Bigger, Better Brains:
Neuroscience, Music Education and the Pre-Service Early Childhood and Primary (Elementary) Generalist Teacher

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Abstract

Since the early 1990s, there has been an enormous amount of research into the ways in which music listening and music training can improve our understanding of the structural and functional aspects of the human brain. As research in this interdisciplinary field, known as neuromusical research, advanced, it was also discovered that formal music training may have significant effects on brain development. As this is a relatively new field of research, the findings from these studies have remained predominantly in the area of neuroscience and have not been widely disseminated to educators or applied to educational practice. This thesis initially aimed to explore the possible applications of these findings in music education practice. It was then modified, due to the outcomes of the literature review, to examine the effects of these findings on the values that pre-service generalist primary (elementary) teachers hold towards music education.

This thesis consisted of two interrelated studies. Study A mapped the current neuromusical research literature related to the effects of formal music training and summarised the significant findings to date. The mapping methodology included a four-stage process to determine the breadth of the field and identify categories, connections, correlations and contradictions across the findings.

Study A revealed that neuromusical research findings are not advanced enough to be confidently applied to music education practices, which indicated the need to modify the initial focus of the thesis. This resulted in Study B, which consisted of a quasi-experimental quantitative study to measure the possible impact of neuromusical research findings on the perceptions of music education held by pre-service generalist primary (elementary) teachers. This study took the form of a ten-week teaching intervention with a pre- and post-test survey, and the resultant data was analysed for changes in values towards music education.

Study B revealed that the values held by the participant group towards music education improved significantly after the teaching intervention. Furthermore, the
experiment group, who were exposed to the neuromusical research findings, had more positive values than the control group in the majority of measures. Exposure to the neuromusical research findings was shown to affect the experiment group participants’ values in a number of ways: they indicated a higher level of confidence in the delivery of music education, rated music education at a higher level of importance in the curriculum, used higher levels of critical thinking and educational philosophy to justify the value of music education and performed better in their assessment items.

This study has shown that exposure to the neuroscientific and aesthetic benefits of music education can positively influence the values pre-service generalist teachers hold towards the discipline. This is worthy of further research, as it could help improve the rate and quality of the delivery of music education by generalist teachers when they enter the profession.
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 fewer than 100,000 words in length, exclusive of tables, maps, bibliographies and appendices.

Signed

Date 30/11/2012
Preface

This thesis could not have been completed without the assistance of several professional organisations.

Eamonn Donohoe and Lam Truong from DatacomIT compiled the survey data. Sandy Clarke from the Statistical Consulting Centre at the University of Melbourne undertook initial statistical computation using SPSS and assisted me in interpreting the statistical findings.

All professional editing services were conducted in accordance with the Melbourne School of Graduate Research In Detail publication *The Editing of Research Theses by Professional Editors*. Elite Editing completed the proofreading of the thesis in line with Standard D (Language and Illustrations) and Standard E (Completeness and Consistency). The editor’s area of academic specialisation is Linguistics. The service provided was in accordance with the Australian Standards for Editing Practice.
Dedication

This thesis is dedicated to my wonderful husband, Michael. His unfailing confidence in my ability to complete this process has carried me through many long days of reading, writing and redrafting. He is kind and compassionate when needed, funny and irreverent when warranted and always unfailingly level headed when I am definitely not. He supported me through the birth of our wonderful daughter half way through my PhD, which makes him a saint in my eyes. Thank you.
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Contents

Abstract .............................................................................................................................. iii
Declaration ......................................................................................................................... v
Preface .............................................................................................................................. vii
Dedication .......................................................................................................................... ix
Acknowledgements .......................................................................................................... xi
Contents ............................................................................................................................. xiii
List of Tables ...................................................................................................................... xix
List of Figures .................................................................................................................... xxi
Chapter 1: Introduction ................................................................................................. 1
  1.1 First Steps Into the Field of Neuroscience ............................................................... 1
  1.2 An Unconventional Journey ..................................................................................... 4
  1.3 Purpose of the Thesis ............................................................................................... 6
  1.4 Research Questions .................................................................................................. 7
  1.5 Significance of the Thesis ....................................................................................... 8
  1.6 Structure of the Thesis ............................................................................................ 10
Chapter 2: Study A—Mapping the Neuroscience Literature (Methodology) ............ 13
  2.1 Overview of Study A .............................................................................................. 13
  2.2 Reviewing and Mapping the Literature .................................................................. 13
  2.3 Neuromusical Research: Beginnings ..................................................................... 14
  2.4 The Literature Mapping Methodology ................................................................... 16
  2.5 Stage 1 (Broad Reading Within the Body of Research) .......................................... 17
  2.6 Stage 2 (Categorisation and Connections) ............................................................. 19
    2.6.1 Research Categories ......................................................................................... 19
    2.6.2 Research Centres ............................................................................................ 22
  2.7 Stage 3 (Distillation of the Findings and Categories) ............................................ 23
    2.7.1 Selecting a Line of Research ........................................................................... 23
    2.7.2 Distillation of Categories ................................................................................ 25
    2.7.3 Areas of Contention ....................................................................................... 25
  2.8 Stage 4 (Critical Summary and Analysis of the Relevant Findings) ..................... 27
Chapter 3: Study A—Mapping the Neuroscience Literature (Results) ..................... 31
3.1 Cognitive Abilities ................................................................. 31
  3.1.1 Memory ........................................................................ 32
  3.1.2 Executive Function ........................................................ 34
  3.1.3 Specific Mathematical Skills ............................................ 38
  3.1.4 Music Processing ............................................................ 38
  3.1.5 Language and Music ....................................................... 39
  3.1.6 Conclusions .................................................................. 42
3.2 Biological and Physiological Findings .................................... 42
  3.2.1 Universal Effects of Music .............................................. 43
  3.2.2 Positive and Negative Reactions to Music ......................... 43
  3.2.3 Body and Brain Connections .......................................... 44
  3.2.4 Musical Aptitude ............................................................ 45
  3.2.5 Conclusions .................................................................. 46
3.3 Neural Development .............................................................. 47
  3.3.1 Music Processing Pathways .......................................... 47
  3.3.2 Brain Plasticity and Pruning ............................................ 48
  3.3.3 Learning Pathways ....................................................... 49
  3.3.4 Conclusions .................................................................. 51
3.4 Disseminating Information (Study A1) .................................... 52
3.5 Definition of ‘Musician’ (Study A2) ....................................... 55
  3.5.1 Defining ‘Musician’ and ‘Non-musician’ ............................. 56
  3.5.2 Guiding Principles for Musician Criteria .......................... 61
3.6 Conclusion ............................................................................ 61
Chapter 4: Study B—Application in the Classroom (Literature) .......... 65
  4.1 Overview of Study B .......................................................... 65
  4.2 Value Theory ..................................................................... 66
  4.3 Values and Music Education .............................................. 69
  4.4 The Pre-Service Primary Generalist Teacher ......................... 72
  4.5 The Pre-Service Primary Generalist Teacher and Music Education .. 75
Chapter 5: Study B—Application in the Classroom (Method) .......... 81
  5.1 Development of Experiment Instruments ............................. 82
  5.1.1 Description of Research Site and Participant Group ............ 82
  5.1.2 Survey Design ................................................................ 83
  5.1.3 Parts A and B: Demographic Information .................... 85
5.1.4 Part C: Musical Background .......................................................... 85
5.1.5 Part D: Value of Music Education .................................................. 87
5.1.6 Parts E, F & G: Importance, Delivery and Confidence of Music Education ................................................................. 90
5.2 Choice of Statistical Scales and Formatting ........................................ 93
5.3 Validity and the Pilot Study .................................................................. 95
  5.3.1 Internal Validity .............................................................................. 96
  5.3.2 External Validity ............................................................................ 98
5.4 Ethics .................................................................................................. 99
5.5 Development of Teaching Intervention ............................................... 100
  5.5.1 Educational Philosophy and Practice ............................................. 100
  5.5.2 The Curriculum and the Learners .................................................. 104
7.4.2 Entering the Learning Experience .................................................. 110
7.4.3 Progression Through the Dependent Stages of Learning ................. 111
7.4.4 Progression Through the Independent Stages of Learning ............. 114
5.5.3 Incorporating Neuromusical Research into the Teaching Intervention ........................................................................................................ 117
  5.5.4 The Teaching Intervention ............................................................ 121
Chapter 6: Study B—Application in the Classroom (Results) ..................... 129
  6.1 Identity Code .................................................................................... 129
  6.2 Demographic Information .................................................................. 130
  6.3 Musical Background .......................................................................... 131
  6.4 Value of Music Education .................................................................. 133
    6.4.1 Quality of Life Benefits ............................................................... 136
    6.4.2 Summary of the Quality of Life Statement Group ....................... 138
    6.4.3 Social-Emotional Benefits ........................................................... 140
    6.4.4 Summary of the Social-Emotional Statements .............................. 142
    6.4.5 Aesthetic Benefits ...................................................................... 143
    6.4.6 Summary of Aesthetic Statements ............................................. 145
    6.4.7 Neuroscience Benefits ............................................................... 145
    6.4.8 Summary of Neuroscience Statements ...................................... 150
    6.4.9 Non-Factored Benefits ................................................................. 151
    6.4.10 Summary of Value of Music Education Results ......................... 153
  6.5 Importance of Subjects ...................................................................... 154
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.5.1 Summary of the Importance of Music Education Results</td>
<td>156</td>
</tr>
<tr>
<td>6.6 Delivery of Music Education</td>
<td>157</td>
</tr>
<tr>
<td>6.6.1 The Role of the Generalist Teacher in the Delivery of Music Education</td>
<td>157</td>
</tr>
<tr>
<td>6.6.2 Summary of the Role of the Generalist Teacher Results</td>
<td>160</td>
</tr>
<tr>
<td>6.6.3 Music Education and Other Subject Areas</td>
<td>161</td>
</tr>
<tr>
<td>6.6.4 Summary of Music and Other Subjects Results</td>
<td>162</td>
</tr>
<tr>
<td>6.6.5 Compulsory Music Education</td>
<td>163</td>
</tr>
<tr>
<td>6.6.6 Summary of Compulsory Music Education Results</td>
<td>165</td>
</tr>
<tr>
<td>6.6.7 Confidence in Teaching</td>
<td>166</td>
</tr>
<tr>
<td>6.6.8 Summary of the Confidence in Teaching Results</td>
<td>167</td>
</tr>
<tr>
<td>6.7 Confidence in Teaching the Arts</td>
<td>167</td>
</tr>
<tr>
<td>6.7.1 Summary of Confidence in Teaching the Arts Results</td>
<td>169</td>
</tr>
<tr>
<td>6.8 Open Response Questions</td>
<td>169</td>
</tr>
<tr>
<td>6.8.1 The Value of Learning a Musical Instrument</td>
<td>170</td>
</tr>
<tr>
<td>6.8.2 Summary of Value of Learning a Musical Instrument Results</td>
<td>177</td>
</tr>
<tr>
<td>6.9 Experiences of Learning a Musical Instrument</td>
<td>177</td>
</tr>
<tr>
<td>6.9.1 Teachers</td>
<td>178</td>
</tr>
<tr>
<td>6.9.2 Accomplishment and Social Themes</td>
<td>179</td>
</tr>
<tr>
<td>6.9.3 Music As an Art and Themes of Well-Being</td>
<td>179</td>
</tr>
<tr>
<td>6.9.4 Practice</td>
<td>180</td>
</tr>
<tr>
<td>6.9.5 Summary of Experiences of Learning a Musical Instrument</td>
<td>180</td>
</tr>
<tr>
<td>6.10 Valuable Learning During the Teaching Intervention</td>
<td>181</td>
</tr>
<tr>
<td>6.10.1 Summary of Valuable Learning During the Teaching Intervention</td>
<td>188</td>
</tr>
<tr>
<td>Chapter 7: Discussion</td>
<td>189</td>
</tr>
<tr>
<td>7.1 Main Findings</td>
<td>189</td>
</tr>
<tr>
<td>7.2 Research Questions</td>
<td>190</td>
</tr>
<tr>
<td>7.3 Study A: Discussion</td>
<td>191</td>
</tr>
<tr>
<td>7.3.1 Neuromusical Research in Study B</td>
<td>195</td>
</tr>
<tr>
<td>7.3.2 Value of Mapping Exercise</td>
<td>197</td>
</tr>
<tr>
<td>7.3.3 Study A2: Definition of a Musician</td>
<td>197</td>
</tr>
<tr>
<td>7.3.4 Future Uses for This Criteria</td>
<td>199</td>
</tr>
<tr>
<td>7.4 Study B: Discussion</td>
<td>199</td>
</tr>
<tr>
<td>7.4.1 Study B: Discussion of the Teaching Intervention</td>
<td>203</td>
</tr>
</tbody>
</table>
7.4.5 Relevance of Findings ........................................................................................................ 204
7.4.6 Study B: Discussion of the Impact of the Neuromusical Research.................. 209
7.4.7 A Model for Pre-Service Generalist Teacher Education in Music.......... 215
7.5 Limitations of the Study ........................................................................................................ 219

