Test (2 sided)*, that the supervision of students who were participating in problem-solving tutorials and laboratory experimentation was significantly different.
For the other cases where the $p$ values are >0.05, the null hypothesis of no difference between the practiced supervision of students performing problem-based tutorial exercises and laboratory experimentation can be retained. However, in order to decrease the chance of incorrectly concluding that no difference exists, investigations with larger numbers of participants would be required. Testing the hypothesis in as many different teaching contexts as possible would also be valuable.

It has been claimed that the intimate environment usually present in tutorials, small classrooms and practical or laboratory sessions, provides the students with the best opportunity for deep approaches to learning (Toohey, 1999). Clarke (2003a) observed that while performing kikan-shido “on many occasions [the] teachers would kneel or sit beside a student [or students] and engage them in conversation about the task they were attempting” (Clarke, 2003a: 10). In this way, the practiced pedagogy was customised by appropriate questioning, explaining, illustrating, and scaffolding, in an attempt to facilitate the opportunity for deeper approaches to learning (Biggs, 2003).

The incorporation of over-the-shoulder teaching/learning further aided the learning process. As a sub-set of kikan-shido, it was primarily used by the academic either to illustrate issues or to ascertain the student’s current levels of understanding, with the intention of offering any appropriate highly targeted assistance (Twidale, 1999). If, on a one-to-one basis, the academic decided to demonstrate or troubleshoot various parts of the experiment, the student was able to watch this activity over the shoulder of the academic. Thus on a turn-by-turn basis, over-the-shoulder teaching/learning was conducted by all participants - the academic looking over the shoulder of the student, the student looking over the shoulder of the academic and/or another student, and so on.

In some of the observed laboratory sessions, the academics also used the opportunity provided by kikan-shido to check on their students’ preliminary work. The mandatory completion of such pre-laboratory exercises is one of the two
asynchronous activities that are commonly part of face-to-face learning-by-doing pedagogy - the other being an individual- or a group-submitted, out-of-session-produced, formal report, detailing the experiment, its results and the ensuing conclusion(s). The complete student experience illustrates how in practice the received education may be represented as points on a continuum (Rosenberg, 2001), where the extremities are commonly referred to as synchronous (Latchman, et al., 1999) and asynchronous respectively.

Irrespective of the subject matter covered in the sessions, the format of each one was very similar. In all instances, the observed common major activities were:

- the academic verbally overviewing the session’s aims and objectives for the benefit of all the students;
- the academic, with the aid of a projector and/or white board, demonstrating to the whole class the procedure necessary to obtain some key outcomes;
- the academic monitoring student activity while walking around the room;
- the academic, using the student’s computer, demonstrating, one-to-one, some relevant process to the student;
- the academic conversing with the student(s) on a variety of issues.

This qualitative analysis indicated that the observed kikan-shido and over-the-shoulder teaching/learning pedagogy was an integral part of the delivery of experiential learning which in turn has been identified as a key learning style for sciences-based education. In addition to the obvious verbal and visual interactions that are part of the pedagogy, the face-to-face mode facilitates a number of non-verbal behaviours, such as “smiling, having a relaxed body posture and position, speaking to the students rather than to the chalkboard, using [visual] humor, and modulating the voice” (Weaver & Albion, 2005: 703), that encourages many learner preferences. Furthermore, the students’ perception of their classroom or laboratory environment has been shown to have an effect on their experiences and the consequential learning outcomes (Newby & Fisher, 1997, 1998).
4.3: Researching online experiential learning

4.3.1: Research details

In an attempt to investigate the practiced pedagogy for experiential learning in an online environment, three randomly selected academics, who asynchronously supervised computer-screen-based experiential learning at Higher Education facilities in Australia and the United States, were interviewed either in person or by telephone. These academics devised learning tasks that asked the students to electronically submit reports detailing their completed virtual laboratory experimentations that comprised either observing the outcomes shown on video clips of actual experiments (Rodríguez, Silva, Rosano, Contreras, & Vitela, 2001), or obtaining their own results from a software simulator running remotely on a computer network server.

These interviews produced qualitative results that were biased by the interviewees’ perspectives, since their retold experiences were “from the point of view of those who live[d] it” (Schwandt, 1994: 118). In fact, selectivity is prevalent for all data gathering (Miles & Huberman, 1994). While these three academics were very experienced with the delivery of face-to-face education, they all admitted to having very limited past exposure to online teaching. They all concurred with Kuriloff (2005) that the online absence of many face-to-face interactions were difficult to compensate, and with Rohfeld and Hiemstra (1995) who articulated some of the important responsibilities of the online instructor, which included:

- keeping discussions on track, contributing special knowledge and insights, weaving together various discussion threads and course components, and maintaining group harmony.

(Rohfeld & Hiemstra, 1995: 91)

The three academics also agreed with the vital need to maintain a variety of clear bi-directional communication channels between all the participants. Tucker and Cordani (1998) recommended that these should include:

- student-and-academic, particularly regarding the submission and return of assessable work;
• academic-and-many students, where the information originates from and is controlled by the academic;
• many-and-many, that is open to all, and monitored by the academic;
• many-and-many, forming a subgroup that is academic- and/or student-organised.

4.3.2: Analyses of the results
In line with common practice, the syllabi of all three subjects under consideration were delivered asynchronously via narrow bandwidth written communication (Feenberg, 1999). In each case the students’ progress was indirectly monitored by the respective academic, who deduced this from their postings in chat rooms, on bulletin boards, in news groups and/or the contents of received e-mails. All these communication modes had clearly identifiable limitations; for example:

online discussion forums promoted high levels of cognitive engagement and critical thinking, [but] the virtual learning space of an online forum did not promote the coherent and interactive dialogue necessary for conversational modes of learning.
(Thomas, 2002: 361)

Fundamentally, for collaborative learning to occur, the participants must engage in what they perceive as a normal discussion (Pincas, 1998). However, this perception is virtually impossible to achieve while using any of the above-listed, online communication tools that inherently allow for many conversation threads to be open simultaneously, thus eliminating the fundamental face-to-face experience of ‘turn taking’ (Berge & Collins, 1995a; Mitchell, Dipetta, & Kerr, 2001).

On rare occasions, when a student’s command of the English language was insufficient and tended to cause problems, the academic had to resort to the use of synchronous technology such as the telephone or even a webcam. The academics’ perceived need to occasionally turn to synchronous verbal and/or visual communication further confirms the merit of face-to-face dialogue (Thomas, 2002). Postman (1992) clearly identified that oral communication facilitates group learning, and cooperation and social responsibility, while print is
more suitable for individual learning, competition and personal independence, thus highlighting the conclusion that these two communication modes will never deliver identical pedagogical outcomes.

All the interviewees agreed that asynchronous communication potentially provided the participants with ample time to think before writing their responses (Guan, et al., 2006) - a characteristic of this technology that has been confirmed by other researchers (Cheaney & Ingebritsen, 2005; de Moraes, et al., 2003; Hmelo-Silver, et al., 2005; Stodel, et al., 2006). Interestingly, none of them indicated, as found by Toohey (1999), that some of their students may have been reluctant to expose risky opinions to the scrutiny of others, which is permitted by online submissions. However, they did highlight one negative aspect that resulted in the students’ feelings of isolation and dissatisfaction with their courses that was caused by the often significant communication delays unbearably slowing or even prematurely halting the current discussion threads’ progress.

The three academics also identified the inherent ‘at any time and from anywhere’ nature of asynchronous online delivery (Guan, et al., 2006; Guzmán, et al., 2005; Vat, 2001) as the main reason for them choosing this approach. In line with the findings of Beuschel (1998) two of them only offered the online activities as supplemental rather than as alternatives to the traditional forms of teaching. The third one delivered a totally online version, since all its participating students were physically dispersed in different time zones around the globe. All three were in agreement that such high levels of flexible access to education are not easily available in face-to-face environments; and acknowledged that such freedoms must exact greater levels of student commitment (Cheaney & Ingebritsen, 2005; de Moraes, et al., 2003; Vat, 2001).

Furthermore, students from cultures where teaching is purely oral, for example the Native Americans (Baldwin, 1995), and/or who have a difficulty communicating by the written word (Baldwin, 1995; Stodel, et al., 2006) found that the necessity for written responses was very frustrating. The broad suitability of text-based
online communications for the delivery of non-lecture-based content has been queried because of this medium’s inherent lack of context cues that limit one’s ability to persuade others (E.V. Wilson, 2003). Another identified limitation of written communication is its inability to convey useful face-to-face non-verbal reactions such as “paying attention, understanding, agreeing, [being] surprised, shocked, confused or even [being] in the room” (Wainfan & Davis, 2004: 25). This has been confirmed by students, who after experiencing a variety of communication modes while completing group projects, identified their face-to-face as more effective than their text-based online interactions (E. V. Wilson, Morrison, & Napier, 1998).

After the completion of each interview, the resulting notes were analysed with the aim of identifying any attempts, by the respective academics, at some form of kikan-shido and/or over-the-shoulder teaching/learning pedagogy. This analysis resulted in the matrix shown in Table 4.4. In this way the online-supervised problem-based learning was indirectly ‘observed’ by the researcher, where the source of the ‘observations’ were second-hand; based on the perceptions from a single, and a possibly, biased source – the academic responsible for delivering the subject. Naturally, triangulation\textsuperscript{11} of the results from data would have been useful, particularly since in online delivery, the student experience, as well as the overall outcome, is noticeably effected by technology, such as the characteristics of access gateways that significantly contribute to “making the learning timely and meaningful … [by] providing information, assessment, bulletin boards, chat rooms, and grade databases” (McKelvy, 2000: 49).

\textbf{4.4: Comparing the pedagogy}

Of the research questions listed in \textit{Chapter 1.3}, the following were examined in this part of the study:

\textsuperscript{11} “Triangulation has been generally considered a process of using multiple perceptions to clarify meaning, verifying the repeatability of an observation or interpretation” (Stake, 2005: 454).
Table 4.4: Implied and deduced participant interaction for online experiential activity.
Q1: Which kikan-shido activities and over-the-shoulder teaching/learning pedagogies were observable in face-to-face supervised laboratory experimentation?

Q2: Which kikan-shido activities and over-the-shoulder teaching/learning pedagogies were observable in face-to-face supervised problem-solving tutorial classes?

The issue of common and exclusive practiced pedagogy is presented in a Venn diagram, shown in Figure 4.2, which was created by the researcher with reference to the face-to-face and online supervisory pedagogy summarised in the three matrices shown in Table 4.1, Table 4.2 and Table 4.4.

There appeared to be a significant number of common pedagogies practiced by both the observed and the interviewed academics. The clearly asynchronous items in the overlapped region of the Venn diagram, and marked with an *, tend to be delivered outside of any face-to-face sessions. The placing of a pedagogy into the overlapped area does not imply complete equivalence. The reality is that the characteristics of the physical components of the online learning platforms, particularly the often considerable communication delays that are inherent in asynchronous delivery, cannot be ignored.

Due to the asynchronous nature of their systems, the interviewed academics were restricted to practicing an ‘inferred’ version of kikan-shido and over-the-shoulder teaching/learning. As confirmed during the interviews, student progress was typically ascertained by attempting to interpret the regularly received written student communications, such as e-mails, postings and uploaded files, which were assumed to reflect the on-going progress of both the individuals and the cohort as a whole. Similar styles of feedback have also been used during on-campus delivery, where assessable submissions, such as assignments, preliminary laboratory work and formal laboratory reports may be used to indirectly determine student progress; hence classifying these activities as examples of inferred kikan-shido and/or inferred over-the-shoulder teaching/learning.
Figure 4.2: Common and exclusive pedagogy observed in face-to-face (F2F) and deduced in asynchronous online active learning environments
Face-to-face venues not only support real-time, synchronous, kikan-shido and over-the-shoulder teaching/learning, but also facilitate all the important non-verbal communication elements such as facial gestures, body language and hand movements (Brooke, 2008).

Delivering online distance education via the Internet or a wide-area network theoretically permits the economic participation of anyone from ‘any place’ and at ‘any time’. Additionally, the inherent delays of asynchronous online communication remove the pressures caused by the need for immediate reply and tend to facilitate more reflective responses as well as affording “those with physical limitations or personal reticence to participate fully and equally in communicative activities” (Berge & Collins, 1995b: 4). While the latter is a contentious equity issue for a number of students, its seamless accomplishment in face-to-face environments has been found to be inherently impractical, often resulting in highly embarrassing situations and negative educational outcomes for all concerned.
Chapter 5 - Face-to-face and online supervised experiential learning trial

The ongoing face-to-face interaction between teacher and students, and among students themselves, was an integral part of a university education … online teaching and learning can be done with high quality if new approaches are employed … and if professors make an effort to create and maintain the human touch of attentiveness to their students. (Regalbuto, 1999: 2)

5.1: Overview

This chapter investigates the possibility of mimicking over a local-area network of computers the pedagogy practiced during the face-to-face supervision of student problem-solving in a tertiary institution. As documented in the previous chapter, the analyses of the observations and recordings of participant interactions in face-to-face laboratories and problem-solving tutorials have clearly indicated that kikan-shido with over-the-shoulder teaching/learning was employed by the supervising academics. The wide range of interactions that are possible with kikan-shido and over-the-shoulder teaching/learning stimulated the investigation of communication systems that could facilitate online the participant collaborations that take place in the classroom (Latchman, et al., 1999; Woodley, 2001). Ultimately giving distance educators access to a Web-based facility that enables them to mimic both real-time kikan-shido and over-the-shoulder teaching/learning should “broaden the set of activities that are used to support learning in an e-learning context” (Britain, 2004: 3), and consequently minimise the discouragement of students, which in turn is the often stated reason for them aborting their studies (Böhne, et al., 2004b).
The ability to give prompt feedback, that is an inherent characteristic of face-to-face, over-the-shoulder teaching/learning, is one of Chickering and Gamson's (1987) ‘Seven Principles of Effective Education’ (Dziuban, Shea, & Arbaugh, 2005) and is a valuable bonus of this teaching style.

The data collection and analyses instruments that were used included:
- audio recordings of face-to-face and online supervised tutorials;
- reflective journal of supervising academic;
- audio recordings of post-event focus groups;
- transcription of audio recordings into ‘storyboards’ or text;
- post-event surveys of participants;
- binary coding of identifiable participant interactions;
- cross-tabulation of coded data;
- application of appropriate statistical analysis tools to the cross-tabulations.

5.2: Choosing the technology

Researchers have identified the need for both teachers and learners to have access to technologies that facilitate a variety of interactions in an online learning context (Hughes & Hewson, 1998; Ramsden, 2003; Toohey, 1999), which in turn directly affect educational quality (Mandernach, et al., 2006). Early implementations of commercially available learning platforms that combined both ‘desktop conferencing’ and ‘synchronous communication’ appeared to support virtual co-location (Böhne, et al., 2004b; Faltin, Böhne, & Wagner, 2004; Mark, Grudin, & Poltrock, 1999) and provided the ability for the participants to retain many aspects of face-to-face meeting behaviours (Singh, Twidale, & Rathi, 2006); some even considered this to be on par with being supported by a local tutor (Bright, et al., 2008).

However, the currently available software products, such as MasterEye Vision 6 (Codework Ltd., Stockport, UK), NetSupport School (NetSupport Inc., Peterborough, UK) and NetOp School (Netop Solutions A/S, Birkerod, DK), were designed for operation with computers that were connected via a local-area
network (Briner Jr., Roberts, & Worthy, 2005; Rajala, 2004) rather than wide-area networks such as the Internet. An alternative that has been designed for the Internet, enVision (http://www.xiom.org/), contains only one single shared workspace and a real-time communication tool that is text rather than audio based (Hooper, Pollanen, & Teismann, 2006). These features limit such software’s suitability for use in conventional distance education environments.

Windows® NetMeeting™ (Microsoft Corporation, Redmond, WA, USA) is an Internet-based “real-time collaboration and conferencing client” (NetMeeting, 2006) that can be used to establish a connection between two computers only (Herring & Rees, 2001; S. J. E. Taylor, 2001b), making it unsuitable for the supervision of multi-student classes. Still, its ability to enable both ‘application sharing’ (S. J. E. Taylor, 2001b) and ‘audio communication’ has been shown to result in effective teamwork (Barile & Durso, 2002) and greater productivity by the effortless establishment of some “common ground about the object of the … discussion” (G. M. Olson & Olson, 2000: 160). Marques and Hsu (1999) affirmed the appropriateness of Windows® NetMeeting™ for one-to-one tutoring in a distance education context. Other researchers have used this software to investigate online collaboration (Barile & Durso, 2002; Herring & Rees, 2001; Marques, Hsu, & Sharda, 1999; S. J. E. Taylor, 2001b), teleconferencing (Buravkov, 2001; Wade, Wolfe, & Pestian, 2004), virtual classrooms (Marques & Hsu, 1999) and unsupervised, remote, laboratory experimentation (Swamy, et al., 2002; Thai & Upchurch, 2002). Thai, et al. (2006) reported on the success of using a mixture of software (including NetSupport School, NetSupport Control and Windows® NetMeeting™) to allow selected students to demonstrate remote laboratory experiments to others, who were concurrently attending physical venues in both the US and Japan.

Olson and Olson (2000), while investigating ‘computer-supported cooperative work’ by collaborators who were not co-located, found that:

those with video connections produced output that was indistinguishable from that produced by people who were face to face [sic]. The process of their work changed, however, to
require more clarification and more management overhead. …
[In summary] remote work is hard to conduct, even with the best of today's technologies. (G. M. Olson & Olson, 2000: 152)

A commonly cited limitation of the earlier discussed implementations is their inability to innately transmit the often critical non-verbal cues that are part of all face-to-face interactions (Short, et al., 1976). Following their research into the psychology of audio-based telecommunication, Short, et al. (1976) found that much of the visual channel information is also available via the audio channel through a variety of cues such as pitch, drawl, pauses, tones, choice of words, loudness, grammar and sentence completion - in fact, the human auditory channel has been identified as the most important communication medium (Scanlon, et al., 2002). Participants who find themselves in such situations tend to compensate by becoming extra-sensitive to the above-listed voice characteristics, as long as English is not their second language (Veinott, et al., 1999; as cited in G. M. Olson & Olson 2000). The research established that communication tasks that express emotion and/or are designed to manipulate others will suffer the most from the lack of any visual connection. On the other hand, audio-transmitted cognitive information should be relatively unaffected (Short, et al., 1976).

The differences between the options of oral and written online communication are highlighted by the fact that the former “stresses group learning, cooperation and a sense of social responsibility … [while the latter] stresses individualised learning, competition and personal autonomy” (Postman, 1992: 17; as cited in Thomas, 2002). Furthermore, a survey conducted by Ritter and Lemke (2000) confirmed that e-mail was an unviable alternative for face-to-face communication. Consequently, all of these studies clearly vindicate the choice of audio rather than written communication to attempt the successful mimicking online of some elements of face-to-face pedagogy.
Although NetSupport School\textsuperscript{12} has been designed for individual student use in information and computer technology (ICT) laboratory classes, its selection for the trial was based on its applicable features, which include:

- one-to-one, bi-directional audio communication between selectable users;
- the support for showing a computer desktop on selected participants’ screens;
- the ability to monitor either the screen activity of one student or the entire class over a local-area network;
- the facility to remotely take control of the keyboard and the mouse of another computer.

5.3: Details of the trial

A small-scale trial was performed to investigate the following research questions:

Q3: Which kikan-shido activities and over-the-shoulder teaching/learning pedagogies were observable in face-to-face and online-supervised, computer-screen-based, problem-solving tutorial sessions?

Q3.1: How successful was the online student supervision of active learning?

Q3.1.1: What were the participants’ perceptions of being there (telepresence)?

Q3.1.2: What were the participants’ perceptions of being separated from the others (transactional distance)?

Q3.1.3: What were the participants’ perceptions of other participants’ availability (transactional presence)?

In recognition of the fact that any participating student was to receive a potentially different treatment, an ethics application was prepared, submitted to the appropriate committees and an approval subsequently obtained. The student participants were selected from a cohort who was enrolled, in 2007, into a subject on electronic circuit behaviour that is taught in the early years of all engineering

\textsuperscript{12} The researcher acknowledges the in-kind support provided by NetSupport Inc., Peterborough, UK, in the form of a restricted NetSupport School site licence for use in the trial.
degree courses offered at Swinburne University of Technology. For this subject, over its 12 week-long teaching period, each student was timetabled for 36 one-hour lectures, 12 one-hour tutorials, and 6 two-hour laboratory sessions. At the start of the academic year, without being aware of this research project, all the prospective students were instructed to register through an online portal their selection for attending one of 17 timetabled tutorial groups. At the beginning of the second teaching semester, the researcher selected two of these groups to tutor. This selection was based only on the availability of a specific computer laboratory at the already-scheduled tutorial timeslots, on whose desktop computers copies of the software required for the research were already installed. In this way, the student participants were selected in a pseudo-random fashion.

The researcher’s involvement in such a pivotal fashion, by conducting the tutorials, had to introduce some level of bias. However, this was impractical to avoid, since, as the online supervision concept was totally novel and untried, other academics were unwilling to participate in this hands-on component of the study. When questioned about their reluctance, their response was the fear that any consequential negative student feedback could unfairly affect their highly valued teaching records.

In each of the tutorial sessions, the students were scheduled to engage in some ‘pen-and-paper’-based active learning; namely attempting to complete a number of problem-solving exercises. In order to introduce a computer-screen-based activity, the researcher integrated the use of the electronics circuit simulation software, Electronics Workbench™ Multisim 2001 Text Book Edition (Prentice Hall, New Jersey, USA), into his delivery of the curriculum. Consequently, in his two tutorial classes, the students were required to initially simulate electronic circuits on a computer screen, take appropriate measurements of electrical quantities such as voltages, currents and waveforms, and then mathematically verify their results; or alternatively once they completed their calculations verify these with appropriate simulations.
Figure 5.1 shows an example of a circuit simulation created by using the above-mentioned software. From the perspective of this research, the use of such software allowed the introduction of computer-screen-based activities that could be supervised either face-to-face or online. Earlier research found that student use of this software in the study of electronic circuit theorems encourages deeper levels of learning (Banky & Wong, 2007) – making the introduction of this tutoring approach an ethically acceptable alternative.

Consultation with staff from Swinburne University of Technology IT Support resulted in the use of a computer laboratory divided by a glass wall into two physically separated but neighbouring, areas (shown in Figure 5.2). There were 12 networked desktop personal computers in each part of this laboratory. NetSupport School, via its built-in audio communication and a range of application-sharing services, facilitated the remote supervision of the students’ on-screen activities over the University’s local-area network. Figure 5.3 illustrates
**Figure 5.2:** Computer laboratory used for investigating face-to-face and online supervised active learning.

**Figure 5.3:** Network topology for online supervision over a local-area network (LAN).
the layout of the resultant computer-mediated communication network that was created by *NetSupport School* thus enabling the online supervision of active learning.

During each of the tutorial classes, the supervision of the students’ computer-screen-based activities was either face-to-face or online, and, as shown in Table 5.1, was varied week-by-week and group-by-group. This approach has been identified as ‘*Quasi-experimental Design*’ (S. M. Ross & Morrison, 2004).

![Table 5.1: Student activity supervision modes.](image)

As seen in Table 5.2, the numbers of students who attended these tutorials also varied from week-to-week and from group-to-group. The initial ‘settling-in period’ followed by relative stability of attendee numbers that was observed for these two tutorial groups is typical for tutorial classes in tertiary institutions.

In compliance with the ethics approval for this project, during the first session, the students in each tutorial group were given a copy of the mandatory ‘plain language information document’ (shown in Appendix B.1) and a ‘consent form’ (shown in Appendix B.2) that was to be individually signed and then returned at the following session by those who elected to participate in the research project. These preliminaries were followed by an introduction to both the simulation and the collaboration software. The resultant student activity enabled the researcher to familiarise himself, *in-situ*, with the user interface of *NetSupport School*. 

<table>
<thead>
<tr>
<th>Teaching Week</th>
<th>Content</th>
<th>Group 07</th>
<th>Group 11</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Software Familiarisation</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>Tutorial 1</td>
<td>face-to-face</td>
<td>face-to-face</td>
</tr>
<tr>
<td>3</td>
<td>Tutorial 2</td>
<td>online</td>
<td>online</td>
</tr>
<tr>
<td>4</td>
<td>Tutorial 3</td>
<td>face-to-face</td>
<td>online</td>
</tr>
<tr>
<td>7</td>
<td>Tutorial 7</td>
<td>online</td>
<td>online</td>
</tr>
<tr>
<td>8</td>
<td>Tutorial 8</td>
<td>face-to-face</td>
<td>face-to-face</td>
</tr>
<tr>
<td>9</td>
<td>Tutorial 9</td>
<td>online</td>
<td>face-to-face</td>
</tr>
<tr>
<td>10</td>
<td>Tutorial 10</td>
<td>face-to-face</td>
<td>online</td>
</tr>
<tr>
<td>11</td>
<td>Tutorial 11</td>
<td>online</td>
<td>online</td>
</tr>
<tr>
<td>12</td>
<td>Focus group</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

*Table 5.1: Student activity supervision modes.*
As already detailed in Chapter 4.2.2, the data collection process employed a three-layered interpretive model for media-rich research into social interaction that is underpinned by the ‘event matrix’ and consists of: the ‘raw data layer’, the ‘observed events layer’ and the ‘analysis layer’ (Wortham & Derry, 2006).