Chapter 8: Conclusions and Implications ................................................................. 221

8.1 Implications of Findings ................................................................................................. 221
  8.1.1 Implications for Policy Makers and Educational Leaders ......................... 223
  8.1.2 Implications for Practising Teachers.......................................................... 224
  8.1.3 Implications for Pre-Service Generalist Teachers, Specialist Teachers
       and Teacher Educators .................................................................................. 225
8.2 Future Directions .......................................................................................................... 226
  8.2.1 Following the Neuromusical Research ...................................................... 226
  8.2.2 Engaging with the Neuromusical Field...................................................... 227
  8.2.3 Exploring New Models .............................................................................. 227
  8.2.4 Justifications for Music Education ............................................................ 228
  8.2.5 Bigger, Better Brains .................................................................................. 229

References .......................................................................................................................... 233

Appendix 1: Ethics Approval ............................................................................................. 257
Appendix 2: Consent Form ................................................................................................. 259
Appendix 3: Confidentiality Form (Experiment Groups 3 & 4)................................. 261
Appendix 4: Plain Language Statement ........................................................................... 263
Appendix 5: Pre-Test Sample (Full Survey) ................................................................. 265
Appendix 6: Post-Test Survey (Pages 1 & 6 Only) ....................................................... 271
Appendix 7: Title Page (Bigger, Better Brains Booklet) ............................................. 273
Appendix 8: Snapshot of Research (Bigger, Better Brains Booklet)......................... 275
Appendix 9: Music Education and Memory (Bigger, Better Brains Booklet).......... 277
Appendix 10: Music Education and Executive Function (Bigger Better Brains
       Booklet) ............................................................................................................. 279
Appendix 11: Music Education and Language (Bigger, Better Brains Booklet) ....... 281
Appendix 12: Music Education and Music Processing (Bigger, Better Brains
       Booklet) ............................................................................................................ 283
Appendix 13: Music Education and Our Bodies (Bigger, Better Brains Booklet) .. 285
Appendix 14: Music Education and Musical Talent (Bigger, Better Brains Booklet) ............................................................................................................................ 287
List of Tables

Table 1: Research Centres .......................................................... 22
Table 2: Information Sheets by Title, Focus and Literature ............... 53
Table 3: Studies Included in Study A2 .......................................... 57
Table 4: Survey Parts .................................................................. 84
Table 5: Statements in Themed Groups ......................................... 89
Table 6: Survey Questions on Music Education Delivery and Integration .......... 92
Table 7: Qualitative Questions on Musical Experience ...................... 93
Table 8: Teaching Intervention Outline ........................................ 124
Table 9: Survey Return Rates ...................................................... 130
Table 10: Frequency Distribution of Demographic Information .......... 131
Table 11: Frequency Distribution of Musicians and Non-Musicians ........ 131
Table 12: Frequency Distribution of Musical Instruments ................. 132
Table 13: Frequency Distribution of Instrumental Music Background .... 132
Table 14: Non-Musicians’ Instrumental Music Background ................ 133
Table 15: Pre- and Post-Test Means for Statement Groups (All Groups) .... 134
Table 16: Mean Difference for Statement Groups (All Groups) .......... 135
Table 17: Mean Difference for Statement Groups (Control & Experiment Groups) ................................................................. 136
Table 18: Quality of Life Statements ............................................. 136
Table 19: Pre- and Post-Test Results Within the Quality of Life Statement Group 137
Table 20 - Mean Differences for Individual Quality of Life Statements ...... 138
Table 21: Social-Emotional Statements ......................................... 140
Table 22: Pre- and Post-Test Results Within the Social-Emotional Statement Group ................................................................. 140
Table 23: Mean Differences for Individual Social-Emotional Statements .... 142
Table 24: Aesthetic Statements ..................................................... 143
Table 25: Pre- and Post-Test Results Within the Aesthetic Statement Group .... 143
Table 26: Mean Differences for Individual Aesthetic Statements .......... 144
Table 27: Neuroscience Statements ............................................ 145
Table 28: Pre- and Post-Test Results Within the Neuroscience Statement Group . 146
List of Figures

Figure 1: Evolution of the Study .............................................................. 6
Figure 2: Division of Research Questions by Study .................................. 8
Figure 3: Thesis Structure ....................................................................... 11
Figure 4: Overview of the Mapping Process ........................................... 17
Figure 5: Excerpt from the Mind Map ..................................................... 19
Figure 6: Connection and Pictorial Exercise excerpt ............................... 21
Figure 7: Selection of Symbols Used in the Literature Mapping Process ....... 21
Figure 8: Research Questions by Study—Question 2 ............................... 28
Figure 9: Overview of Categories and Subcategories ............................... 28
Figure 10: ‘Music Education & Brain Development’ Information Sheet Example... 54
Figure 11: ‘How Do We Understand Music?’ Information Sheet Example .... 55
Figure 12: Guiding Principles for Musician Criteria ................................ 61
Figure 13: Research Questions by Study—Question 3 and 4 ..................... 61
Figure 14: Relationship Between Study A and Study B ......................... 82
Figure 15: Research Questions by Study—Question 5 ............................. 83
Figure 16: Guiding Principles for ‘Musician’ Criteria ................................ 86
Figure 17: Inclusionary Criteria For a Musician ....................................... 87
Figure 18: Division of Participant Groups ............................................... 87
Figure 19: Austin/Reinhardt Scale Diagram (Part D) ............................... 94
Figure 20: Austin/Reinhardt Scale Visual Reinforcement (Part D) ............. 94
Figure 21: Hash Scale Diagram (Part F) .................................................. 94
Figure 22: Hash Scale Visual Reinforcement (Part F) ............................... 94
Figure 23: Music Curriculum Model for Pre-Service Primary Teachers (Jeanneret, 1995) ........................................................................................................ 106
Figure 24: Trajectory of Learning .......................................................... 110
Figure 25: Gardner’s (2004) Changing Minds Model, Including Aspects of Pedagogical Model for Music Curriculum for Pre-service Generalist Teachers ....... 117
Figure 26: Diagram of Gardner’s (2004) Changing Minds Model by Researcher .. 119
Figure 27: Unit Description, Outcomes and Learning Aims ..................... 121
Figure 28: Overview of Weekly Tutorials ............................................... 122
Figure 29: Excerpt from Study B Survey—Importance of Subjects.................155
Figure 30: Level of Agreement/Disagreement With Statements on Generalist
Teachers’ Role ........................................................................................................160
Figure 31: Level of Agreement/Disagreement With Music and Other Subject
Statements .............................................................................................................162
Figure 32: Frequency Distribution for Compulsory Music Education (Control) ....164
Figure 33: Frequency Distribution for Compulsory Music Education (Experiment)
..............................................................................................................................165
Figure 34: Excerpt from Study B Survey—Confidence in Teaching the Arts ......168
Figure 35: Text Analytics of Themes for the Control Group (Question 78) ........182
Figure 36: Text Analytics of Themes for the Experiment Group (Question 78).....183
Figure 37: Text Analytics of Concepts for the Control Group (Question 78) .......184
Figure 38: Text Analytics of Concepts for the Experiment Group (Question 78)...184
Figure 39: Trajectory of Learning .........................................................................204
Figure 40: Impact of Neuromusical Research Findings on Gardner’s (2004)
Changing Minds Model ..........................................................................................211
Chapter 1: Introduction

My initial interest in the field of neuromusical research was sparked by a paper written by Hodges (2000). This paper was a transcription of a conversation between Hodges and a panel of four notable neuromusical researchers at the time. One question posed by Hodges (2000) towards the end of the interview struck a chord; since our audience consists of music educators, what should they know about music and the brain? The panel’s responses were informative but did not yield any practical suggestions about how neuromusical research might change the way we understand and teach music. As a music educator, I wanted to take that further step to understand the implications of neuromusical research on music education pedagogy. It became apparent from the panel’s responses that they could not respond in terms of music education pedagogy, as they had no expertise in the area. This realisation highlighted a gap in the field of neuromusical research.

To understand the implications that neuromusical research may have on pedagogy, the literature would need to be examined by a music educator rather than a neuroscientist. The responses from the members of Hodges’ (2000) panel lacked consistency and did not provide concrete answers. As a music educator, this drove me to seek a greater understanding of the field of neuromusical research. Subsequently I began exploring the research findings to date in these areas to determine if they could alter my practice as a music educator.

1.1 First Steps Into the Field of Neuroscience

Since the early 1990s, there has been an enormous amount of neuromusical research, which is the interdisciplinary study of the brain using neuroscience and music. Through the development of the functional magnetic resonance imaging (fMRI) machine and PET scans, scientists can now observe the structure and function of the brain in real time. Consequently, neuroscientists now have a greater understanding of how the human brain processes and stores information.
As neuroscientists utilised these new technologies, they discovered that using music as stimuli revealed unique information about the brain. When participants listened to music, multiple areas of the brain were used to process the information. This was in contrast to activities involving listening to language or reading, where the processing only occurred in a single area. As research progressed, it appeared that as the brain processes musical stimuli, it performs multiple activities simultaneously. This was unlike anything that neuroscientists had encountered before, and it led to a large number of exploratory studies to further understand these complex processes.