For the face-to-face supervised sessions, the verbal interaction that occurred (the ‘event matrix’) was recorded on a portable audio recorder (the ‘raw data layer’) by clipping a lapel-microphone to the academic. These recordings were transcribed into ‘storyboards’ (the ‘observed events layer’) with the subsequent addition of time stamps and the corresponding images from the Microsoft® PowerPoint® slide shows that were used to pace the students’ activities during each tutorial class, as shown in Figure 4.2.

For the online, supervised sessions, each student’s computer screen activities (the ‘event matrix’) were recorded using the appropriate in-built feature of NetSupport School (the ‘raw data layer’). NetSupport School’s feature of bi-directional audio communication over the local-area network was utilised to facilitate discussion between the participants who were wearing personal microphone-headsets during these tutorials. Later, these recordings were converted into video files (the ‘observed events layer’)

<table>
<thead>
<tr>
<th>Teaching Week</th>
<th>Content</th>
<th>Group 07</th>
<th>Group 11</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Software Familiarisation</td>
<td>20</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>Tutorial 1</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td>Tutorial 2</td>
<td>17</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>Tutorial 3</td>
<td>15</td>
<td>9</td>
</tr>
<tr>
<td>7</td>
<td>Tutorial 7</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>Tutorial 8</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>9</td>
<td>Tutorial 9</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>10</td>
<td>Tutorial 10</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>11</td>
<td>Tutorial 11</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>12</td>
<td>Focus group</td>
<td>10</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 5.2: Student attendance summary.
The resultant documents were analysed for any identifiable kikan-shido (O'Keefe, et al., 2006) and/or over-the-shoulder teaching/learning activities with reference to the descriptors discussed in Chapter 2 (the ‘analysis layer’) and listed in Table 5.3. As recommended by Miles and Huberman (1994), the first few pages of each storyboard or at least the first 15 minutes of each video were coded on at least two occasions several days apart, in order to confirm that the code-recode reliability during the analysis process was in excess of 95% in all instances.

<table>
<thead>
<tr>
<th>Venue type</th>
<th>Academic (Teacher)</th>
<th>Student (Teachee)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Id</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student Group Id</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer based</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardware based</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of students</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students/computer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data projector &amp; screen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whiteboard</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBSERVED KIKAN-SHIDO</th>
<th>PRACTICED OTST/L PEDAGOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1 - Selecting Work</td>
<td>Student(s) demonstrate work to all</td>
</tr>
<tr>
<td></td>
<td>Academic watches students’ activity</td>
</tr>
<tr>
<td></td>
<td>Academic demonstrates using projector to all</td>
</tr>
<tr>
<td></td>
<td>Academic demonstrates using whiteboard to all</td>
</tr>
<tr>
<td>M2 - Monitoring Progress</td>
<td>Academic watches students’ activity one-to-one</td>
</tr>
<tr>
<td>M3 - Questioning Students</td>
<td>Questioning</td>
</tr>
<tr>
<td></td>
<td>Analyzing</td>
</tr>
<tr>
<td>M4 - Monitoring Homework Completion</td>
<td>Academic watches students’ activity one-to-one</td>
</tr>
<tr>
<td>G1 - Encouraging Students</td>
<td>Academic encouraging students one-to-one</td>
</tr>
<tr>
<td>G2 - Giving Instruction/Advice at Desk</td>
<td>Academic advises using student’s computer one-to-one</td>
</tr>
<tr>
<td></td>
<td>Academic uses artefacts to illustrate one-to-one</td>
</tr>
<tr>
<td></td>
<td>Academic watches students’ activity one-to-one</td>
</tr>
<tr>
<td>G3 - Guiding Through Questioning</td>
<td>Questioning</td>
</tr>
<tr>
<td>G4 - Re-directing Students</td>
<td>Academic advises using student’s computer one-to-one</td>
</tr>
<tr>
<td></td>
<td>Academic uses artefacts to illustrate one-to-one</td>
</tr>
<tr>
<td></td>
<td>Academic watches students’ activity one-to-one</td>
</tr>
<tr>
<td>G5 - Answering Questions</td>
<td>Academic advises using academic’s computer one-to-one</td>
</tr>
<tr>
<td>G6 - Giving Advice at Board</td>
<td>Academic using projector one-to-one</td>
</tr>
<tr>
<td></td>
<td>Academic advises using whiteboard one-to-one</td>
</tr>
<tr>
<td>G7 - Guiding Whole Class</td>
<td>Organising</td>
</tr>
<tr>
<td>G1 - Handout Material</td>
<td>Organising</td>
</tr>
<tr>
<td>G2 - Collect Material</td>
<td>Organising</td>
</tr>
<tr>
<td>G3 - Arranging Room</td>
<td>Organising</td>
</tr>
<tr>
<td>S1 - School Related</td>
<td>Socialising</td>
</tr>
<tr>
<td>S2 - Non-School Related</td>
<td>Socialising</td>
</tr>
</tbody>
</table>

**Table 5.3:** Matrix headings for analysing kikan-shido and over-the-shoulder teaching/learning events

For this investigation, the procedure described above was chosen in preference to the multi-camera recording technique used by O'Keefe, et al (2006), in part because the latter can only be used on one student per session in a face-to-face venue. Furthermore, the use of an outside observer was also rejected since it is virtually impossible to subsequently scrutinise and verify the collected data with any degree of confidence (Polgar & Thomas, 1995). In general, observers often
fail to notice activities that may have had a critical influence on the results. However, audio or video recordings of the sessions result in permanent records that permit the researcher, expert(s) and/or other interested parties to repeatedly review the behaviour of an academic or a group of students, in order to code or recode it anytime (Fraenkel & Wallen, 2006).

As soon as practicable after the conclusion of each tutorial session, the researcher also documented for later analyses, his reflections on the aims, execution, and success of either the face-to-face or the online supervision of the participating students’ activities.

The last session for each tutorial group was devoted to a post-trial survey, shown in Figure 5.4, and a focus group that was led by two colleagues of the researcher, both of whom were not directly involved in this research activity. In these focus groups, the students were canvassed for:

- their perception of isolation while being supervised;
- the availability of help if and when needed;
- a qualitative comparison between their learning experiences in face-to-face supervised tutorials in other subjects;
- a qualitative comparison between their learning experiences in the face-to-face and online supervised sessions comprising the research trial;
- the importance of the response times of any student-academic interaction to their learning experience.

The two right-most columns of Table 5.3 list the ‘student-academic interactions’ and the ‘student activities’ that were targeted by the supervisor with the corresponding kikan-shido and/or over-the-shoulder pedagogy during the trial. These are subsets of two lists of classroom interactions and activities which were presented in the post-trial survey, shown in Figure 5.4, and created by summarising the findings of Laurillard (2002), Duffy & Cunningham (1996) and Marton & Ramsden (1988).
Please indicate, by placing an X in the column that best describes your opinion regarding each of the following statements:

<table>
<thead>
<tr>
<th>Column</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
<th>Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q4.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

During the semester while you were using the circuit simulator software your tutor was available to assist you either while being physically next to you (F2F) or over the LAN.

Please indicate by placing an X in the appropriate columns if, while using the simulator, you noticed your tutor performing any of the following teaching tasks with you:

<table>
<thead>
<tr>
<th>Teaching Tasks</th>
<th>F2F</th>
<th>LAN</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Questioning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explaining</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emphasising</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illustrating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rewarding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interpreting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organising</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socialising</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adapting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Challenging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demonstrating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discussing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encouraging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Giving feedback</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guiding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interacting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reflecting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rewarding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scaffolding</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In your opinion what are the educational values of the F2F activity monitoring that you have received in these tutorials:

In your opinion what are the educational values of the LAN activity monitoring that you have received in these tutorials:

---

Figure 5.4: Post-trial questionnaire.
The reflective journal, the post-trial survey and the focus groups afford a level of triangulation that should minimise any systematic bias that may have been introduced into the collected data (Patton, 1999), which are summarised, analysed and discussed in the next chapter of this thesis.
Chapter 6 - Analyses and discussion of the trial results

*Not everything that counts can be counted and not everything that can be counted counts.*

(From a sign in Albert Einstein's office at Princeton University, Princeton, NJ.).

### 6.1: Overview

The data collection design employed both observable practices\(^\text{13}\) and the participants' interpretations of those practices\(^\text{14}\) (Clarke, 2002a). Recordings enable post-analysis from different perspectives by experts, as often as necessary (Derry, 2007; Hiebert, et al., 2003). Theoretically, recorded data facilitates the subsequent use of both quantitative and qualitative research tools following the required completion of their conversions into objective and verifiable forms (Jacobs, Kawanaka, & Stigler, 1999).

The following sets of data were collected during the trial:

- identification of any kikan-shido activities and over-the-shoulder teaching/learning pedagogy by examining the recordings of both face-to-face and online supervised tutorial sessions (*Table 6.1* and *Table 6.2*);
- identification of any kikan-shido activities and over-the-shoulder teaching/learning pedagogy by examining the academic’s post-event reflective journal entries of both face-to-face and online supervised tutorial sessions (*Table 6.3* and *Table 6.4*);

\(^{13}\) Obtained from session recordings.

\(^{14}\) Obtained from post-event reflective journal entries, post-trial questionnaires and post-trial focus group contributions.
• responses to a post-trial student survey (shown in Figure 5.4) on a Likert scale, seeking the overall help they received and their feelings of isolation during both face-to-face and online supervised tutorial sessions (Table 6.6);
• responses to a post-trial student survey (shown in Figure 5.4) on a binary scale, seeking their perception of the presence of a list of teaching tasks and learning activities (Table 6.7 and Table 6.8);
• responses to a post-trial student survey (shown in Figure 5.4) free-form questions, seeking the educational benefits of face-to-face and online supervised tutorial sessions that comprised the completed trial;
• transcripts of post-trial focus groups conducted by independent academics.

Subsequent analyses of the collected data, which are detailed in this chapter, established that:
• software utilities that support network-based audio communication and remote computer desktop control enable the online mimicking of some face-to-face pedagogy;
• post-trial feedback of participant perception indicated a reduction in transactional distance and an improvement in transactional presence and telepresence for students who were engaged in some computer-based learning-by-doing while being supervised in real-time over a local-area network.

6.2: Analyses of the collected data

6.2.1: General Observations
A visual inspection of the columns labelled \textbf{T1} to \textbf{T4} and \textbf{T7} to \textbf{T11} in Table 6.1 and Table 6.2 clearly indicates that there were minimal differences between the identified activities and pedagogies for the recorded face-to-face and online supervised tutorial sessions. A similar conclusion may be drawn from examining Table 6.3 and Table 6.4 which record the academic’s recollections of the events as described in the entries of the post-event reflective journal which was
completed following each face-to-face or online supervised tutorial session. In line with the findings of O’Keefe, et al (2006) such differences may be accounted for by the degree of difficulty of the given tasks and/or the needs of the students who were performing these rather than by any limitations of the employed technology. The results also indicate that Laurillard’s Conversational Framework processes, as detailed in Figure 2.3, were achieved in both supervisory modes with the use of kikan-shido.

With reference to Table 5.1, tutorials T4, T9 and T10 were ‘matched pairs’, in that during each of these sessions the two student groups, Group 07 and Group 11, were subjected to either face-to-face or online supervision while covering essentially the same curriculum. However, this sample is too small for conducting a ‘matched pair’ analysis.

Conversely, the binary data obtained for the activities and pedagogies for the 16 tutorial sessions, T2 – T5 and T8 – T11 for both groups, may be statistically analysed for any significant differences between the two supervision modes practiced during the trial.

The entries in Tables 6.1, 6.2, 6.3 and 6.4 effectively contain binary data; that is an ‘X’ in a cell indicates the presence of the corresponding item, while an empty cell represents its absence. There is no attempt to indicate the intensity and or quality of the items identified in this way. As already mentioned in Chapter 4.2.3, cross-tabulation is conventionally performed in order to explore the relationship between two categorical variables that result from binomially-classified objects (Francis, 2007). Since the sample size in this case was small (n=16), the practical significance of any obtained statistical result has to be limited (J. Cohen, 1988). In an attempt to minimise this potential drawback, Fisher's Exact Test (2-sided) was identified as the most appropriate statistic for tables of data with such small frequencies.
<table>
<thead>
<tr>
<th>GROUP 07 Tutorials</th>
<th>Academic (Teacher)</th>
<th>Student (Teacher)</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
<th>T7</th>
<th>T8</th>
<th>T9</th>
<th>T10</th>
<th>T11</th>
<th>T12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Versus type</td>
<td>F2F online</td>
<td>F2F online</td>
<td>F2F online</td>
<td>F2F online</td>
<td>F2F online</td>
<td>F2F online</td>
<td>F2F online</td>
<td>F2F online</td>
<td>F2F online</td>
<td>F2F online</td>
<td>F2F online</td>
<td>F2F online</td>
<td>F2F online</td>
<td></td>
</tr>
<tr>
<td>Academic Id</td>
<td>K</td>
<td>K</td>
<td>K</td>
<td>K</td>
<td>K</td>
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<td>K</td>
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<td>K</td>
<td>K</td>
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<td>K</td>
<td>K</td>
</tr>
<tr>
<td>Student Group Id</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
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<td>Computer Based</td>
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<tr>
<td>Hardware Based</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Number of students</td>
<td>15</td>
<td>17</td>
<td>15</td>
<td>15</td>
<td>12</td>
<td>12</td>
<td>10</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students computer</td>
<td>1 &amp; 2</td>
<td>1 &amp; 2</td>
<td>1 &amp; 2</td>
<td>1 &amp; 2</td>
<td>1 &amp; 2</td>
<td>1 &amp; 2</td>
<td>1 &amp; 2</td>
<td>1 &amp; 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data projector &amp; screen</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whiteboard</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**OBSERVED KIKAN-SHIDO ACTIVITIES**

**PRACTICED OTSTJ. PEDAGOGY**

**M1 - Selecting Work**

- Student(s) demonstrate work to all
  - Academic watches students’ activity
    - Monitoring: Practicing
  - Academic demonstrates using data projector to all
    - Illustrating: Evaluating
  - Academic demonstrates using whiteboard to all
    - Illustrating: Evaluating
  - Academic uses artefacts to illustrate one-to-one
    - Illustrating: Evaluating
  - Academic watches students’ activity one-to-one
    - Monitoring: Practicing

**M2 - Monitoring Progress**

- Academic watches students’ activity one-to-one
  - Monitoring: Practicing
  - Illustrating: Evaluating
  - Evaluating: Evaluating

**M3 - Questioning Students**

- Academic watches students’ activity one-to-one
  - Monitoing: Practicing
  - Practicing: X

**M4 - Monitoring Homework Completion**

- Academic watches students’ activity one-to-one
  - Monitoring: Practicing
  - X

**G1 - Encouraging Students**

- Academic encouraging students one-to-one
  - Rewarding: Engaging

**G2 - Giving Instruction/Advice at Desk**

- Academic gives student’s computer one-to-one
  - Illustrating: Evaluating

**G3 - Guiding Through Questioning**

- Academic watches students’ activity one-to-one
  - Monitoring: Practicing
  - Practicing: X

**G4 - Redirecting Students**

- Academic uses artefacts to illustrate one-to-one
  - Illustrating: Evaluating

**G5 - Answering Questions**

- Academic watches students’ activity one-to-one
  - Monitoring: Practicing

**G6 - Giving Advice at Board**

- Academic using data projector one-to-one
  - Illustrating: Evaluating

**G7 - Guiding Whole Class**

- Academic watches students’ activity one-to-one
  - Monitoring: Practicing

**O1 - Handout Material**

- Organising: Organising

**O2 - Collect Material**

- Organising: Organising

**O3 - Arranging Room**

- Organising: Organising

**S1 - School Related**

- Socialising: Socialising

**S2 - Non School Related**

- Socialising: Socialising

*Table 6.1:* Observed participant interaction during the researched tutorial sessions for Group 07.
<table>
<thead>
<tr>
<th>GROUP 11 Tutorials</th>
<th>Academic (Teacher)</th>
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<th>T2</th>
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</table>

**OBSERVED KIICAN-SHIDO ACTIVITIES**

**PRACTICED OTS/2 PEDAGOGY**

**M1 - Selecting Work**
- Students demonstrate work to all
- Academic supervises students’ activity
- Academic demonstrates using data projector to all
- Academic demonstrates using whiteboard to all

**M2 - Monitoring Progress**
- Academic supervises students’ activity one-to-one
- Academic uses artifacts to illustrate one-to-one
- Academic uses artifacts to illustrate one-to-one
- Academic uses artifacts to illustrate one-to-one

**M3 - Questioning Students**
- Academic supervises students’ activity one-to-one
- Academic uses artifacts to illustrate one-to-one
- Academic uses artifacts to illustrate one-to-one
- Academic uses artifacts to illustrate one-to-one

**M4 - Monitoring Homework Completion**
- Academic supervises students’ activity one-to-one
- Academic uses artifacts to illustrate one-to-one
- Academic uses artifacts to illustrate one-to-one
- Academic uses artifacts to illustrate one-to-one

**G1 - Encouraging Students**
- Academic encourages students one-to-one
- Academic uses artifacts to illustrate one-to-one
- Academic uses artifacts to illustrate one-to-one
- Academic uses artifacts to illustrate one-to-one

**G2 - Giving Instructions/Advice at Desk**
- Academic advises students’ computer one-to-one
- Academic uses artifacts to illustrate one-to-one
- Academic uses artifacts to illustrate one-to-one
- Academic uses artifacts to illustrate one-to-one

**G3 - Guiding Through Questioning**
- Academic encourages students one-to-one
- Academic advises students’ computer one-to-one
- Academic uses artifacts to illustrate one-to-one
- Academic uses artifacts to illustrate one-to-one

**G4 - Re-directing Students**
- Academic advises students’ computer one-to-one
- Academic uses artifacts to illustrate one-to-one
- Academic uses artifacts to illustrate one-to-one
- Academic uses artifacts to illustrate one-to-one

**G5 - Answering Questions**
- Academic advises using academic’s computer one-to-one
- Academic uses artifacts to illustrate one-to-one
- Academic uses artifacts to illustrate one-to-one
- Academic uses artifacts to illustrate one-to-one

**G6 - Giving Advice at Board**
- Academic advises using academic’s computer one-to-one
- Academic uses artifacts to illustrate one-to-one
- Academic uses artifacts to illustrate one-to-one
- Academic uses artifacts to illustrate one-to-one

**G7 - Guiding Whole Class**
- Academic encourages students one-to-one
- Academic advises students’ computer one-to-one
- Academic advises students’ computer one-to-one
- Academic advises students’ computer one-to-one

**G1 - Handling Material**
- Organising
- Organising

**G2 - Collecting Material**
- Organising
- Organising

**S1 - School Related**
- Socialising
- Socialising

**S2 - Non-School Related**
- Socialising
- Socialising

---

*Table 6.2*: Observed participant interaction during the researched tutorial sessions for **Group 11**.
<table>
<thead>
<tr>
<th>GROUP 07 (reflective journal)</th>
<th>Academic (Teacher)</th>
<th>Student (Teacher)</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
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**Table 6.3:** Reflective journal identified participant interaction during the researched tutorial sessions for Group 07.
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<th>GROUP 11 (reflective journal)</th>
<th>Academic (Teacher)</th>
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</table>

**Table 6.4:** Reflective journal identified participant interaction during the researched tutorial sessions for **Group 11**.
The significance probability \( p \) value for Fisher’s Exact Test (2-sided) is the probability of obtaining, by chance, an observed difference (in either direction) that is the same as or more extreme than actually observed in the data which has no real or underlying difference. Thus, the smaller the \( p \) value, the more convincing is the evidence of this difference. The tests were carried out at the 0.05 level, meaning that the conclusion of a real difference may only be drawn if the obtained \( p \) value is less than 0.05. It is worth reiterating that this test does not indicate the magnitude, the importance or the significance (in the common meaning of this word) of the difference between the compared data. The statistical software SPSS Statistics 17 for Windows® (SPSS Inc., Chicago, IL.) was used to generate the cross-tabulations and to calculate the respective probabilities that are summarised in Table 6.5.

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<tr>
<th>OBSERVED KIKAN SHIDO ACTIVITIES</th>
<th>PRACTICED OTST/L PEDAGOGY</th>
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<th>Inf</th>
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<td>Academic demonstrates using data projector to all</td>
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<td>Academic demonstrates using whiteboard to all</td>
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<td>M3 - Questioning Students</td>
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<td>M4 - Monitoring Homework Completion</td>
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<td>G2 - Giving Instruction/Advice at Desk</td>
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<td>G6 - Giving Advice at Board</td>
<td>Academic advises using academic's computer one-to-one</td>
<td>1</td>
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<tr>
<td></td>
<td>Academic using data projector one-to-one</td>
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<td>0.596</td>
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<tr>
<td></td>
<td>Academic advises using whiteboard one-to-one</td>
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<td>1</td>
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<td>G7 - Guiding Whole Class</td>
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<td>G1 - School Related</td>
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<tr>
<td>G2 - Non-School Related</td>
<td>0.308</td>
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Table 6.5: Summary of the probabilities (\( p \)) as calculated by Fisher’s Exact Test (2 sided) that face-to-face and online supervision activities/pedagogy are significantly different.
A visual inspection of the second right-most column of Table 6.5 (headed ‘Obs’ and obtained for Tables 6.1 and 6.2) indicates a calculated $p > 0.3$ for each case. Also, a visual inspection of the right-most column of Table 6.5 (headed ‘Jnl’ and obtained for Tables 6.3 and 6.4) indicates a calculated $p > 0.438$ in each case. Since all of these $p$ values are much greater than 0.05, the null hypothesis of no difference between the practiced face-to-face and online supervision using NetSupport School or a similar software utility is retained in each case - consistent with no overall difference between the supervisory methods. In order to decrease the chance of incorrectly concluding that no difference exists, investigations with larger numbers of participants would be required. Testing in different teaching contexts would also be valuable.

The post-trial survey, shown in Figure 5.4, required the student participants to complete four Likert-scale type questions. The concept of the five response-alternatives is based on a scale proposed by Likert (1932) that he did not intend to be a summated one. However, there is an underlying assumption of a variable, the value of which represents attitudes and opinions (Clason & Dormody, 1994). Hence the resultant ordinal scale should be analysed with acknowledgement of this variable’s discrete nature by comparing the proportions of the responses in each category rather than working with the means and standard deviations of the ensuing distributions. Table 6.6 summarises the Likert-scale responses of the participating students, which were collapsed into two categories after obtaining the percentage of the ‘disagreed’ and consequently the ‘not disagreed’ responses.

The responses to the multiple-choice questions soliciting student perception of ‘student-academic interaction’ and ‘student activity’ while using the simulator software are tabulated in Table 6.7 and Table 6.8 respectively. These 2x2 tables summarise the number of respondents who identified, or did not, their participation in 30 different interactions and/or activities during the tutorial sessions where their problem-solving efforts were supervised by either one of two methods; namely face-to-face or online.
Table 6.6: ‘Disagreed’ responses to Q1 – Q4 of post-trial questionnaire that is detailed in Figure 5.4.

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Table 6.7: Percentage and number of responses to the perceived ‘student-academic interaction’ question on post-trial survey.
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<td>Y 1% 5% 6%</td>
<td>N 44% 19% 63%</td>
</tr>
<tr>
<td>Organising</td>
<td>Y 19% 13% 31%</td>
<td>Y 3% 2% 5%</td>
<td>N 31% 38% 69%</td>
</tr>
<tr>
<td>Socialising</td>
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<td>Y 0% 7% 7%</td>
<td>N 13% 44% 56%</td>
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<tr>
<td>Adapting</td>
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<td>Y 0% 6% 6%</td>
<td>N 13% 50% 63%</td>
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<td>Challenging</td>
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<td>Y 2% 6% 8%</td>
<td>N 25% 25% 50%</td>
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<td>Demonstrating</td>
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<td>Y 7% 2% 9%</td>
<td>N 44% 0% 44%</td>
</tr>
<tr>
<td>Discussing</td>
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<td>Y 4% 9% 13%</td>
<td>N 19% 0% 19%</td>
</tr>
<tr>
<td>Encouraging</td>
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<td>Y 1% 7% 8%</td>
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<tr>
<td>Giving feedback</td>
<td>Y 13% 44% 56%</td>
<td>Y 2% 7% 9%</td>
<td>N 38% 6% 44%</td>
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Table 6.7 (continued): Percentage and number of responses to the perceived ‘student-academic interaction’ question on post-trial survey.
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Table 6.7 (continued): Percentage and number of responses to the perceived ‘student-academic interaction’ question on post-trial survey.