A study by Rauscher, Shaw and Ky (1993) brought neuroscience and music to the attention of the broader public. Published in *Nature*, Rauscher et al.’s (1993) short paper outlined an experiment that found improvements in spatial reasoning tests by those participants who listened to a sonata by Mozart prior to testing. Don Campbell (2000) later used these findings to launch the theory known as the ‘Mozart Effect’, which was based on the premise that exposure to classical music made you smarter. While numerous subsequent studies have been unable to replicate the specific findings outlined in Rauscher et al.’s (1993) study (Fudin & Lembessis, 2004; McCutcheon, 2000; McKelvie & Low, 2002; Newman et al., 1995; Steele, Brown & Stoecker, 1999), additional neuromusical research has revealed that musical training, rather than music listening, can enhance brain development.

In a parallel field of research, neuroscientists began to compare the brain function and structures of musicians to those of non-musicians. Preliminary research compared professional adult musicians to participants with no musical training (Brandler & Rammsayer, 2003; Gaser & Schlaug, 2003; Koelsch, Schroger & Tervaniemi, 1999; Munte, Altenmuller & Jancke, 2002). These studies found significantly higher levels of brain plasticity and verbal memory and denser levels of gray matter in musicians. These findings led to studies with both adults and children to ascertain when, what type and how much musical training may have an effect on brain development (Hyde et al., 2009; Schlaug, 2006; Tervaniemi, 2009).

The division of the research paths and subsequent findings was a significant discovery in the initial stages of this thesis. Music had been used in the field of neuroscience in two ways: to gain a greater understanding of brain structures and
functions and to study the specific effects of music education on brain development. Through experiments that monitor the way the brain behaves while participants listened to music, neuroscientists have learnt more about how the brain processes auditory, linguistic and rhythmic information. Using some of the same types of experiments, neuroscientists have compared the brain functions and structures of musicians with non-musicians and found significant differences between the two groups. Participants who have had musical training have far superior brain development and generally have faster learning abilities (Hyde et al., 2009), deeper social conscience and better levels of health (Schlaug, 2001). As I reviewed the literature, I found myself scribbling the same statement in the margins: *musicians have bigger, better brains.*

Yet, as I scribbled this phrase down, I began to question if my definition of a musician was comparable with the definition used by neuroscientists. Within the music education field, a musician could be a person who plays an instrument, but could also be a composer or a musicologist. The educational pathway to becoming a musician could take many forms, take widely different periods of time and follow distinctly different methodologies. Is a musician a person who has learnt a violin via the Suzuki method from the age of three and progressed to individual lessons or competed in competitions, or is it a person who learnt guitar in a secondary school classroom and then taught themselves by copying well-known performers, or is it a child who has participated in weekly Kodaly class lessons and sung in the school choir? While the studies of the possible effects of music education on brain development are interesting, their definition of what constitutes a musician has a great impact on the ability to compare their findings. From the very first steps into this field, the term ‘formal music training’ emerged in the neuroscientific studies, which was generally defined as learning a musical instrument predominantly in the traditional one-to-one weekly lesson format. While this is one form of music learning, the term ‘music education’ is far broader and encompasses classroom pedagogy, informal learning environments and social music learning experiences. In order to explore the field of neuromusical research effectively, the distinction between formal music training as classified by neuroscientists and music education as classified by myself as a music educator needed to be at the forefront of my mind.
In the decade since Hodges’ (2000) interview, an enormous amount of neuromusical research has been undertaken. Numerous studies have validated and refined the benefits of formal music training on brain development, but the impact of these findings on music education pedagogy, practice and curriculum has not yet been extensively examined. As a researcher, this gap should have pointed clearly to a topic and research questions upon which to base my thesis. Yet concerns persisted: Was research into the effects of neuromusical research on music education pedagogy limited in that the neuromusical findings were not yet substantial enough? Was the step I wanted to take too large? Was there enough research basis to effectively test the hypotheses I may have about music education pedagogy?

1.2 An Unconventional Journey

At this point, the direction of the thesis took a left-hand turn. The result was a somewhat unconventional pathway through the research process and a dissertation structure that deviates from the traditional format. This thesis outlines two complementary studies: Study A was a literature review and Study B was a quasi-experimental study. Study A took the form of a mapping exercise that aimed to categorise and condense the existing literature in the field of neuromusical research. This provided a framework to arrange and classify new research findings quickly and developed an instrument to gain an overview and insight into this large and complex field of research. Study A focused on extending Hodges’ (2000) question to the panel: how would this neuromusical research affect or be applied to my practice as a music educator? As part of this thesis I continued to pose questions concerning the nature of any connections between the neuromusical research findings and my practice as an educator.

Study A resulted in a number of outcomes. The first outcome was a categorised review of the neuromusical research findings that would be of interest to music educators. The findings needed to be presented in a manner that music educators could engage with, considering they were not experts in neuroscience. This resulted in the second outcome of Study A, Study A1, which transformed the review findings into information sheets specifically aimed at engaging music and general educators.
in the neuromusical research. The third outcome from Study A was the revelation that the application of neuromusical research in music education pedagogy was, at this stage, not possible. Although there was a significant amount of neuromusical research, its focus had not yet extended into comprehensive models of music processing that music educators could confidently compare with established methodologies. Preliminary models did exist (Koelsch & Siebel, 2005; Peretz et al., 2009) but were not advanced enough to start influencing music education pedagogy. The fourth outcome of Study A was the need to produce a definition of ‘musician’ across the neuroscientific field. This definition was at the centre of Study A2 and served a number of purposes. It allowed for better comparisons between neuroscientific studies and provided music educators with a context within which to view the neuromusical findings. The outcomes from Study A provided the focus and parameters for Study B.

Study B was a quasi-experimental study that endeavoured to bring the key scientific findings from Studies A, A1 and A2 into the classroom and assess the impact they had on students’ perceptions of the value of music education. Study B required a teaching intervention with a well-researched participant group. Therefore, it required the combination of the findings from Study A with a teaching approach based on research into pre-service teacher education (Figure 1).
After a somewhat unconventional journey towards a research focus and questions, the following became the focus for this thesis.

1.3 Purpose of the Thesis

After a somewhat unconventional journey towards a research focus and questions, the purpose of this thesis became an examination of the impact that scientific ‘proof’ has on the value pre-service teachers place on music education for their students. All students undertaking Primary or Early Childhood teaching degrees in Australia will complete a unit in music education, usually as a part of a broader arts education unit. One of the challenges in teaching such a unit is getting the pre-service teachers to recognise the importance, centrality and necessity of quality music education to their students’ learning and development. Traditional statements promoting music education as an avenue for self-expression and teamwork only go so far. This thesis examines if objective, science-based statements have an impact on the value placed on music education by pre-service teachers versus the traditional aesthetic-based statements.
This thesis also outlines a philosophical basis that informs the design and delivery of a learning experience. This philosophy aims to change pre-service teachers’ minds on the value of music education for their students. The methodology has three tiers: philosophy, pedagogy and curriculum. The philosophy is based on the theories of Eisner (2002a) and Dewey (1934) on the arts as experiential learning. The pedagogy builds on this basis with the work of Rubin (1985) concerning teaching artistry and Rogers’ (1979) concepts of facilitation. The curriculum flows from these strategies and is based on Gardner’s (2004) Changing Minds model.

1.4 Research Questions

The thesis attempts to explore answers to the following primary and secondary questions.

Primary Question
1. Can recent findings in neuromusical research have an impact on the perceptions of music education held by pre-service teachers?

Secondary Questions (Study A)
2. Are there identifiable categories within neuromusical research focused on music?
3. What categories and findings in recent neuromusical research have relevance for music education?
4. What potential impact might these findings have on music pedagogy?

Secondary Questions (Study B)
5. What potential impact might these findings have on perceptions of the value of music in education?

These questions are discussed periodically throughout the thesis. As the structure is not entirely linear, diagrams are used to contextualise each question in relation to Study A and Study B as the thesis progresses (Figure 2).
1.5 Significance of the Thesis

This research gains its significance through the unique perspectives and contributions it provides to the fields of neuromusical research and music education. The first contribution is a broad review of the neuromusical literature from the perspective of a music educator rather than a researcher within a scientific background. The findings are presented with a non-scientific audience in mind, resulting in a distinctive resource for those outside the science field.

The neuromusical field is both relatively new and narrow at this time. The primary significance of this study is that it adds depth and clarity to a recently developed and sparse field of research. While important work was completed in the 1990s, it was not until the 2000s that dedicated research institutes such as the BRAMS Laboratory and the Dana Foundation were established. Similarly, key researchers and large scale studies (Levitan & Tirovolas, 2009; Peretz & Zatorre, 2005, Schellenberg, 2005) in the field needed time to complete and publish their findings. As few comprehensive reviews exist of these findings at the time of writing, this thesis will contribute to the review of literature in this field.

Although the neuromusical field contains two distinct disciplines, until recently it has not been a wholly interdisciplinary field. As the technology that enabled real-time brain observation was developed in the neuroscience field, much of the research has remained in that field. Only recently have interdisciplinary institutes been established,
the most notable being the BRAMS Laboratory jointly established by University of Montreal and McGill University, McMaster Institute for Music & the Mind at McMaster University and Levitan Laboratory of Perception, Cognition and Expertise at McGill University.

Within these research institutes, there are only a few music education specialists who are viewing the research through their specialised lens. This thesis contributes to the establishment of the necessary links between neuromusical researchers and generalist educators. Furthermore, this thesis is one of the first to test the impact this research has on generalist educators who bring their own specialist lens to the findings.

The participant group surveyed in this thesis is one of the most important in the music education cycle: pre-service early childhood and primary teachers. As the 1995 Senate Enquiry into Arts Education found:

Generalist primary classroom teachers, because of their own poor arts experience at school, and because of inadequate teacher training, lack confidence to teach the arts. As a result . . . there is a strong impulse to marginalise the arts in their teaching (Arts Education, 1995, p. 49)

More recently, the quality of music education in schools and the teacher education programs that provide the training have been prominent features in both the National Review of School Music Education (NRSME) report (Pascoe et al., 2005) and the Making the Progression: Report of the National Music Workshop (2007). The NRSME Report urged for an increase in hours allocated to music education instruction in tertiary teaching degrees. This is echoed by Jeanneret et al. (2006), who found that the low level of previous knowledge, skills and confidence displayed by students caused tertiary music education units to focus on the improvement of basic levels of arts education before considering the inclusion of arts pedagogy.

Even before these students begin their professional careers, they will be exposed to ground-breaking research into the benefits of music education. How this will influence the value they place on music education in comparison with other subjects is only half of the question. The other crucial aspect that must be addressed is the method used to overcome the lack of confidence and lack of expertise they bring to
music education. Part of this thesis will examine not only the introduction of new scientific research but also the manner in which that research is experienced. To be effective and permanent, change in values must be both logical and emotional in nature. This thesis will utilise a model of change based on Gardner’s (2004) Changing Minds theory.

Gardner (2004) begins his book Changing Minds with an obvious comment on human nature: ‘we talk all the time about changing our minds’ (p. 1). He goes on to say that, in his opinion, it is one of the least understood human experiences (2004, p. 1). As an educator, I spend my professional life changing minds, even if it is one tiny piece of information at a time. In front of my eyes, both the adults and children that I teach are adjusting their understanding of the world and their place within it. Yet, I am still surprised when I see a number of concepts fall into place at once, otherwise known as the ‘Ah-ha’ moment (Nauert, 2011), or when a student seems unable to grasp a concept, no matter how I try to explain it.