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Table 6.8: Percentage and number of responses to the perceived ‘student activity’ question on post-trial survey.
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*Table 6.8 (continued):* Percentage and number of responses to the perceived ‘student activity’ question on post-trial survey.
As listed in the two right-most columns of Table 5.3, each kikan-shido activity and/or over-the-shoulder teaching/learning pedagogy targets an identifiable ‘student-academic interaction’ that should result in a consequential ‘student activity’. Collation of the interactions (Table 6.9) and the activities (Table 6.10) were obtained from session observations (Table 6.1 and Table 6.2) and the post-event reflective journal entries by the supervisor (Table 6.3 and Table 6.4).

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Table 6.9: ‘Academic-student interactions’ obtained from session observations and post-event reflective journal entries.

The corresponding post-trial survey responses were extracted from Table 6.7 and Table 6.8 and tabulated in Table 6.11 and Table 6.12 for a comparative analysis of the academic’s intentions with the students’ perceptions during the face-to-face and online supervised tutorial sessions. The first column in each of these tables shows the percentage and the number of sessions from the observations and the post-event journal; while the second column shows the percentage and number of student responses from the post-trial survey. The values are not intended to
reflect quality, only a level of success of the supervisor’s intentions. A visual inspection confirms that at least 13% of the students perceived each of the planned interactions and the same number recalled performing the corresponding activity irrespective of the practiced supervisory mode.

<table>
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<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
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</table>

Table 6.10: ‘Student activities’ obtained from session observations and post-event reflective journal entries.

Misinterpretation by respondents of a single word prompt that has both a common and a specialist meaning – such as ‘scaffolding’, ‘rewarding’ and ‘evaluating’ – could have biased their responses. The size of this effect may be minimised by sampling a much larger implementation of the trial set-up or providing clear definitions for such specialised terms.
<table>
<thead>
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<th>Post-trial survey responses:</th>
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<td>N</td>
</tr>
<tr>
<td>F2F</td>
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<td>0%</td>
</tr>
<tr>
<td>LAN</td>
<td>100%</td>
<td>0%</td>
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<tr>
<td></td>
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<td>N</td>
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<tr>
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<td>F2F</td>
<td>8%</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Monitoring</td>
<td>F2F</td>
<td>8%</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Organising</td>
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<td>5%</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>N</td>
</tr>
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<td>Questioning</td>
<td>F2F</td>
<td>8%</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Rewarding</td>
<td>F2F</td>
<td>7%</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>N</td>
</tr>
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<td>F2F</td>
<td>6%</td>
</tr>
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<td></td>
<td>Y</td>
<td>N</td>
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</table>

Table 6.11: ‘Student-academic interactions’ from two perspectives.
Table 6.12: ‘Student activities’ from two perspectives.
The ‘free-form’ post-event survey responses succinctly summarised some of the student-perceived general benefits of face-to-face delivery in statements such as: “(the) tutor is right there so you can ask questions”, “easier to ask more questions”, “able to get more explanation” and “much more personal and quick”. While a desirable outcome of the synchronous online supervision is encapsulated by: “George can show me (online) when I am making a mistake”.

Diverse views on the technology used in the trial were also aired during the post-event focus groups. For example one student stated that while being supervised online “I could imagine looking at a website and somebody is looking [at what I was doing]”. Whilst another student remarked that: “I quite like the idea of [my] mouse being controlled by somebody in another room”.

6.2.2: Monitoring student activity with over-the-shoulder teaching/learning pedagogy

A visual inspection of the entry labelled M2 in Tables 6.1, 6.2, 6.3 and 6.4 qualitatively indicates that over-the-shoulder observation of student activity did occur during all the delivered sessions where, one can assume, it was pedagogically appropriate. As shown in Table 6.5, the ‘unmatched’ statistical analysis of the data in these four tables, also confirmed that the null hypothesis of no difference in the way a student’s activities were monitored by the academic’s use of over-the-shoulder teaching/learning pedagogy with some elements of kikan-shido, whether in a face-to-face or an online supervisory mode as observed and recorded in the post-event reflective journal entries could not be rejected.

The recollections by the students to the post-trial survey question of being monitored (which is reproduced in Figure 5.4) while participating in tutorial activities indicated that all reported experiencing some supervisor monitoring. For 50% of them this occurred during both supervisory modes; for 88% of them during online supervision only; for 63% of them during face-to-face supervision only; and none of them recalled never being monitored (first entry in Table 6.7).
The post-event student focus group responses to the question of noticing any observable differences between the monitoring modes included “not a lot”, and “I find it more comfortable having it face-to-face; I find it [being supervised online] a bit weird to tell you the truth”. Another participant responded with an overall objection to the structure of the trial with the pronouncement that “if you come to University you want face-to-face delivery”.

The preceding analyses indicate that some elements of over-the-shoulder teaching/learning pedagogy, as practiced in face-to-face environments, was mimicked and identified as such by the participants during the online supervision of student problem-solving during the trial.

6.2.3: Giving instruction/advice at desk with kikan-shido activities

In this case the visual inspection of the entries labelled G2 and G4 in Tables 6.1, 6.2, 6.3 and 6.4 qualitatively indicate that one-to-one student-academic interactions occurred during all the delivered sessions where, one can assume, this was required. As shown in Table 6.5, the ‘unmatched’ statistical analysis of the data in these four tables, also confirmed that the null hypothesis of no difference in the way a student was helped by the academic’s use of kikan-shido, whether in a face-to-face or an online supervisory mode as observed and recorded in the post-event reflective journal entries could not be rejected.

The occurrence of this teaching style was triangulated by the analysis of the students’ responses to the Likert-scale type post-trial survey questions, Q1 and Q2. As shown in Table 6.6 the analysis determined that 31.3% of the responding students disagreed that they received tutor help during the sessions irrespective of the supervisory mode practiced by the academic.

A similar result was obtained from the students’ multiple-choice answers on whether they received any assistance during the trialled modes of supervision. For 63% this occurred while being supervised in a face-to-face mode and for 56%
while being supervised online. Also, 6% recalled not receiving any assistance and 25% stated they had received it under both supervisory modes (Table 6.8).

Additionally, the academic’s ability to demonstrate processes to the students appeared not to have been greatly affected by the two modes of supervision. For 44% of them this occurred during both supervisory modes, for 88% of them during online supervision only, for 56% of them during face-to-face supervision only and none of them recalled not being demonstrated to by the academic during the series of tutorials (Table 6.7).

‘Illustrating’ was a clear beneficiary of online supervision (88% versus 19%). The ability for the supervisor to remotely control each student’s computer keyboard and mouse facilitated the demonstration of issues to the assistance seeker, in addition to being able to offer any descriptive advice over the simultaneously established audio link. The facilitation of pedagogy such as ‘questioning’ and ‘interacting’ is highlighted in the significant percentages of students (between 63% and 75%) who identified these instruction modes while being supervised online.

However, the academic’s ability to emphasise issues was clearly curtailed during online supervision, highlighted by the fact that only 19% of the students identified this being present during online supervision versus 63% of the students who identified this during face-to-face supervised sessions (Table 6.7). Similar results were obtained for the students’ perceived activity of emphasising where the percentages were 19% and 69% for online and face-to-face sessions respectively (Table 6.8). These outcomes can be easily explained by the fact that hand and facial gesturing, which are inherently present during human-human interactions in face-to-face settings (Klerfelt, 2007) were not supported by the software used to communicate with the students over the local-area network.

Two student-academic interactions, namely ‘explaining’ and ‘guiding’, were identified as being present by only about half of the students for both supervisory
modes (Table 6.7). A number of technical problems were encountered throughout the trial, which may have led to perceived absence of these two classical forms of pedagogy.

The preceding analyses indicate that some kikan-shido activities, as practiced in face-to-face environments, were mimicked during the online supervision of student problem-solving during the trial. The term ‘telekikan-shido’ has been coined to describe this form of the pedagogy.

6.2.4: Student feelings of isolation

This issue was canvassed directly from the students in the Likert-type post-trial survey questions, Q3 and Q4. Analysis of the responses indicated that just under two-thirds of the cohort did not feel isolated while being monitored and/or helped by the tutor over the local-area network during the trials (Table 6.6).

Post-trial focus group comments such as: “[feeling uncomfortable] when I didn't request any help and my mouse was grabbed. You think: what's going on? What am I doing? I didn't do that. And then he started talking to me. And then you say: Ahh!” and “it's easier to ask a question. If you e-mail [a] question he may never get around to it and it's harder to explain. When someone is there, you know, and you start explaining it and you say: do you understand? Then they say: no I don’t. You can try to [have it] explain[ed] again” confirm a perceived reduction in the participants’ feelings of isolation that is an ever-present consequence of currently practiced online education delivery.

It appears from Table 6.7 that less than half of the trial participants perceived some fundamental group-specific interactions, such as ‘encouraging’, ‘rewarding’ and/or ‘socialising’ during the trials, with less than 6% experiencing any of these during both supervisory modes. These responses are a reflection of the fact that the students worked on their own, rather than in groups. This issue can be easily rectified since there are no technical reasons why future versions of software, like NetSupport School, will not be able to facilitate group work between students.
6.3: Discussion and recommendations

6.3.1: Discussion of the results

Of the research questions listed in Chapter 1.3, the following were examined in this part of the study:

Q3: Which kikan-shido activities and over-the-shoulder teaching/learning pedagogies were observable in face-to-face and online-supervised, computer-screen-based, problem-solving tutorial sessions?

Q3.1: How successful was the online student supervision of active learning?

Q3.1.1: What were the participants’ perceptions of being there (telepresence)?

Q3.1.2: What were the participants’ perceptions of being separated from the others (transactional distance)?

Q3.1.3: What were the participants’ perceptions of other participants’ availability (transactional presence)?

Barclay (2001) considers education to be more than just the attainment of new knowledge or expertise - it is a social activity, and as far as he is concerned the establishment of an environment where this can occur has to be the academic’s most important priority. In fact, in distance learning, interaction between participants is the key for successful learning outcomes for the students (Bright, et al., 2008; Roblyer & Wiencke, 2003; Sitzmann, et al., 2008).

Verbal discourse is interactive in character, while written communication is transactional (Thomas, 2002). Consequently a text-based online communication medium is inherently unsuitable for mimicking face-to-face conversation in distance education. In all instances, the teacher has to guide and motivate the students by ongoing interaction in order to create a social presence that is a necessary precursor to both collaboration and persuasive discussions (Garrison & Anderson, 2003). During the tutorials that comprised the trial, the teacher-student interactions focused on the construction and exploration of the simulations the
students were asked to complete. This learning-by-doing approach is essential in both remote and face-to-face teaching of technical subjects where deeper levels of learning will result from the students’ exposure to practical work (Chirico, Scapolla, & Bagnasco, 2005). However, little research has been carried out in ‘virtual’ venues due to the relative newness of this latter concept (Cheaney & Ingebritsen, 2005).

In a face-to-face environment, which has been rated as the most sociable medium (Short, et al., 1976), both verbal and nonverbal teacher immediacy behaviours have significant effects on student learning (Gorham, 1988; Mark, et al., 1999). The findings that during this trial the supervisor was able to mimic, online, so much face-to-face pedagogy is not surprising if one compares the constraints of face-to-face interaction, specifically “co-presence\textsuperscript{15}, visibility\textsuperscript{16}, audibility\textsuperscript{17}, co-temporality\textsuperscript{18}, simultaneity\textsuperscript{19}, sequentiality\textsuperscript{20}” (Clark & Brennan, 1991: 142), with the communication features available with the software utility used, namely NetSupport School. In summary, for the students who were supervised online, the face-to-face interactions listed above were facilitated in the following manner:

- ‘co-presence’ in a virtual sense by sharing the computer desktop,
- ‘audibility’ via the audio link over the network,
- ‘co-temporality’ and ‘sequentiality’ from the synchronous communication, and
- ‘simultaneity’ resulting from the bi-directional nature of the communication channels.

\textsuperscript{15}“Co-presence typically implies access to the same artifacts to support conversation, allowing deictic reference and shared context” (Olson and Olson, 2000: 159).
\textsuperscript{16}“Visibility: A and B are visible to each other, as in face-to-face communication and video conferencing” (Clark and Brennan, 1991: 141).
\textsuperscript{17}“Audibility: A and B communicate by speaking, which can be very effective for conveying factual information” (Clark and Brennan, 1991: 141).
\textsuperscript{18}“Co-temporality: B receives roughly the same time as A, so the message is received immediately” (Clark and Brennan, 1991: 141).
\textsuperscript{19}“Simultaneity: A and B can send and receive at once and simultaneously” (Clark and Brennan, 1991: 141).
\textsuperscript{20}“Sequentiality: A’s and B’s turns cannot get out of sequence as in synchronous communication” (Clark and Brennan, 1991: 141).
‘Visibility’ is the only previously listed constraint that was not supported by the software employed in the trial. Just the transmission of thumbnail-sized ‘talking heads’, occupying valuable computer-screen real estate, is of little ultimate benefit, since the image size of the participants, as well as the possible delays in any accompanying audio will strongly affect the naturalness of any resultant conversations (Tang & Isaacs, 1993) and the apparent inter-participant distance, called proxemics (G. M. Olson & Olson, 2000). In fact students who participated in remote laboratory experimentation gave a ‘least important’ rating for a video image of their tutor (Böhne, et al., 2004a). A system that deals with this problem is the ‘ClearBoard’ (Ishii, et al., 1993) which is a shared online working surface used between two participants. It displays each partner’s face as a full-screen watermark on the other person’s desktop, hence enabling easy glances at each other’s faces and even virtual eye contact while collaborating online. This is a two-way video conferencing tool that endeavours to transmit some nonverbal face-to-face communication elements (Roblyer & Wiencke, 2003).

Facial expression and body language are two mechanisms used in the construction of ‘intersubjectivity’, a compelling component of face-to-face communication (Hollan & Stornetta, 1992). Such nonverbal and paraverbal cues (for example voice tone, voice volume and voice inflection which are inherently transmitted via audible communication channels) enable the orderly progression of conversations (Warkentin, 1997), as well as contributing to the creation of social presence in face-to-face environments (Tu, 2000b). Lobel, et al. (2005) qualitatively found that written communications containing emoticons, short comments, images, logos, and/or coloured text are attempts at sharing some nonverbal cues in order to establish a forum for shared experiences that are the foundations of social occurrences like “peer pressure, accountability, and competition” (Kellogg & Erickson, 2002: 1). Whereas prompt feedback, which is achievable with synchronous communication, has been found to counteract the lack of visual prompts for online learners (Finkelstein, 2006).

21 “Intersubjectivity is a topic that a number of philosophers of communication have discussed. Simply put it refers to the creation of a context in which ‘I know that you know that I know what we are talking about’” (Hollan and Stornetta, 1992: 124).
Correlation between interactive instruction and effective learning has been established by other researchers (Bernard, et al., 2004; B. W. Brown & Liedholm, 2002; Offir, et al., 2008; Zirkin & Sumler, 1995). The pedagogies practiced with kikan-shido and over-the-shoulder learning/teaching in face-to-face settings require that both the teacher and the student deliberately make his/her thinking processes visible to the other (Collins, et al., 1991). Both shared desktops (Tang & Isaacs, 1993) and shared views of a common object under discussion (Nowak, et al., 2004) have been found to be extremely valuable for the support of distributed online collaboration. In a sense, the provision of the same physical view of a task places the involved participants into a ‘high interaction situation’ (Gutwin & Greenberg, 1995). During this trial, the communication features of NetSupport School enabled this to occur in an online context, making it the right choice for achieving the educational aims of the exercise.

Telepresence has been described as making one feel present in a computer generated environment (Bright, et al., 2008). Some students’ comments during the post-trial focus groups hinted at the establishment of shared presence or shared space between the academic and the student. Additionally, post-trial survey responses also indicated that a majority of the participants did not feel isolated during online supervised activities. Jelfs and Whitelock (2000) found that merely providing students with audio feedback helps to create a sense of teacher presence. The inbuilt communication features of NetSupport School, namely audio and remote desktop control, implemented across high-speed computer networks contributed to the reduction in transactional distance and an improvement in transactional presence and telepresence, as reported by the students.

During the trial, NetSupport School clearly enabled the supervising academic to easily and promptly encourage, via the audio link, individual student contributions and frequently identify the need for any potential guidance by remotely monitoring the students’ computer screens and, if necessary, control their
keyboards and mice to demonstrate as well as explain any necessary processes. Moreover, unlike with asynchronous communication the synchronous nature of the deployed online communication modes ensured that any consequential discussions did not progress too slowly and that the students’ questions were always answered promptly (Guan, et al., 2006).

In order to validate the interactive quality of the trial implementation during the online supervision of student experiential learning, a rubric, developed by Roblyer and Wiencke (2003) for assessing the interactive features of instructor-led online delivered courses, was completed. The ensuing conclusion acknowledged that wider deployment of such systems should result in “enhancing both achievement and student satisfaction in distance learning courses” (Roblyer & Wiencke, 2003: 95).

Of course just the use of appropriate technologies is not the panacea. Academics who deliver courses in online environments must have and/or develop instructional skills that foster a feeling of intimacy amongst the student body (Arbaugh, 2000a). Furthermore, the effort required from an academic for online teaching is at least as much as for classroom teaching (Stahl, Koschmann, & Suthers, 2006).

The sets of data obtained from the post-event reflective journal entries and the tutorial recordings enabled some level of triangulation of the findings, since the same events were respectively analysed from the participant’s viewpoint23 and from a viewpoint other than that of the participant24. This was an attempt to reduce some biases by ensuring that the resultant findings were not artifacts of a single research method (Patton, 1999). Furthermore, participating students were selected randomly and the ‘instruments’ used, in particular Laurillard’s

22 “Current and anticipated applications of the rubric include use by students as part of post-course evaluations and by researchers and instructors as a tool to allow more meaningful examination of the role of interaction in enhancing achievement and student satisfaction in distance learning courses” (Roblyer & Wiencke, 2003: 77).

23 Referred to as the “emic” (Pike, 1954; as cited in Wortham & Derry, 2006: 849).

24 Referred to as the “etic” (Pike, 1954; as cited in Wortham & Derry, 2006: 849).
Conversational Framework, kikan-shido and over-the-shoulder teaching/learning have been validated by others, as already discussed in Chapter 2.

Since the presumption of randomly selected participants is sacrosanct for attaining statistically meaningful results (McGuinness, 2005), the question of whether it was ethical to use a random-based participant selection for this trial needs to be examined. If there was no prior knowledge on whether the proposed online delivery (one treatment) is better or worse than face-to-face student supervision (the other treatment) then there should be no ethical implications resulting from this style of selection process (Glantz, 2002). In fact, the value of using circuit simulation software in the teaching of electronic circuit behaviour has been researched in other contexts (Aldrich, 2005; Laurillard, 2002; Ramsden, 2003; Tait, 1994).

In summary, while it is true that in general “computer-mediated communications are regarded as less personal and possessing diminished social presence and social context cues when compared to face-to-face communication” (Rovai, 2002a: 8), this research has shown that some elements of face-to-face pedagogy can be mimicked online with communication software, like NetSupport School, which has features that facilitate the following:

- real-time voice and optional visual contact between all participants,
- one-to-one sharing of computer desktops and applications,
- the capacity for graphics-based interaction, in order to annotate any participant’s desktop,
- a means for learners to indicate that they have questions, or are confused,
- applications for assessing student moods, opinions, comprehension and for soliciting questions or feedback,
- the ability for many-to-one sharing of computer desktops in order to view all learners’ activities in real-time.

25 With a view to ‘future-proof’ the recommendations of this research, this list summarises the necessary characteristics of an online venue that supports the synchronous supervision of experiential learning. It is based on the “VIRTUAL CLASSROOM” (Finkelstein, 2006: 58).

26 The clear differentiator from software that supports synchronous remote help such as eCustomer Support (Goetz, et al., 2010).
The need for systems that facilitate these forms of teaching/learning and lessen the participants’ feelings of isolation is recognition of the fact that:

all of what constitutes the process of education when teacher and student are able to meet face-to-face also constitutes the process of education when teacher and student are physically separated. (Shale, 1990: 334)

6.3.2: Recommendations for future studies

Recent collaborative learning research has confirmed that students in online environments, if given access to multiple synchronous communication channels, were able to practise deep approaches to learning (Dimitracopoulou, 2005). Collaboration between students has been identified as an important contributor to those students’ academic performance (Barclay, 2001; Crook, 2005; Ma & Nickerson, 2006). Due to the physical limitations of the trial venue, group-work that would have required student-student online communication was not investigated, even though NetSupport School has the features needed to support such forms of interaction. While no correlation has been found between the perception of interactivity and the time spent interacting with others (Yacci, 2000) there could be value in extending future research to incorporate this issue as well.

The randomly selected student participants, who were on-campus, quickly realised that others doing the same subject were able to participate in face-to-face tutorials. This resulted in some of them voicing their concerns about being exposed to ‘non examinable’ activities and potentially fuelling some resentment on their part that ultimately could have affected the collected data. Therefore it would be sensible to conduct future studies with complete cohorts of students.

NetSupport School’s inability to transmit the instructor’s nonverbal behaviours needs further examination. Gorham (1988) has established a close association between nonverbal actions and learning quality, as did Alibali and Natan (2007) for the teacher’s gestures during scaffolding and the students’ comprehension of the lesson material. Researchers have argued that efficient comprehension depends on the simultaneous reception of both vocal and non-vocal
communication cues (Nowak, et al., 2004). Any investigation involving non-verbal behaviour must be experimental, since the lack of such cues during face-to-face conversations has totally different consequences to those that may occur while conveying the same content via an audio-based telecommunication system (Short, et al., 1976).

For the conducted trial there were no attempts made to account for the potential enthusiasm of the participants towards the trial outcomes, the cause of which have been identified by others as the ‘Novelty Effect’\(^{27}\), the ‘John Henry Effect’\(^{28}\) (Phipps & Merisotis, 1999) and the ‘Hawthorne Effect’\(^{29}\) (Adair, 1984).

Furthermore, any demographic data was also ignored. However, other researchers have found no significant correlation between off-campus students' satisfaction and their age, gender, grade level, and computer literacy (So & Kim, 2005) so this should not be a major deficiency of the trial results.

The issue of student computer literacy was not canvassed in this study. In general, the computer users’ perception of the employed technology’s usefulness for the task at hand, as well as its ease of use affects their attitude towards the experience of that event. During online education activities, this in turn can motivate the students’ performance and subsequent engagement with the learning process (Arbaugh, 2000a). Some studies have extrapolated that the more time students spend online, the greater is their satisfaction with this style of learning (Arbaugh, 2000a). One has to assume that the participants’ existing levels of computer competency had to create some bias on their various survey and focus group responses. Since ‘computer competency’ tends to be a generational issue, and there were no mature-age students participating in the trial, and given the

\(^{27}\) Attributed to the simple fact that the participants may be engaged in something new and different.

\(^{28}\) Attributed to the participants’ subconscious threat of possible failure inciting them to perform better than what would normally be expected.

\(^{29}\) Proposed following the analysis of staff motivation studies completed between 1924-1927 at the Western Electric Hawthorne Works in Chicago, IL., where some of the experimental outcomes were found to have been influenced by the fact that the participants felt privileged by the knowledge of being part of a research exercise.
scientific nature of the field of study involved in this investigation, the individual computer competency levels amongst all the participants should be high.

There is no suggestion that online education is single faceted, in fact a mix of learning modes has been shown to “produce the best outcomes” (Owens, et al., 2009: 55). Elbeck and Mandernach (2009) describe, what appears to be an ever-expanding list of learning options that facilitate various levels of flexibility and pedagogies using synchronous and asynchronous technologies. While “real-time instructional tools hold great promise for supporting student learning in distance education” (Ng, 2007: 11), the workload created by the changing role of and the preparation by the academic must be investigated. An important outcome of such a study has to be the recommendations for both the training of potential system users (Bliesener, 2006; Lee & Tsai, 2010; Owens, et al., 2009; Oz, 2005; Shank, 2008a) and the provision, by the host institution(s), of dedicated technical support (A. H. Moore, Moore, & Fowler, 2005).