Through mostly trial and error, I have developed my better practice methodology for teaching that achieves generally positive results. Students display their understanding of the material we have been learning and some move to a more independent level of learning to seek out further information on the subject. I have been frustrated that this method, while moderately successful, does not reach all students. The method of teaching that I employ when providing information to students will be crucial to the results of Study B.

1.6 Structure of the Thesis

As this research process and thesis followed an unconventional path, some of the preliminary chapters need to be viewed in a complementary rather than linear manner. Figure 3 illustrates the structure of this thesis.
Figure 3: Thesis Structure
Chapter 2: Study A—Mapping the Neuroscience Literature

(Methodology)

2.1 Overview of Study A

The aim of Study A was to answer three of the secondary research questions. These were concerned with the categories that existed in the body of neuromusical research (Q2), how the findings from these categories might be relevant to music education (Q3) and their potential impact on music education pedagogy (Q4). This study took the form of an extensive literature review of 192 sources, which included peer-reviewed journal papers, research reports commissioned by governments and research institutes, conference proceedings, interviews and panel-session transcripts. As a review of this material had not been conducted previously, it was necessary to design effective processes to ensure the thorough and appropriate outcomes from the review. Therefore, Study A took on the form of a research project using a distinct methodology that enabled the mapping of the literature and produced results and conclusions. This chapter outlines these steps in Study A.

2.2 Reviewing and Mapping the Literature

This literature review began in 2008 in preparation for application to commence this PhD study and was concluded in 2012 upon submission of this thesis. The literature reviewed spanned an extensive period and multiple disciplines. Although the field of neuromusical research was underway in the 1990s, it did not yield any significant, validated findings until the mid-2000s. At this time, educators began to question how and if these findings should inform their practice. In 2003, Geake and Cooper suggested that ‘the education profession could benefit from embracing rather than ignoring cognitive neuroscience’ (p. 7), but in the following year, Gruhn (2004) believed that we did not know enough within the field of neuromusical research to start making pedagogical decisions. In their extensive study on the educator’s view of the role of neuroscience in education, Pickering and Howard-Jones (2007) found
that there was a ‘high level of enthusiasm for attempts to interrelate neuroscience and education, although conceptualizations about what this entails differ widely’ (p. 109).

By 2009, more declarative statements such as ‘there is compelling neuroscientific evidence that music training produces a direct effect on the structure and function of the brain’ (Jakobson, Lewycky, Kilgour & Stoesz, 2008, p. 52) appeared in the literature. Hodges (2009), the researcher who originally sparked my interest in the field, also stated:

musical training changes the brain. There is abundant evidence (Edwards & Hodges, 2007; Hodges, 2006) that the brains of adult musicians, especially those who started studying music seriously before the age of 7, are demonstrably different than those of untrained individuals. (p. 74)

These statements are being made about the general neuromusical research field, but more specific findings have also been validated. It has been reported that the degree of structural or functional enhancement in specific brain areas correlates with the age that formal music training commenced (Pantev, Engelien, Candia & Elbert, 2001), the number of years of training (Sluming et al., 2002) and the amount of practice engaged in it (Bengtsson et al., 2005; Pascual-Leone, 2001). Together, these findings lend strong support to the claim that active engagement in formal music training ‘sculpts’ the brain (Jakobson et al., 2008, p. 53).

The field of neuromusical research has recently moved from a fledgling area of exploration to an established field of validated research. It will continue to expand at an exponential rate, and this literature review serves as an exploration of findings along the upward trajectory of studies in the field.

### 2.3 Neuromusical Research: Beginnings

The beginning of the twenty-first century saw significant advancements in the research into the structure and function of the brain. Two significant catalysts contributed to this occurrence:
1. The ability to see the brain functioning in real time using technologies like the fMRI machine.

2. The discovery that using music as a stimulus provided neuroscientists with a plethora of new information about how the brain is structured and functions. In essence, listening to music ‘lights up the brain’ in ways that neuroscientists had not seen before. This development allowed new theories and understandings of brain development to be considered.

This field emerged in the final decade of the twentieth century, but as it was so new, protocols needed to be established before larger studies could take place. The findings from these early studies were reported in the form of short peer-reviewed papers in scholarly scientific journals such as *Nature*. The experiments were based on the use of music listening as an intervention. For example, to establish if music listening affects the functions of the brain, participants would be measured for a specific cognitive function and undergo a period of listening to music, and then be measured again.

One of the first issues was what to call the field. Although this question has not been definitively resolved, a distinction was needed for the purposes of this literature review. The field of neuroscience is the study of the nervous system but has a very broad scope, taking in molecular, cellular, developmental, structural, functional, evolutionary, computational and medical aspects of the nervous system. The brain is the primary controller of the nervous system, which is why neuroscience is related to the brain. The field of neuromusical research is where music is used in some way to investigate all of the above aspects of the brain. This can be in any way from listening to music when completing a task through to the study of brain function of participants with various levels and types of formal music training (Peretz & Hebert, 2000; Peretz & Zatorre, 2005). This distinction was important to establish before embarking on the literature review and was used as one criterion for the selection and review of individual studies as detailed in Section 2.5.

Some of these preliminary and not yet replicated studies were seized upon by researchers outside the neuroscience field as evidence that music listening improved learning and ‘made you smarter’. It was through numerous publications, websites
and public advertisements based on this premise that the wider public became aware of the field of neuromusical research. Meanwhile, larger and more substantial research experiments were taking place and reported as both peer-reviewed project papers and summary papers in plain English in the early to mid-2000s.

During the establishment period in the 1990s, the field began to develop its own nomenclature. The lack of a clear set of key words with which to search was one of the first hurdles to negotiate in this literature review. Similarly, the variety of researchers bringing their own viewpoints to the research meant that there was no clear line of review through the body of research. All of these elements within the field led to the need for a detailed mapping process to ensure that appropriate research was selected for inclusion in the review and examined in an appropriate way.

2.4 The Literature Mapping Methodology

In order to determine the scope and focus of this thesis, a lengthy mapping exercise was completed that resulted in a synthesis of current neuromusical research. Given the relative youth and inconsistent nomenclature of the field, it was vital to construct criteria for the selection and review of research material to ensure that no vital information was overlooked. The literature search was hampered initially by factors such as the lack of standardised key words used across the field, highly individualised studies with significantly different parameters and the lack of papers that summarised the findings across numerous studies. The mapping process consisted of four stages, some of which occurred simultaneously and were used as a validation method for the selection, review and evaluation of the literature (Figure 4).
2.5 Stage 1 (Broad Reading Within the Body of Research)

Stage 1 of the mapping exercise involved broad reading within the body of research. This resulted in the development of initial categories, including:

1. Neuroscientific studies that used music as a stimulus to understand basic brain function and structure;
2. Neuroscientific studies on differences in the brain structure and function of participants who had experienced prolonged and formal music education;
3. Cognitive neuroscientific studies on the physiological and neural effects of music exposure and participation;
4. Summaries of the research findings aimed at non-scientific readers;
5. General and music educators’ perspectives on the neuromusical research findings.

The aim of the process of broad reading was to establish the breadth and depth of the research findings. The choice of research material needed to encompass the work of neuroscientists, cognitive neuroscientists, cognitive psychologists, neuromusical researchers, music educators, music education researchers, general education researchers and music education philosophers. The review utilised several educational and medical databases (ERIC, EBSCO, MEDLINE), as well as the recently completed MusicBIRD, an online database that organises and summarises the field of neuromusical research (Edwards, 2008). The research was both discipline specific and interdisciplinary, resulting in an array of sources requiring review.
Another aspect of the review process was my own low level of expertise in the field of neuroscience. This meant that popular press sources such as *Nature* were an excellent starting point, as they summarised in plain language the complex and discipline-specific findings of peer-reviewed articles from journals such as *Brain And Cognition* and *Annals of the New York Academy of Science*. After reviewing these summaries, it was far easier to continue onto the original research sources.

In conjunction with the review of the neuroscience literature, there was the growing body of research by music educators and music education philosophers about the possible impact of the neuromusical research in the educational field. Reimer (2004) critically reviewed and highlighted the possibilities of research in the specific field of music and emotions. Such commentaries on this emerging neuromusical field and its effects on music education are important because they rightfully caution against using this preliminary research to fundamentally alter the established pedagogy of music education.

Stage 1 included a broad sweep of research included full empirical studies, studies that compared musicians and non-musicians, studies that used music as a stimulus to determine general functional and structural workings of the brain, brief summaries of findings in publications such as *Nature* and commentaries on the research by music education practitioners and philosophers. Sources were identified by the surname of the first researcher and an identification number that correlated with a list of full references.

A cornerstone of any good review process is the formation of criteria for the exclusion of research from the review. These criteria took some time to establish because the research is so diverse and interlinked. The two research fields examined in detailed are neuroscience and education. Neuroscientific studies that did not shed light on musicians’ brain function or structure and education studies that were not closely based on verified scientific findings were excluded.
2.6 Stage 2 (Categorisation and Connections)

The program ConceptDraw MINDMAP was used to record and compare the findings. The map is presented in Appendix 16 and an excerpt from it is presented in Figure 5. As the mind map expanded, two significant pathways for mapping emerged:

1. Research categories.
2. Research centres (including leading researchers).

![Mind Map Image]

**Figure 5: Excerpt from the Mind Map**

2.6.1 Research Categories

In order to track the various research areas and foci, it was just as important to categorise each resource source as it was to read it. This resulted in a long list initially, but as more research was added individual categories were subsumed into larger groups. The first set of categories developed was:

1. Neural Development
2. Music, Brain and Body
3. Genetics
4. Emotion
As Figure 4 shows, a number of processes occurred simultaneously at this point in the mapping process. As a greater number of entries were made on the mind map, correlations and connections between researchers and research findings were also made and graphically represented by linking individual research studies with lines (Figure 6). This allowed both correlations and contradictions across studies to be identified. An additional tool used in the mind mapping process was the pictorial representation of findings (Figure 7). This allowed for a holistic analysis of the findings and the ability to identify findings across multiple areas of the field. A selection of symbols and their uses can be seen in Figure 7. At the conclusion of the mapping process, the mind map contained over 400 entries and required printing on A1-sized paper (Appendix 16).
Figure 6: Connection and Pictorial Exercise excerpt

- A finding or idea that dramatically changed the course of the research or thinking
- A smaller finding or idea that changed the course of research or thinking
- An important thought in relation to music education
- An important question in relation to music education
- An area or idea to find out more about
- An area or idea to examine in greater depth

Figure 7: Selection of Symbols Used in the Literature Mapping Process
Through this exercise, it was possible to refine the research categories. This list served as the structure for Stage 3 of the mapping process, the distillation and summary of the findings.

2.6.2 Research Centres

The leading researchers in the field initially appeared as individuals, but as their research developed and focused on particular areas research centres and institutes were established (Table 1). This development assisted the mapping process, as the review could be based around the output of these institutes, rather than a search for individual researchers.