Finally, this trial did not attempt to compare the relative effectiveness of the students’ learning during the delivered tutorial sessions (Arbaugh & Benbunan-Fich, 2005). One technique for achieving this could have involved the administering and then the analyses of appropriate pre- and post-treatment assessments (Thurmond, et al., 2002). Krathwohl, et al. (1964) have argued that depending on which effected behaviours are being researched, the resultant conclusions may be highly problematic since the students’ exposure to the necessary teaching styles may not have been over long enough periods of time and therefore it’s the length of time rather than the teaching technique that caused the results.

It is recommended that any future research into this topic should be designed to attempt to address the above potential sources for errors. Furthermore, rather than the researcher conducting the teaching sessions, such a study should ensure the involvement of academics who are unaware of the research questions in an attempt to rule out the possibility of the “experimenter bias phenomenon” (Alavi,
1994: 173). Also, during any post-treatment interviews, the participants should be encouraged to prompt themselves by reviewing appropriate segments of videos that were recorded during their respective sessions (Clarke, 2001). This ensures that the original events are not distorted or permanently lost by relying purely on memory recollections (Roth, 2007).

In any case, this research must have a pedagogical rather than a technological focus. From the experience of others (Mitchell, et al., 2001) it is clear that it has to be ‘active’ rather than ‘descriptive’ in approach in order for it to be grounded in real-life educational practices. Both Clarke (2002b) and Shimizu (2003) recognised that an important object of this area of research is an attempt to identify beyond the obvious and visible educational events, therefore to maximise the potential outcomes, the collected data should be analysed by a research team whose members possess wide-ranging and complementary expertise.

Finally, the statistical analysis performed with Fisher’s Exact Test (2-sided) and summarised in Table 6.5 indicate that the null hypothesis of no difference between the supervision of the students during face-to-face and online conducted tutorial sessions should not be rejected. To reduce the chance of wrongly retaining this hypothesis, all further investigations should involve larger numbers of participating students.
Chapter 7 - Future directions: opportunities and challenges

With the new technologies distance education can to a large degree simulate or approach conventional face-to-face education. (Rekkedal & Qvist-Eriksen, 2003).

7.1: Overview

The trial of face-to-face and online supervised experiential learning, detailed in Chapter 5, was restricted to a local-area network, and the subsequent findings, as discussed in Chapter 6, indicated that the resultant online environment did enable the mimicking of some pedagogy that is observable in face-to-face contexts. The possible benefits from applying such systems to distance education, particularly via a wide-area network, such as the Internet should be further investigated. In order to be competitive, universities are becoming obliged to offer their students the best of both educational environments - real and virtual (Coates, 2006). This chapter presents a proposition for the establishment of an online venue where a student, via a browser-based gateway accesses a selection of remote and virtual laboratory experiments, selects one, and then collaborates in real time with other students and supervising academics in a manner that mimics the student attending a brick-and-mortar facility.

The provision of student access to hands-on experimentation for technology-based coursework, whether it is delivered face-to-face or online, is equally important (S. A. Brown & Lahoud, 2005). With the growth of online education, the need exists for new and innovative ways to achieve the interactive environment that is necessary for quality outcomes (S. A. Brown & Lahoud, 2005), particularly the
facilitation of laboratory experimentation by distances learners (Steidley & Bachnak, 2005). While the common advantage cited for both remote and virtual laboratories is the unrestricted access that is inherent in their current implementations, the presence of an expert mentor is critical and “will have a substantial effect upon the learning experience above and beyond that of changing access mode” (Lindsay & Good, 2005: 621). The suggestion that asynchronous communication, such as e-mail, may have the desired benefits of face-to-face conversation is a contentious one (Nickerson, et al., 2007). Conversely, researchers have confirmed that synchronous remote support of such learners with the application of computer-desktop sharing and video-chat can be as effective as if the supervisor was local to the students (Faltin, et al., 2004).

The two implementations of Internet-based laboratory venues that are currently in use for distance education are virtual laboratories (where activity is on software simulated artifacts), and remote laboratories (where physical artifacts are controlled remotely) (Guzmán, et al., 2005). At the University of Illinois, a study of on-campus students who completed an equal number of computer-simulated and real laboratory experiments showed better mastery of chemical concepts compared with those who completed the ‘classical’ sessions only (Pickering, 1988). Other studies indicated that students who obtained experimental results differing from their expectations tended to question the reliability of their simulation(s) rather than the soundness of their understanding when they experimented with simulated equipment (Lowe, Murray, Li, & Lindsay, 2008). In contrast, their experimentation with real laboratory equipment tended to motivate further investigation of any discrepancies; with the consequential benefit of deeper approaches to learning (Alhalabi, Hamza, Hsu, & Romance, 1998). The universal acceptance of flight simulators for pilot training suggests that as simulation quality improves, and the behaviour of both real and simulated systems become eventually identical, the remote students should be unable to identify the type of equipment they are working with, hence both their experiences with (Clow, 1998; Zobel, 2001), and their confidence in the obtained results from either forms of experimentation will be the same.
Because classroom instruction is so different to laboratory-based teaching, research into the effectiveness of the latter is imperative (Herrington & Nakhleh, 2003). Higher levels of interaction between the teacher and the learners are clearly observable during student experimentations, in particular while receiving various forms of one-to-one assistance with the interpretation and completion of the prescribed procedures, as well as with the explanation of their findings.

### 7.2: Student experimentation in a remote laboratory

Online accessible laboratories have been called ‘web labs’ (R. J. Ross, Boroni, Goosey, M., & P., 1997), ‘distributed learning labs’ (Winer, Chomienne, & Vazquez-Abad, 2000) even, strictly-speaking incorrectly, ‘virtual labs’ (Ko, et al., 2000) by different researchers. In all these examples, physical equipment or artifacts with appropriate computer interfaces are remotely controlled via wide-area and/or local-area networks. Consequently, there is a physical separation between the experiment and the experimenter. The lack of assistance from laboratory demonstrator(s) has been identified as a significant limitation, particularly since expert advice is critical during experiential learning (Bright, et al., 2008).

By removing the co-location requirement, a number of logistic and financial benefits may be realised, including (Lowe, et al., 2008):

- the learner’s ability to complete laboratory work off-campus any time of the day, any day of the week;
- reduction in equipment maintenance costs caused by equipment theft and/or misuse;
- secure access to expensive and highly specialised experimental apparatus;
- improved utilisation of infrastructure through the sharing of facilities across programmes and/or institutions.

In Australia, the exploitation of ‘remote laboratory classes’ in engineering education is relatively immature and tends to be highly experimental in character (Lowe, et al., 2007). Globally, there appears to be a greater number of published
studies dealing with engineering remote laboratories, thus flagging the importance of this issue in the training of future engineering professionals. The reasons offered for this focus are that:

engineering is an applied science, and the labs are a place to practice the application of scientific concepts. Also, educators in the engineering disciplines may be more likely to have the technical skills needed to create technology-enriched labs. While there are some commercial simulators available for certain engineering and science-related topics, to our knowledge there are no off-the-shelf remote laboratory systems currently available and therefore, professors who desire them are likely to develop them themselves if they have the requisite skills. Alternatively, the impetus for the creation of a remote laboratory may come from an engineer’s desire to build something.

(Ma & Nickerson, 2006: 4)

A number of researchers in this field have concluded that student access to remote laboratories is the necessary experiential learning environment for technology-based, distance education (S. A. Brown & Lahoud, 2005; Chirico, et al., 2005; Cooper, et al., 2000; Feisel & Rosa, 2005; Scanlon, et al., 2002; Sivakumar, et al., 2005; Swamy, et al., 2002; Thai & Upchurch, 2002; Wong, et al., 1999). Since the writing of user-interface software for remote laboratories has been identified as extremely challenging (Feisel & Rosa, 2005), the use of commercial software, such as Windows® NetMeeting™ (Microsoft Corporation, Redmond, WA, USA) or Timbuktu® (Netopia Inc., Alameda, CA, USA), has been highly recommended as an alternative (Gillet, et al., 2002).

For the online teaching of electrical engineering syllabi, remote “spectroscopy, measurements, control systems and simulation laboratories” (Sivakumar, et al., 2005: 586) have already been used successfully. In the main the student activity in such implementations tended to be unsupervised although the importance of academic assistance during remote experimentation has been identified (Gillet, et al., 2002; Scanlon, et al., 2002). In practice this type of online activity is rare, asynchronous and often primitive. For example, one (the PEARL project30) involving a spectroscopy-based experiment afforded synchronous access to a tutor

30 The Practical Experimentation by Accessible Remote Learning Project was originally conceived to make experimental work accessible to disabled students (Cooper, et al., 2000).
employing a text-based chat facility rather than bidirectional audio channels (Scanlon, et al., 2004).

7.3: Student experimentation with software simulated systems

Documented examples on the use of simulators in education include a variety of training programmes in the military and in industry (Zobel, 2001). Modern simulators are currently used to train individuals to control the movement of aircraft, automobiles, and ships, as well as professionals such as air traffic controllers, anaesthetists and ocular surgeons. In manufacturing, the use of simulators has enabled cost-effective product development and debugging. In leisure and entertainment, video games and virtual worlds can be considered as simulations of real and/or imaginary environments. The immersive nature of some latter day implementations, using real-life data and imagery, has been shown to engage and educate students in very powerful ways, although the more veteran ‘video gamer’ tended to find the experience rather frustrating (Jones, Kalinowski, & Hicks, 2007).

The advantages of using simulators include:

- allowing the user to modify system parameters and observe the outcomes without any harmful side effects;
- pausing the processes in order to review more deeply what has occurred;
- eliminating component or equipment faults that affect outcomes;
- supporting user-paced progress in discovery and understanding of issues;
- being a more cost-effective implementation of potentially expensive systems;
- facilitating the presentation of “dry concepts” in another way – by the hands-on integration of theory and practice.

A major disadvantage of the use of software simulations for physical entities such as electronic circuits is that the user is unable to physically handle the circuit components; hence some elements of conscious and subconscious learning may not be inherently available. The financially driven popularity for simulating, as
well as monitoring and/or controlling industrial processes is an opportunity to economically replace many of the less reliable and often significantly more expensive laboratory experiments that use real equipment with commercially available simulated ones.

Weisner and Lan (2004) concluded from their research, that there was no compromise in the learning outcomes of students who used computer-based laboratories in the engineering curriculum. However, detractors have suggested that the only thing students can learn from simulations is the skill to run that particular software (Ma & Nickerson, 2006). In fact, such an undesirable outcome is a direct reflection on the complexity of the user-interface, rather than on the pedagogical merit of using simulators in education.

7.4: Student experimentation while being supervised with ‘telekikan-shido’

Holmberg (1986) described distance education as studying “not under the continuous, immediate supervision of tutors present with their students in lecture rooms or on the same premises” (B. Holmberg, 1986: 26). In order to incorporate the characteristics of e-learning, Bernard, et al. (2004) expanded it to include “the use of technical media” (Bernard, et al., 2004: 3) and “the provision of two-way [multi-channel] communication” (Bernard, et al., 2004: 3) between the teacher and the learner(s). The research described in this thesis enables the use of networked computers in this educational context, by facilitating the online delivery of some face-to-face pedagogy. There is no suggestion that this form of distance education should become mandatory. However, it should be an integral part of the repertoire of teaching tools that are available for the online supervision of problem-solving learners over a distance education platform - the network topology of which is shown in Figure 7.1 and Figure 7.2. In the long term, the on-going efforts of the relevant technology providers to continue improving the performance speeds of their offerings will definitely enhance such systems’ users’ future teaching/learning experiences. However, Laurillard (2002) was
Figure 7.1: Topology for Internet-based online supervision of student experimentation with remote laboratory equipment.