<table>
<thead>
<tr>
<th>Institute &amp; Country</th>
<th>Leader(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Dana Foundation, US</td>
<td>Chair: Edward D. Rover</td>
<td>A private philanthropic organisation based in New York, which supports brain research through grants and educates the public about the successes and potential of brain research. It has a particular interest in the study of the brain and arts education.</td>
</tr>
<tr>
<td>BRAMS (International Laboratory for Brain, Music and Sound Research), Canada</td>
<td>Co-Directors: Isabelle Peretz, Robert J. Zatorre</td>
<td>A research centre dedicated to research excellence, jointly affiliated with the University of Montreal and McGill University, Canada. It is devoted to the study of music cognition with a focus on neuroscience.</td>
</tr>
<tr>
<td>McMaster Institute for Music and the Mind, US</td>
<td>Chair: Laurel Trainor</td>
<td>An interdisciplinary group of researchers including psychologists, neuroscientists, music theorists, musicians, mathematicians, kinesiologists, health scientists and engineers, based in Ontario.</td>
</tr>
<tr>
<td>Music Research Institute (MRI), US</td>
<td>Chair: Donald Hodges</td>
<td>An institute within the School of Music in North Carolina, which has an active research programme devoted to understanding the phenomenon of music.</td>
</tr>
<tr>
<td>MARCS Auditory Laboratories, Australia</td>
<td>Chair: Denis Burnham</td>
<td>An organisation based at the University of Western Sydney, which focuses on pure and applied research on auditory perception and cognition, particularly on the significant domains of speech, and music and the related areas of human movement and communication.</td>
</tr>
<tr>
<td>Max Planck Institute for Human Cognitive and Brain Sciences, Germany</td>
<td>Directors: Angela Friederici, Wolfgang Prinz, Tania Singer, Robert Turner, Arno Villringer</td>
<td>An institute based in Leipzig, which researches human cognitive abilities and cerebral processes, with a focus on language, music and action.</td>
</tr>
</tbody>
</table>
Several of these centres are structured along highly interdisciplinary lines, in recognition of the way in which brain research findings could have applications in multiple fields. A common thread across all of the neuroscientific studies is a warning about the preliminary nature of their findings. As a consequence, any educational developments based on this research need to be qualified with the same warnings. In the emerging interdisciplinary field of neuroscience and education—known by a variety of names, such as brain-based education (Howard-Jones, Pickering & Diack, 2007), neuroeducation (Hardiman, M., Magsamen, S., McKann, G., & Eilber, J. (2009), neurodidactics (Gruhn, 2004) or neuopedagogy (Patten, 2004)—the leaps in practice have not necessarily taken heed of the preliminary nature of the research. A study by Howard-Jones et al. (2007) into educators’ perceptions of neuroscience in education concluded that:

Perceptions of applying neuroscience in education have been partly influenced by so-called ‘brain-based’ learning programmes whose science is now seriously contested. While many teachers feel they have observed improved learning outcomes from these programmes, the teachers we interviewed would appreciate greater access to evaluative evidence that scrutinises their scientific basis and their effectiveness. (p. 47)

The swift development of this field has meant that keeping up with findings through only journal articles is insufficient. With a lag time of up to two years between an author’s submission to a journal and publication, the ability to review all the research is not possible using journals only. Consequently, it was important to stay abreast of the news from a number of research institutes that focus on the brain and music.

2.7 Stage 3 (Distillation of the Findings and Categories)

2.7.1 Selecting a Line of Research

At the conclusion of Stage 2 it became clear that two distinct yet complementary lines of research existed within the broad field of neuromusical research:

1. The effects of music listening on brain function.
2. The comparison of the brain function and structure of musician and non-musicians.

These two lines of research were performing significantly different experiments and yielding markedly different results. It was important to select one of these lines in order to effectively compare the findings across studies and compile a summary. The second line of research comparing musicians and non-musicians was selected, as it was more clearly defined than the complementary field of music listening at the time of this research thesis. There was also a solid level of agreement and replication across scientific studies comparing musicians and non-musicians brain function and structure, such as:

- Musicians have been found to have a larger corpus collosum, the connective bridge between the right and left hemisphere, enabling messages (synapses) to move more effectively and quickly between different hemispheres of the brain (Peretz & Zatorre, 2005).
- Musicians have been found to have a larger motor cortex, the area of the brain involved in planning control and voluntary motor functions (Peretz & Zatorre, 2005).
- Musicians have been found to have faster and more synchronised neural firings, due to development of neurofilament (tubes that transport messages) in upper cortical layers (Hannon & Trainor, 2007).
- Musicians have been found to have larger responses to sound in the brainstem and auditory cortex (Hannon & Trainor, 2007).
- The auditory cortex of professional musicians’ brains is 130% denser than that of non-musicians (Janata et al., 2002)
- When comparing professional musicians, amateur musicians and non-musicians, there is a positive correlation between gray matter volume and amount of formal music training. There is also no decrease in gray matter volume in relation to the level of musical training, meaning the more musical training a person experiences, the more gray matter a person’s brain develops and the more complex function the brain can complete (Gaser & Schlaug, 2003).
2.7.2 Distillation of Categories

Once the line of research for this thesis was determined, three broad categories emerged, which captured all of the previously separated categories:

- **Cognitive abilities** can be described as how the brain acts (brain function).
- **Biological factors** are the genetic predispositions we are born with and **physiological effects** are the way our bodies function in response to the messages from the brain (nature/nurture).
- **Neural development** is the way the brain grows and changes (brain structure, plasticity and pruning).

2.7.3 Areas of Contention

At this stage of the literature mapping process, a number of areas of contention also emerged among the studies:

- Executive function
- Impact of neuromyths on research
- Language and music
- Music predisposition
- Definition of a musician

It is important to note that research into these areas is only new and significant disagreement exists due to the lack of replicated findings across numerous studies and of commonly accepted testing protocols in neuromusical research.

‘Executive function’ involves the interaction of multiple brain structures and functions to regulate our cognitive and emotional response to events, particularly conflict or problem-solving situations. We use executive function every day and in multiple ways. Much of the contention is concerned with the way executive function is measured and the complexity of the function itself.

‘Neuromyths’ is a term used initially by Goswami (2006) and Hall (2006) to describe the misinformation, oversimplification or overinterpretation of findings in
brain research. The two most common neuromyths are the concepts of critical periods of development and left- and right-brained individuals. The terms are not incorrect, but their common usage has led to misunderstanding about neuromusical research findings. For example, the correct use of critical and optimal periods of development has caused confusion (Flohr & Hodges, 2006), and Abbott (2009) found that ‘nearly half of the neuroimaging studies published in prestige journals in 2008 contain unintentionally biased data that could distort their scientific conclusions, according to scientists at the National Institute of Mental Health in Bethesda, Maryland’ (p. 1).

One of the early discoveries in the neuromusical field was the apparent connection between the language and music centres of the brain (Patel, 2003). This led to a significant amount of research into how music and music training may aid in language acquisition and syntax. Again, language development incorporates a large number of areas and functions in the brain, and testing this connection requires longitudinal studies that begin while a child is still in the womb. With such a young field, this type of research is only just beginning.

A recurring theme in the literature is the question of musical predisposition; that is, the nature or nurture influences on people who continue formal music training. It is argued that children with higher levels of cognitive function and brain plasticity, for example, will seek out experiences such as music training. This would mean that studies comparing musicians and non-musicians are not examining the effects of formal music training on brain development but the difference between two groups of people already predisposed to those differences (Monaghan, Metcalfe & Roxton, 1998; Pantev, Roberts, Schulz, Engelien & Ross, 2001). This issue has not been fully resolved in the intervening decade and must be investigated if the effects of musical training are to be verified.

Another significant area of contention was the definition of a ‘musician’. Many studies were based on a comparison of an experimental group of musicians with a control group of non-musicians. Many also used the term ‘formal music training’ to signify the musical activities to which the musicians had been exposed. The anomaly was that these groups were not defined by standardised criteria. This is a valid
approach as many of the studies were attempting to answer three interrelated questions: what type of formal music training had an effect on brain development and processing, what was the optimal age period in a child’s development to undertake this training, and for how long did the training need to be undertaken? However, when it came to comparing the findings from the studies, this anomaly created additional variables. At this stage of the review, the criteria for the experimental group of musicians ranged from any of the following:

- Instrumental lessons lasting longer than 16 consecutive months (Schlaug, 2006);
- Music experience for at least 15 months (Hyde et al., 2009);
- Music making experiences that involves social interaction (Koelsch & Siebel, 2005);
- Two years of consistent instrumental and classroom music experience (Tervaniemi, 2009);
- The ability to read music and any form, no matter what the length, of formal music training (D’Esposito, 2008); and
- More than two years and nine months of formal music training (Jentschke & Koelsch, 2009).

In order to create a consistent and research-informed ‘musician’ criterion for this thesis, a smaller satellite review was undertaken (Study A2), which is outlined in Section 3.5.

2.8 Stage 4 (Critical Summary and Analysis of the Relevant Findings)

This stage consisted of a summary of the findings and evaluation of the strength of the research field at present. The summary took its structure from the three categories that were identified during the mapping process: cognitive abilities, biological and physiological findings and neural development. The literature review process in itself answered the second research (Figure 8).
The three categories encompassed the various areas of neuromusical research that could be of interest to music educators. The subcategories within each category form the structure for the results of the literature review in Chapter 3. The categories and sub-categories are summarised in Figure 9.
While the Stage 4 summary was a vital element of the mapping process, the results pointed towards an unexpected conclusion that affected the direction and focus of this thesis.
Chapter 3: Study A—Mapping the Neuroscience Literature

(Results)

This chapter outlines the results of Study A. The results are divided into three categories: cognitive abilities, biological and physiological findings and neural development. It then describes the two satellite studies that led from these results. Study A1, which transforms the findings of the review into information sheets specifically aimed at engaging music and general educators in neuromusical research, and Study A2, which creates a definition for ‘musician’ from 14 neuroscientific studies. The chapter concludes with answers to thesis questions 3 and 4. Study B will be described in Chapter 4.

3.1 Cognitive Abilities

The findings to date in the field of cognitive abilities are significant but preliminary. As the field enters its third decade, a greater number of longitudinal studies are being published. They focus on either replicating previous findings or refining broader studies, which signals a move into a new phase of research in the field. There is still significant debate over the impact of the findings, and researchers routinely warn of the dangers of exaggerating the casual relationships or positive correlations they may indicate. When examining these findings, it is important to remain mindful of the specific parameters of each study. These include the size of the experiment group, the specific task the participants were asked to complete, the longitudinal nature of the study, the age of the participants and the criteria used to define a ‘musician’.

The specific focus areas in terms of cognitive abilities are memory, executive function, near and far transfer, specific mathematical skills, music processing and connection of music skills with language acquisition.
3.1.1 Memory

Current research shows that musicians have significantly higher abilities in the area of memory than non-musicians. Jonides (2008) presented evidence that people who have undergone formal music training have more advanced skills in both short- and long-term memory retention and memory retrieval. From this research, Jonides (2008) hypothesised that musicians’ brains use the strategies they learn in musical rehearsal to form neural pathways that make both memory storage and retrieval more effective. In the same year, Jakobson et al.’s (2008) study supported the idea that ‘formal music training is associated with superior performance in multiple domains of memory functioning, above and beyond any effects it may have on general intelligence’ (p. 50).

Dunbar (2008) concurred with the research findings but proposed that musicians use symbolic means to retrieve memories more effectively, such as the use of pictures or narrative to link somewhat distant areas of memory. Dunbar also attributed this ability to the skill of arts trained individuals to both respond to and generate creative ideas. Participants identified as non-musicians in this study were found to have the ability to respond but not necessarily to generate creative ideas or objects. This leads to the question, are musicians naturally creative or does formal training from a young age make them so? This question is discussed in detail in Chapter 7.

Jakobson, Cuddy and Kilgour (2003) proposed that there is a connection between music training and verbal memory. They found that music training strengthened the order in which aural information is processed, and that this development improved overall verbal memory. This study was based on previous findings by Chan, Ho and Cheung (1998) that adults who receive music training before the age of 12 had a better memory for spoken words, and suggested that music training could have long-term positive effects on verbal memory.

A related area of verbal memory is auditory memory. Tervaniemi, Rytkonen, Schroger, Ilmoniemi and Naatanen (2001) found that musicians had a greater ability to hear melodic contour, but musicians who performed music primarily without a
score, such as violinist or pianists, displayed even greater skills in auditory discrimination. The level of auditory discrimination was so high that this specific group of musicians continued to detect melodic irregularities even when their attention was taken away from the sounds.

Fujioka, Ross, Kakigi, Pantev and Trainor’s (2006) study began to explore this link. After one year of musical training using the Suzuki learning technique on violin, a number of learning behaviours were enhanced, including musical and non-musical working memory.

Jäncke’s (2008) research proposed that music and memory are connected through the way the brain responds to and processes emotion. The study indicated that emotion is a memory enhancer, and therefore the ability of music to illicit emotional responses acts to improve the many memory types that the brain creates, such as sensory and working memory. Jäncke explored the possibilities that ‘if music has such a strong influence on emotions and our cognitive system, this raises the question of whether the memory-enhancing effect of emotional music can be used to enhance cognitive performance in general’ (p. 4).

While earlier research focused on auditory memory differences between musicians and non-musicians, the effects of music training on memory development has broadened to visual as well as verbal memory development. These developments are called near and far transfer. Near transfer is the development of skills that are closely related to the musical activity, such as the development of fine motor skills in instrumental musicians. Far transfer is the development of skills that are not closely related to the musical activity, such as the ability to monitor and moderate emotional reactions in conflict situations. Music training develops the skill of audiation, the use of musical memory to both recall and predict what we will hear. This skill is developed from a very young age (Gordon, 2003). Audiation is a near-transfer development in the brain, meaning that it is a direct result of music training on a musical skill. However, it has been proposed that the development of audiation skills

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1 Audiation takes place when one hears and comprehends music silently, the sound of the music no longer being or never having been physically present (Gordon, 2003, p. 25)
also has a far-transfer effect on both verbal and visual memory. Musacchia, Sams, Skoe and Kraus (2007) have found that musicians have ‘more robust auditory and audiovisual brainstem responses to speech and music stimuli’ (p. 15894) than non-musicians.

In a continuation of Jakobson et al.’s (2008) research into musicians and memory, it was found that music training also enhances visual memory. Musicians have been found to have superior abilities in both immediate recall and delayed recall of visual and verbal materials. This means musicians are better able to remember spoken words and details about things they have seen than non-musicians. Two studies validated these findings: Degé, Wehrum, Stark and Schwarzer’s (2011) study, which was conducted over a two-year period of music training and George and Coch’s (2011) study, which used two different types of measures. All of these enhanced abilities in memory point to the benefits of musical training for learning capacity. While some of the findings may have an impact on the teaching strategies used in music education, they have implications beyond the music classroom. If one of the pillars of learning is well-developed memory (Dewey, 1910), then music training should be seen as a fundamental part of any curriculum.

3.1.2 Executive Function

Executive function is the ability to regulate our responses, particularly in conflict situations. This ability involves a sophisticated relationship between our cognitive and emotional reactions and can been seen as the ability to problem solve in a social and personal manner rather than a maths equation. Executive function is not limited to one specific area in the brain but involves the ways in which discrete parts of the brain interact in different scenarios. One of the significant areas encompassed in executive function is attention. This can be attention to detail, to differences and similarities or to both verbal and non-verbal signals or the ability to focus on a task for an extended period of time.

Executive function has been examined by a number of researchers and at present some significant yet largely speculative findings exist. Musicians have been found to have a higher level of executive function than non-musicians. Gruzelier and Egner
(2004) found that music training positively influences neural signals associated with attention and relaxation. Posner, Rothbart, Sheese and Kieras (2008) found that conflict resolution training and musical training both led to improvement in intellectual tests. Berkowitz and Ansari (2008) found that the continuous process involved in musical improvisation causes brain activity to overlap a number of regions. Bialystok and DePape (2009) found that musicians’ brains perform in a similar manner to those of bilingual speakers when it comes to non-verbal spatial awareness tasks that measure levels of executive function. Among a myriad of other tests, Hanna-Pladdy and MacKay (2011) found that musicians perform better in executive processing than non-musicians. This particular study, as well as a previous study by Wan and Schlaug (2009), linked musical training to the preservation of cognitive function in advanced age.

A number of studies comparing the attention abilities of musicians and non-musicians provide significant findings. Geake’s (2009) study concluded that ‘superior use of executive and metacognitive strategies such as inward-directed attention’ (pp. 165–166) leads to musicians improved performance in many aspects of schooling. Hannon and Trainor (2007) found that music training influences a number of musical and non-musical brain processes, including attention.

Strait and Kraus (2011) found that music training had significant developmental effects on auditory attention and suggested that ‘musical training may aid in the prevention, habilitation, and remediation of individuals with a wide range of attention-based language, listening and learning impairments’ (p. 1). Moser’s (2005) study found that music training and participation in amateur music making activities led to a higher level of executive function in a large group of participants over 55 years of age. However, there is sustained debate on the validity of these findings. They could be a result of musical training or because the people choosing to learn a musical instrument naturally possess a high level of executive function. Neville et al. (2009) summarised this research conundrum to the Origins of Human Dialog conference in Paris:

Learning music requires focused attention, abstract, relational thinking and fluid intelligence (executive control [function]). Therefore, it is highly likely that a major factor in producing the positive correlations between
music and cognition are the result of the fact that people with better cognitive skills choose to learn music. (p. 278)

If the scope is widened to music education, rather than formal music training through learning a musical instrument, there are a number of studies worthy of inclusion in the review. Winsler, Ducenne and Koury (2011) completed a study of 89 three- and four-year-old children, roughly half of whom were enrolled in Kindermusik music and movement classes in the US. The study tested self-regulation, a primary element of executive function, through a number of different means. The children involved in the music classes displayed higher levels of self-regulation in speech, decision-making tasks and social situations. These findings supported the earlier findings by Zachopoulou, Tsapakidou and Derri (2004) and Lobo and Winsler (2006).

Studies examining conditions on the Autism/Asperger’s spectrum and Attention deficit-hyperactivity disorder have found significant links with executive function capacities and IQ levels. These studies have shown that executive function is often impaired while IQ levels are higher than the norm (Brown, Reichel & Quinlan, 2011; Chan et al., 2009; Cordeiro et al., 2010). Consequently, the possibility of music training enhancing executive function is an equally significant and controversial connection. The catch phrase ‘music makes you smarter’, used in conjunction with the Mozart Effect theory, comes to mind. As a consequence of the popularisation of such a claim in the 1990s, researchers have been careful to qualify and quantify this claim through extensive studies.

Schellenberg (2001) wrote a summary of neuromusical research findings and commented that although some evidence existed, ‘compelling evidence for a causal link remains elusive’ (p. 355). Ivanov and Geake (2003) replicated Rauscher et al.’s (1993) original study in a primary school environment and warned that although the Mozart Effect was present, there were so many variables in the participants and setting that it could not be applied to general intelligence as measured by IQ.

Formal music training involves dedication, time and attention to a given activity. This could also be said about the process of mastery of any activity. As Levitan (2006) outlined:
It seems unlikely from what we now know that musical expertise is wholly different from expertise in other domains. Although music certainly uses brain structures and neural circuits that other activities don’t, the process of becoming a musical expert—whether a composer or performer—requires many of the same personality traits as becoming an expert in other domains, especially diligence, patience, motivation, and plain old-fashioned stick-to-it-iveness. (p. 216)

Although select research and significant anecdotal evidence have been gathered connecting music training and executive function, no clear link had been established in the mid-2000s.

By the end of the decade, researchers had come far closer to defining the link between executive function and music training. Trainor, Shahin and Roberts (2009) concluded that musical training affects oscillatory networks in the brain associated with executive function and that superior executive functioning could enhance learning and performance in many cognitive domains, therefore being evidence of far transfer. Strait, Kraus, Parbery-Clark and Ashley’s (2010) research into the auditory mechanisms of musicians shows that musicians have a stronger relationship, via the development of their auditory skills (near transfer), between their overall conceptual and perceptual abilities (far transfer), which could be a ‘possible remediation strategy for language based learning and auditory processing disorders’ (p. 27). This strategy could translate to the ability for extended musical training to assist students with other aspects of learning, such as reading. Findings like these may have a profound impact on how music education is perceived in the broader educational community if presented in an appropriate manner and form. Although the value of music education has been anecdotally recognised for some time, expressing these scientific findings in an understandable manner to policy makers, teachers and teacher educators could radically alter the perception of music education in a broader curriculum setting. Alternatively they could be easily misunderstood, misused and misappropriated to suit political and cultural interests, and it is important to be mindful of the complex issues inherent in the application of these findings to music education pedagogy, practice and advocacy.
The field of executive function is so complex and interlinked with multiple brain/body functions that the current body of research only scratches the surface. It would be inappropriate to base any pedagogical or policy changes upon the current findings; this point is discussed in more detail in Chapter 7. However, musical stimulus and musicians’ brains are being used extensively to discover more in the area of executive function.

3.1.3 Specific Mathematical Skills

As part of the connection between formal music training and far transfer, musicians have shown a higher capacity than the norm in performing specific mathematical skills. While there have been connections made between musical training and higher mathematical skills in the past, the most recent research has only uncovered evidence of higher geometrical skills not other numerical skills as previously thought (Gazzaniga, 2008; Spelke, 2008). There is still debate over the effect music training has on mathematical skills. There has been a long-held belief that there is a relationship between music training and enhanced mathematical skills (Cheek & Smith, 1999; Vaughn, 2000), but this may be more to do with the higher general IQ levels of the participants (Hille, Gust, Bitz & Kammer, 2011).

Within this area, Posner et al. (2008) has put forward the idea that different art disciplines (visual art, drama, dance, etc.) create different and distinguishable neural pathways, which may be the reason for very specific far transfer cognitive skills developing in different students. For example, while musicians may have higher geometrical skills, dancers have been found to have higher observation skills. When musicians have been compared with drama students, it was found that musicians have far higher cognitive skills, especially in conceptual rather than perceptual tasks (Hannon & Trainor, 2007).

3.1.4 Music Processing

Several researchers have proposed music processing models to explain the pathway that the brain uses to detect, dissect and process musical sounds (Koelsch, 2011; Koelsch & Siebel, 2005; Peretz et al., 2009). The Musical Lexicon proposed by
Peretz et al. (2009) outlines the complex relationship between musical and speech processing. It highlights the sequential and simultaneous neural functions that work to create a centre of musical knowledge within the brain. Koelsch and Siebel’s (2005) Neurocognitive Model for Music Perception, which was reviewed and expanded by Koelsch (2011), outlines a similar process but connects each step of the process with the creation of meaning and emotion simultaneously. Tervaniemi et al. (2009) found that music processing is a multi-modal process that is dynamic. The act of processing music takes into account the type of sound, expertise and attention demands, meaning it is not a process that is modular or sequential from the top-down. Hodges (2009) also summarised the current research in this area as follows:

- Music is represented in widely distributed but locally specialised neural networks. In contrast to the notion of a music centre, music activates the front–back, top–bottom, and left–right parts of the brain. Specific aspects of music processing take place in localised areas, but these are connected to broadly diffuse networks. (p. 73)

When distilled, these models could prove useful to music educators in understanding the listening process and could inform and alter the current approaches to music education. This is discussed further in Chapter 7.