Figure 7.2: Topology for Internet-based online supervision student experimentation with simulated laboratory equipment.
adamant that the fundamentals of education should not change with the availability of new technologies when she stated that:

> at the heart of a university is the iterative dialogue between teacher and learner, nurturing the ideas and the skills that constitute understanding. As we imagine the future forms of universities, that dialogue should remain the salient feature, with the delivery infrastructure always in support of it, never in the foreground. (Laurillard, 2002: 241)

Immersing students into a virtual world is an example where evolving technologies could enhance user experience. The earliest descriptions of virtual reality concepts, in an Internet-based 3D context, have been attributed to Stephensen (1992) as these appeared in his prophetic novel *Snow Crash*. In general, such environments not only facilitate synchronous collaboration (Girvan & Savage, 2010), that in turn result in some forms of immediacy (Jarmon & Sanchez, 2008), but they also intensify social presence via the visualisation of each participant (Girvan & Savage, 2010; Jarmon, 2009) in the form of an ‘avatar’ that has been broadly defined as any visual online representation of a computer user (Hemp, 2006). Internet-based 3D immersive worlds\(^{31}\) “enable a greater sense of presence: you get to see, speak to, and chat online with other users (or at least their avatars) while you are in the shared space” (Craig, Downey, Garnett, McGrath, & Myers, 2010: 138) however “much research is [still] needed to fully understand … [its] potential for distance and distributed learning." (Dickey, 2005: 449). Unfortunately, online facilities that ease participant social interactions are not necessarily “conducive to learning solely because student-student and student-instructor exchanges take place” (Larreamendy-Joerns & Leinhardt, 2006: 591), nor will they be automatically consistent with the needs of practicing academics.

Even though it has not really lived up to the "peak of inflated expectations" (Corbyn, 2009) and is now said to be sliding into the “trough of disillusionment”

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(Corbyn, 2009), the characteristics that make Second Life® suitable for use in education, not only include its “ease of use, wide availability and low barrier to entry” (H. Mason & Moutahir, 2006: 31) but:

accommodating learning preferences of Net-Generation students, enhancing student motivation and engagement, providing opportunities for social interaction, facilitating collaboration, increasing a sense of shared presence, dissolving social boundaries, and allowing for exploration, creation, and interaction within a media rich environment its immersion.

(Jarmon, Traphagan, & Mayrath, 2008: 2)

Successful collaborative learning can only occur in environments where the participants have the opportunity to engage in what they perceive to be a normal discussion (Pincas, 1998). In order to achieve such environments a number of universities, colleges (Boulos & Toth-Cohen, 2009; Bugeja, 2007; Girvan & Savage, 2010; Glendinning, 2009) and professional bodies (Heinrichs, Youngblood, Harter, & Dev, 2008; Wiecha, Heyden, SterntHAL, & Merialdi, 2010) have been exploring the use of this cyber facility for educational purposes; an example of one, a cyber classroom, is shown in Figure 7.3. Encouragingly, the results of some early-stage comparative research studies have confirmed that:

the physical presence of avatars, the possibility to communicate in real time and the existence of a shared local space explain why Second Life® produces a more realistic feel of presence than discussion forums or chat rooms. ... Education in Second Life® is closer to face–to–face education than traditional methods in distance education that are [commonly] based on asynchronous communication and two–dimensional media.

(K. Holmberg & Huvila, 2008).

In conclusion, the following is an encapsulation of the student experiences that could occur when the findings presented in this thesis are incorporated into a virtual world that is accessible over the Internet:

In my imagined learning environment there are all the facilities of a brick-and-mortar university, such as multimedia lecture halls and tutorial rooms. Especially ‘learning resources’ areas, with digitised reference materials and access to networked server-hosted specialist software applications, and laboratory spaces where students individually or in small groups might experiment with computer interfaced real equipment and/or simulations all the while being supervised by academics in real
time. … Suddenly it came to me. A teaching and learning environment did not have to be built of bricks and mortar. It could be constructed within a virtual world. Academic avatars using an Internet connection and the appropriate software plug-ins\textsuperscript{32} that support synchronous telekikan-shido, by facilitating mimicked aspects of face-to-face pedagogy which is experienced during on-campus delivery, could supervise student avatars who are pursuing online problem-based learning.

(with apologies to Professor Starr Roxanne Hiltz\textsuperscript{33})

\textbf{Figure 7.3:} Interactive classroom setting in \textit{Second Life®} (Kemp & Livingstone, 2006: 14)

\textsuperscript{32} Plug-ins are accessory software or hardware packages that if used in conjunction with existing application(s) or device(s) enable it(them) to extend its(their) capability(ies) or provide additional function(s).

\textsuperscript{33} See Chapter 3.1 for the original quote from Hiltz (1994: 5).


presented at the Thirty-Fourth Southeastern Symposium on System Theory, Huntsville, AL.


Lobel, M., Neubauer, M., & Swedburg, R. (2005). Selected Topics from A Matched Study between a Face-to-face Section and a Real-Time Online Section of a University Course. *The International Review of Research in Open and Distance Learning, 6*(2).


Rovai, A. P. (2002a). Building Sense of Community at a Distance. *International Review of Research in Open and Distance Learning 3*(1).


Stein, D. S., & Wanstreet, C. E. (2003, October 8-10, 2003). Role of social presence, choice of online or face-to-face group format, and satisfaction with perceived knowledge gained in a distance learning environment. Paper presented at the Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education, Columbus, OH.


Swan, K., & Shea, P. (2005). The Development of Virtual Learning Communities. In S. R. Hiltz & R. Goldman (Eds.), *Learning together online: research on*


Appendix A - List of publications

A.1: Using circuit simulator software in the study of electronic circuit behaviour.


Abstract: This paper reports on a pilot research project that investigated the use of a digital circuit simulation software, EasySim, in the study of digital electronics in the first year of an undergraduate engineering course. The ultimate aim of this research, to be completed in 2005, will be to investigate the student experience with such software and its effect on one of their study outcomes (that is their exam results). Students were encouraged to use the tool during their normal learning activities. Those who used the software found it to be helpful. Statistical analysis of exam results for the pilot group of ten respondents indicated a strong relationship between the exam marks obtained and the time spent using the software.

A.2: Looking for Kikan-Shido: Are elements of it detectable in tertiary engineering pedagogy?


Abstract: Comparative studies of year eight mathematics and science classes in schools around the world have identified Kikan-Shido as a regularly practiced pedagogy. This paper contends that Kikan-Shido in these instances does not result from any identifiable and unique secondary school teaching philosophy and it is likely to be present for the successful delivery of problem-based teaching activities, particularly in mathematics and/or sciences based syllabi. In order to test this hypothesis for engineering education, four active computer-based revision tutorials in a subject that formed part of some undergraduate engineering courses at a tertiary institution were audio recorded and then storyboarded for later analysis. The possible occurrences of Kikan-Shido activities in such a common tertiary learning environment were investigated by analysing the teacher-student verbal communication and then comparing the identified practiced pedagogy with some of those defined for the earlier mentioned global study in secondary schools. A recommendation is made to extend any follow-up studies to include the tabulation of
Kikan-Shido “activity patterns” which may be investigated for their suitability as a catalyst for the development of a metric for teaching quality.

A.3: Exploring the basics with circuit simulation: Support for self-teaching of electrical engineering


Abstract: Students enrolled in the first year electrical engineering subject at Swinburne University of Technology were encouraged to use an electronic circuit simulation software, Multisim 10 from National Instruments, for self-teaching while: (i) confirming any qualitatively predicted circuit behaviour, (ii) validating any quantitative results of problem-based activities and (iii) first predicting the cause, then verifying these predictions, for the behaviour of potentially faulty circuit components. The students’ exposure to this software was facilitated, not only by the mandatory purchase of a copy of the software, but by them being timetabled for all their tutorial sessions into a computer laboratory (rather than a conventional classroom) where under academic supervision they were able to work on desktop computers that had preinstalled copies of the said software. Analysis of two surveys and five post-event focus groups clearly revealed general learner acceptance for using the simulation software for self-teaching in both communal and private settings.

A.4: O (Big) Brother, Where Art Thou?: Exploring the capabilities of synchronous online communication while supervising experiential learning from a distance


Abstract: Good teaching has been described as a ‘conversation’ or as an ‘interactive engagement’ that mandates collaboration between all the participants. The applied communication technologies, broadly classified as synchronous or asynchronous, specifically constrain the available environment for the practiced pedagogy in distance education. In the research reported here the capabilities of a commercially available classroom management tool with built-in bi-directional audio communication and a range of computer application-sharing services were explored. This software was used to supervise online students who were performing computer-based experiential learning. Post-event survey and focus groups returned a majority of favourable participant responses. While the described case study was conducted over a local-area network of computers, the on-going developments in technology ensure that the eventual porting of this concept onto a wide-area network, such as the Internet, will be equally beneficial to the distance education delivery of science-based curricula; for example course work in engineering.
Appendix B – Plain Language Description and Consent Form
B.1: Plain Language Description

**Project Title:** An investigation of the pedagogy of over-the-shoulder teaching/learning in laboratory classes for higher education students.

You are invited to participate in the above research project, which is being conducted by Professor Richard James (supervisor) of the Centre for the Study of Higher Education at the University of Melbourne, Associate Professor Peter Ling (co-supervisor) of Academic Development and Support at Swinburne University of Technology and Mr. George Banky (PhD student) Faculty of Engineering and Industrial Sciences at Swinburne University of Technology. This laboratory class has been selected in consultation with the subject convenor and with the permission of the Dean of your Faculty. This project will form part of Mr. Banky’s PhD thesis, and has been approved by the Human Research Ethics Committee at the University of Melbourne.

The aim of this study is to identify the pedagogy practiced in the face-to-face supervision of computer-based laboratory activities with those identified in online supervision of such sessions while using the commercially available "remote desktop sharing" software: NetSupport School.

Should you agree to participate, you will be asked to contribute in up to four ways. First we would observe and record the interaction between yourself and your laboratory demonstrator while the supervision is face-to-face. Second we would observe and record the interaction between yourself and your laboratory demonstrator while the supervision is online via the Local Area Network. Third, we would ask you to participate in a focus group to discuss your experiences while being supervised in these two distinct ways. Fourth, if randomly selected, we would ask you to attend a one-to-one prompted interview with the researcher and while watching the recordings of the laboratory interactions you will be asked to elaborate, if possible, on your experiences. With your permission, both the focus group and the interview would be tape-recorded so that we can ensure that we make an accurate record of what you say. When the tape has been transcribed, you would be provided with a copy of the transcript, so that you can verify that the information is correct and/or request deletions. There will be no risk of your marks being compromised by the nature of your responses. We estimate that the time commitment required of you outside of laboratory class time would not exceed 30 minutes.

We intend to protect your anonymity and the confidentiality of your responses to the fullest possible extent, within the limits of the law. Your name and contact details will be kept in a separate, password-protected computer file from any data that you supply. This will only be linked to your responses by the researchers, for example, in order to know where to send your interview transcript for checking. In the final report, if cited, you will be referred to by a pseudonym. We will remove any references to personal information that might allow someone to guess your identity; however, you should note that as the number of people we seek to interview is very small, and it is remotely possible that someone may still be able to identify you.

Once the thesis arising from this research has been completed, a brief summary of the findings will be available to you by contacting the researcher (Mr. George Banky, FEIS, Swinburne University of Technology, H38, John Street, Hawthorn, Victoria. 3122). The results will also be presented in publications and at academic conferences. The data will be kept securely by Mr. Banky for five years from the date of final publication, before being destroyed.

Please be advised that your participation in this study is completely voluntary. Should you wish to withdraw at any stage, or to withdraw any unprocessed data you have supplied, you are free to do so without prejudice.

If you would like to participate, please indicate that you have read and understood this information by signing the accompanying consent form and returning it in the envelope provided.

Should you require any further information, or have any concerns, please do not hesitate to contact any of the researchers: Professor Richard James by phone on (03) 8344 7627, Associate Professor Peter Ling by phone on (03) 9214 5712 and/or Mr. George Banky by phone on (03) 9214 8318. Should you have any concerns about the conduct of the project, you are also welcome to contact the Executive Officer, Human Research Ethics, The University of Melbourne, by phone on (03) 8344 2073, or by fax on (03) 9347 6739.

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HREC 0712820

25/07/2007
B.2: Consent Form

Consent Form for Participants in Research Project

**Project Title:** An investigation of the pedagogy of over-the-shoulder teaching/learning in laboratory classes for higher education students.

1. I consent to participate in the project named above, the particulars of which have been explained to me and a written copy of the "plain language" information has been given to me to keep.

2. I authorize the researchers to use for this purpose my contributions to the project.

3. I acknowledge that I have been informed that:
   - The project is for research only;
   - There will be no risk of my marks being compromised by the nature of my responses;
   - I am free to withdraw from the project at any time without explanation or prejudice and to have any unprocessed contributions that has been obtained from me securely destroyed;
   - This project has been approved by the Human Ethics Committee at the University of Melbourne and this approval has satisfied the authorities at Swinburne University of Technology.

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(Signature)                   15/7/2007
(Date)

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(Print Full Name)

This document, once signed, will be retained by the researchers.

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