3.1.5 Language and Music

The link between language and music has been investigated widely. The complexity of the relationship has prompted a large number of studies that have identified subtle, overlapping processes in shared, parallel and distinct brain regions (Hodges, 2009, p. 73). Patel (2008b) highlighted the possibilities for music to help us better understand various brain mechanisms, particularly those related to speech. A significant area of research is the connection between musical syntax and speech syntax. Dammann (2009) suggested that music can help children decode the syntax of ordinary language. Jentschke and Koelsch (2009) went further to suggest that the improved levels of language acquisition in children with more than two years and nine months of musical training proves far transfer in the area of formal music training and language learning. Wandell et al. (2009) reported on the strong functional connections between musicians’ brains and their heightened phonological (speech,
voice and sound) awareness. The brain’s message transport system, the axons, are more diffused in musicians’ brains and therefore send messages to the temporal lobes, which are in charge of recognition and categorisation, more quickly. This allows musicians to process and assimilate some new information faster than non-musicians do, especially in the area of speech recognition and development. The complex area of language education could be significantly influenced by these findings. Concurrent, extended musical training during a period of significant language acquisition, such as the earlier years of schooling, could improve students’ reading and language skills and profoundly alter educational programs.

The correspondence of language and music neural pathways has been a topic of much debate during this period of research. Norton et al. (2005) found correlations between music perceptual skills and both non-verbal reasoning and phonemic awareness. Patel’s (2008a) extensive work in this area has led to a belief that studying music processing networks will shed light on language processing networks. Such pre-existing correlations suggest similarities in auditory and visual patterns.

One specific area of investigation is with music and mirror neurons. Mirror neurons ‘fire both when an action is executed and when that same action is observed or heard’ (Molnar-Szakacs & Overy, 2006, p. 1). In a musical context, this is when music is played on an instrument as well as when it is heard or replayed in the musicians mind. It has been proposed by Overy and Molnar-Szakacs (2006; 2009) that both music and language processes occur in the same way, using the human mirror neuron system. They proposed that music and language are a combination of perception and use of a hierarchically organised sequence of information. Peretz et al. (2009) and Koelsch and Siebel’s (2005) models of music processing highlight similar concepts.

Ettlinger, Margulis and Wong’s (2011) extensive review of the research connecting levels of implicit memory with music and language shows the benefits of music training in this area. Implicit memory is a type of memory that aids procedural activities, which are tasks we complete each day without consciously thinking about them. Musicians have exhibited a higher level of implicit memory, which is thought to aid in language acquisition and development as well as the efficiency of daily functions. Koelsch (2011) proposed an even stronger connection between language
and music, finding that ‘the human brain, particularly at an early age, does not treat language and music as strictly separate domains, but rather treats language as a special case of music’ (p. 16). The ability to acquire and develop language effectively is vital in the knowledge era of the twenty-first century and neuromusical research presents a valid question for curriculum designers as to how the development of literacy skills should be approached in our schools.

An understanding of how music training might improve language and literacy skills has taken some time to be realised. Tallal and Gaab’s (2006) study into this field found evidence of improvement in children’s language and literacy skills after musical training but were unable to pinpoint why this had occurred. As more research is completed, this understanding becomes clearer. Two previously mentioned studies, Strait et al. (2010) and Strait and Kraus (2011), suggested that music training bolstered the cognitive mechanisms that have been shown to be important in language and literacy development. Both studies suggested that musical training could benefit people who may have deficiencies in these areas, due to birth defects or injury, to improve their language and literacy skills. Two studies led by Schon (Schon & Francois, 2011; Schon, Magne & Besson, 2004) also confirmed that music training facilitates the ‘learning of both linguistic and musical structures’ (p. 1). With the on-going focus on literacy standards and debates on language acquisition methods, evidence that music training is linked so closely to the positive development of language should be included in the improvement strategies. Furthermore, neuromusical research should aim to ensure the appropriate balance of learning experiences in schools:

As more time is devoted to reading and math, and as teachers are warned that the scores in these subjects will determine the fate of their school, everything other than reading and math gets less time. This is what doesn’t count: history, literature, geography, science, the arts, foreign languages, physical education, civics, etc. (Ravitch, 2010)

However, Huron (2008) highlighted how little is known at this point about the nature of the connection between music and language. Some studies highlight the connections between both pitch and rhythm with language while others found that rhythm was not related (Patel, 2008a). Such divergent opinions need to be resolved
before educators can support a connection between formal music training in the early years of language acquisition. Alternatively, it could be argued that there is enough evidence at present to begin questioning the educational focus and experience of children during their earlier years of education. The above points are discussed further in Chapter 7.

### 3.1.6 Conclusions

Neuromusical research has shown that formal music training can not only improve a number of individual cognitive skills but also general levels of IQ and executive function, which regulates IQ (Hille et al., 2011). In examining Ravitch’s (2010) statement, is additional time in the school day dedicated to reading and maths the most effective way to enhance learning? Could the neuromusical findings show an alternate and complementary approach where early, sequential and instrumentally based music training could improve a broad range of cognitive abilities, including test scores, student well-being, learning capacities and retention? This is discussed further in Chapter 7. In 2011, Strait, Hornickel and Kraus went so far as to suggest that the ‘definition of common biological underpinnings for music and reading supports the usefulness of music for promoting child literacy, with the potential to improve reading remediation’ (p. 1).

### 3.2 Biological and Physiological Findings

The areas of biology and physiology are obviously vastly different, but in the field of neuromusical research they are often investigated simultaneously. Thus, in terms of categorisation, it is logical to group them together. Biological and physiological responses to music are often linked and spark questions based on the nature/nurture debate around musical understanding, talent, predisposition and capacity. The primary findings are related to the categories of the universal effects of music, positive and negative reactions to music, brain and body connections and musical aptitude.
3.2.1 Universal Effects of Music

The research findings in the biological and physiological benefits of musical experiences and differences in the musician’s brain have provided clarification, and in some cases validation, for many long-held beliefs about music. The much-debated concept that music is universal has been supported in a sense by Ball (2008), who found that music does have a common physiological effect on listeners, even from a variety of cultural backgrounds. Willis (2007) identified that music has the ability to open the affective filters in the brain, meaning that the learning process is more effective. This area of improved well-being through the use of music is part of the final step in Koelsch and Siebel’s (2005) music processing model. After a series of decoding and recoding activities in the brain, the process moves to the premotor system that controls the body’s immune system. At this stage of the process, the brain releases Immunoglobulin A, which is critical in protecting the body from organisms that attack its mucous membranes, the most common entry points within the body for infection. Such a finding lends support to the positive health benefits of listening to and participating in musical activities and is discussed in greater detail in Chapter 7.

The benefits of music on overall health have included the effects of music on the physiological experience of pain. Koelsch et al.’s (2011) study found that listening to music affected the levels of cortisol (a steroid hormone produced in the adrenal gland that aids in metabolism and increases blood sugar) and reduced the ‘sedative requirements to reach light sedation’ (p. 1). The less sedation required, the faster the body can recover from an operation, which improves overall health.

Investigations have also been reported on the physiological effects of music on mental health conditions (Lin et al., 2011). While these studies do not directly relate to musicians and music training, the universal effects of music on well-being and the promotion of healing are important on a broader level.

3.2.2 Positive and Negative Reactions to Music
Trainor et al. (2009) have worked extensively with the concept that music creates ‘good and bad vibrations’ within the neural firings of the brain. When the ear and brain detects musical combinations of pitch and rhythm that it is familiar with, the neural firings produce consonant or ‘good’ vibration in the brain. Conversely, when the ear and brain detects music it is not familiar with, this produces dissonant or ‘bad’ vibration in the ear and brain, which leads to negative emotional and cognitive reactions. These findings were built on earlier work by Blood, Zatorre, Bermudez & Evans (1999) and Blood and Zatorre (2001) who found that intensely pleasant responses to music activated the same brain structures related to other endorphin-producing stimuli such as food, sex and drugs of abuse. Levitan (2008) cited a number of studies that have found that making music has a greater capacity to ‘alter brain chemistry associated with well-being, stress reduction and immune system fortitude’ (p. 98) than listening to music.

As musicians are exposed to both consonance and dissonance in music on a regular basis, they learn to tolerate a range of emotions. Through the development of musical understanding, musicians learn to balance the concepts of surprise and prediction or ‘the stimulation of novelty and the security of the well known’ (Geake, 2009, p. 170). The development of this skill through music training has far-transfer effects on other areas of learning. For music educators this could serve as a new way to broaden students’ appreciation of new music that is outside their everyday field of listening. Such a change in students’ attitudes towards music could also encourage a significant change in their attitudes to social difference, cultural diversity and personal choice. This is discussed further in Chapter 7.

3.2.3 Body and Brain Connections

Wilson (1986) described musicians as small-muscle athletes, and studies have confirmed that ‘musical performance activates numerous brain regions involved in planning and executing motor movements’ (cited in Hodges, 2009, p. 73). These findings have investigated the heightened multisensory processing by musicians (Hodges, Burdette & Hairston, 2006) and the activation of the cerebellum, which controls motor behaviours, even when the participants are not moving (Parsons,
Put simply, when a musician imagines playing their instrument, they activate the area of the brain that controls that movement.

Trainor et al. (2009) and Ball (2008) have both done work on the connection between internal and external understanding and the transmission of music. Trainor et al.’s (2009) work focused on the music understanding cycle:

1. Music is conceived by the brain;
2. Music is then played by the body;
3. The musical listener experiences that music through their sensory organs; and
4. The listener’s brain interprets those experiences in light of their previous experiences and musical understanding.

Ball’s (2008) work is based on understanding the connections between auditory physiology, how the brain interprets music, and acoustic physics, how music is transmitted. Interestingly, it also explores connecting neurology with creativity, and auditory physiology with acoustic physics (Ball, 2008, p. 160). Recent developments in neuroscience research have further complicated, rather than resolved, research into the neurological sources of creativity. A definitive theory to the source(s) of creativity within the brain/body/mind, however complex it may be, could assist educators in developing this aspect of students’ thinking more effectively. This is discussed in Chapter 7.

3.2.4 Musical Aptitude

With such a growth in understanding of musical abilities, the questions of the existence of innate musical talent, musical exposure and the existence of a musical gene have been researched. Trainor (2008) reported that genes have been found to control the neural circuits in the brain, how the brain is wired and how those circuits develop to a certain degree. However, Trainor (2008) also reported that exuberances, or how much the brain is exposed to listening to and making music, can affect the type and extent of neural connections that are formed. Schlaug, Forgeard, Zhu, Norton and Winner (2009) supported this finding with the discovery that intense musical experience, as opposed to pre-existing differences, results in a larger anterior
corpus callosum area. In short, a child may be born with a high aptitude for music but if it is not used, it will not reach its potential.

In a groundbreaking study of 15 families in Finland, Pulli et al. (2008) has identified the specific chromosome linked to musical aptitude and that this aptitude is regulated by several predisposing genes and variants. These findings, while extraordinary, do not lead to fundamental change in the benefits provided by music education to students. It is important to ensure that students not be selected for music education solely based on their genetic predispositions, as music education is beneficial for all students regardless of this genetic cursor. This is examined further in Chapter 7.

3.2.5 Conclusions

Neuromusical research has measured and validated many of the biological and physiological effects of music that have been cited for centuries; music has the capacity to make us feel good and bad, music can help heal us and music engages our intellectual, emotional and physical beings. However, expressed as a scientific fact, these findings may promote different ways of looking at music education pedagogy. This could have both positive and negative ramifications for the development of music pedagogy, as over-reliance on scientific research could create bias. The concept of good and bad vibrations and the universal effects of music could serve as the basis of an entirely new approach to the understanding of musical diversity. Furthermore, a more effective strategy for developing respect for diversity in children could lead to higher levels of cultural tolerance in general. Cultural diversity and tolerance are often seen as a benefit of music and arts education, and indeed focus on these benefits led to the devaluing of music education for its own sake as an art form (Reimer, 1989b). However, at this time when music and arts education are being allocated less time, resources and consequently perceived as less valuable within the school curriculum, is it time to focus again on the non-musical benefits of music education in order to redress its decline?
3.3 Neural Development

Neural development has two distinct fields:

1. Brain structures: the architecture of the brain;
2. Brain functions: the way the brain sends messages, processes information and works within that architecture.

These two fields are closely interlinked, as a change in the architecture can change the way the messages are sent and vice versa. Much of the initial research into this area has been conducted with patients who have suffered traumatic brain injuries (Doidge, 2007; Sacks, 2007). This research has yielded an understanding of the brain structures and functions through observing what happens when these areas are damaged. Both Doidge (2007) and Sacks (2007) have observed that music training and music listening have had a positive impact on patients with traumatic brain injuries, with improvements in patients’ memory, motor skills and cognitive function through music training. Through their work and many others, the more subtle effects of musical training on neural development are beginning to be understood.

3.3.1 Music Processing Pathways

Extensive research has been conducted on the development of neural pathways in the brains of musicians and non-musicians. Neural pathways are the message transport system for the brain. In Hannon and Trainor’s (2007) study, two functions of the neural pathways were observed: the basic and the ‘enculturation’ mechanisms. The basic mechanisms appear to be common to all human beings, and consequently there are combinations of consonant and dissonant sounds that our bodies respond to in common physiological ways, regardless of cultural background. Ball (2008) and Trainor et al. (2009) supported this finding, as they discovered that consonant and dissonant sounds have entirely different neural pathways.

The ‘enculturation’ mechanisms are culturally specific mechanisms created through systematic exposure to one cultural style of music. This means we understand music in two ways, on an emotional/physiological level and a trained, cultural level.
Understandably, the more training a person receives in music, the greater the neural pathways related to enculturation. This action is also referred to by Hannon and Trainor (2007) as musical syntax, an understanding of the language of music. Peretz and He’bert (2000) supported these findings by outlining the neural pathways created for general and cultural musical understanding and how they are supporting, not separate, pathways that lead to the development of the musical lexicon.

Music education already includes cultural understandings but with these findings it can be put forward that music education could increase cultural sensitivity and understanding, which could be used to more effectively encourage tolerance, diversity and equity across cultures. This is discussed in greater detail in Chapter 7.

### 3.3.2 Brain Plasticity and Pruning

The term used for the ability of neural pathways to change is brain plasticity. Discoveries in this area have radically changed fundamental neuroscientific theories of the brain. Previously, the brain was thought to grow during childhood and remain the same in adulthood, following the adage that ‘you can’t teach an old dog new tricks’. Yet with recent findings in brain plasticity, it has been proven that the brain is constantly growing and changing and that the more plastic the brain is, the healthier it will be into old age.

Schlaug (2001) found that a musician’s brain was ‘an ideal model to investigate functional and structural adaptation of the motor and auditory system’ (p. 296), while Munte et al. (2002) proposed that it was an ideal model for investigating changes in brain plasticity.

Musicians have been found to have significantly higher levels of brain plasticity (Hannon & Trainor, 2007; Hyde et al., 2009). Marin (2009) has found that this plasticity is particularly prevalent in the auditory cortex during infancy and that this area, which is the primary processing area of music after infancy, is used far more extensively to support and decode external messages through the sensory systems during the first years of life. The connection between brain plasticity and creative thought have also being examined by Gibson, Folley and Park (2009), who found
that higher levels of activity in frontal cortex correspond with more creative individuals who have enhanced divergent thinking abilities. In a study by Moreno et al. (2009), a group of eight-year-old students displayed improvements in linguistic abilities after six months of music training in comparison to a similar group of students who had not been exposed to music training during the same period. The researchers associated this development with higher levels of brain plasticity due to the formal music training the participants experienced.

Brain pruning is a mechanism in the brain that discards synapses (messages) and neural pathways (message systems) that the brain has decided it no longer needs. These tend to be weaker synapses that are either very new or have not been used for a while. Think of it as a bus service: routes to very new locations have to be mapped out and initially take more work to remember than well-worn routes to established areas, whereas routes that are hardly ever used by patrons are discontinued, as they are not needed anymore. A significant period of pruning occurs during adolescence (Casey, Jones & Hare, 2008; Spear, 2000), and there are preliminary findings into the positive effects of early childhood music training on the type of brain pruning that consequently occurs during adolescence (Hyde et al., 2009. It has been proposed by Munte et al. (2002) that the neural development of musicians’ brains could act as a model to understand the development of pruning functions in the human brain. These findings are discussed further in Chapter 7.

3.3.3 Learning Pathways

Musicians have been found to have higher levels of what D’Esposito (2008) calls slow and fast learning pathways. Slow learning pathways create structural and functional aspects of the brain such as gray matter and initial pathways for messages. Fast learning pathways enable the brain to change these structural and functional areas quickly when new stimulus or information is encountered. This action is also called habituation and means that musicians need less repetition in order to commit new information to memory. Musical training has been found to improve the ability to learn new information or alter that information more effectively.
The National Educational Longitudinal Study First Follow-Up in 1990 supported the observations of music educators that students who participate in extended formal music training tend to display high levels of academic achievement in other areas (Ingels, 1992). It is possible that future studies into neural and learning pathways could provide scientific support to this observation and support a case for the more systematic training of students in music education at a young age. However, a number of fundamental issues inherent in the study design, methodology and participant criteria would need to be addressed.

Many recent discoveries in the neural development area have debunked a number of long-held neuroscientific theories such as left and right brain functions. Previously, the brain hemispheres had been assigned specific functions, but this research has shown, particularly in musicians, that the neural pathways cross the hemispheres regularly, which leads to more effective structural developments, functional capacity and plasticity in the brain. The neural pathways for understanding musical pitch and rhythm are however different (Peretz & Zatorre, 2005). Pitch is processed in the right auditory cortex, whereas rhythm processing is more widespread across bilateral neural networks. Furthermore, metrical rhythms (rhythms that are even) are processed differently to rhythms that are non-metric or uneven. As infants, we are happier to experiment with complex rhythm than we are with pitch that is more closely associated with physiological changes in mood (Trainor et al., 2009). These discoveries also follow onto Ball’s (2008) findings of the distinctly different yet intertwined neural pathways that transport affective and cognitive messages about pitch and rhythm.

The neuromusical research into learning pathways provides two important findings: music training can improve the ability to learn and reveals a deeper understanding of how we create musical meaning. These findings may have an impact on the role of music education could play within the wider educational experience and inform a far older debate on how we create musical meaning. This question is the basis of many music education pedagogies (Elliot, 1995; Reimer, 2003; Swanwick, 1999; Wiggins, 2000) and neuromusical research could both challenge and augment these theories.
3.3.4 Conclusions

Neuromusical research has begun to shed light on a fundamental question that educational philosophers and theorists have grappled with for centuries: how do we learn? The structural and functional aspects of learning can now be tracked in real time and observed more objectively than ever before. To complement our previous approach to understanding learning through observed behaviours, neuromusical research has given us an additional way of understanding the learning process. As highlighted by Flohr (2010, p. 17) ‘Neurological research confirms that the nervous system is richly integrated and the brain functions as a dynamic system transferring information at great speed … Body and mind work in tight reciprocal coordination in the generation of movements and consciousness’.

This learning process is both in the specialised and general areas of learning. Research into the neural pathways that contribute to musical understanding could challenge, develop and reinforce current music education methodologies. Research has shown that children who participate in formal music education can process information faster, more effectively and with high levels of innovation. Research into the effects of formal musical education on general learning capacities could challenge the current place and purpose of music education in any curriculum. However the findings need to be handled with great care, as the current level and type of research and findings are not sufficient to base an argument for a paradigm shift upon.

We are currently negotiating our way through the knowledge era, where the ability to learn is central to all aspects of our society and economy. Hargreaves (2003) supported his belief that the ‘knowledge economy runs on the power to think, learn and innovate’ (p. 3) with the OECD’s (2000) Knowledge Management in the Learning Society report that found that ‘we are moving into a “learning economy” where the success of individuals, firms, regions and countries will reflect, more than anything else, their ability to learn’ (p. 29). If formal music education has been found to support brain development specifically in areas of learning and innovation, should the place and purpose of music education be re-examined in the light of these findings? This could have implications on curriculum design and focus as we move
Beyond the knowledge era. This would require broader comparisons between neuroscience research conducted in each arts area, and at this stage there has been less research undertaken concerning arts disciplines other than music. It may also determine that the research field itself is not advanced enough to apply to music education pedagogy, practice and advocacy. The essence of this question is explored further in Chapter 7.

3.4 Disseminating Information (Study A1)

The literature review revealed that there was a great deal of research in the neuromusical field that would be of interest to music educators. It has the capacity to influence music education philosophy, pedagogy, content and in turn who should be teaching delivering music education to children. The broad implications of the research meant that non-music teachers, school leaders and policy makers might also have an interest in the research findings. However, the findings needed to be presented in a manner that would allow all educators to engage with the research.

Study A1 involved transforming the neuromusical research findings into a resource with which teachers could engage. This required an understanding of the audience’s interests, use of time and motivation to engage with the material, as well as the barriers to understanding the material, such as lack of neuroscientific training. As the information sheets evolved, it became clear that it could be piloted as part of Study B.

Teachers tend to struggle to find time to read extensive documents in their day-to-day routines, which leads to a lack of interest in reading anything that is not directly related to their practice or is not aesthetically engaging. Therefore, the resource took the form of one-page information sheets. Each sheet covered one category that emerged from the literature review, with a few categories combined. The categories in the sheets are presented in Table 2.
Table 2: Information Sheets by Title, Focus and Literature

<table>
<thead>
<tr>
<th>Title of information sheet</th>
<th>Focus of information sheet</th>
<th>Literature review categories included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music Education &amp; Brain Development</td>
<td>Introduction to neuromusical research findings</td>
<td>Brain Plasticity and Pruning (Section 3.3.2)</td>
</tr>
<tr>
<td>Music Education &amp; Memory</td>
<td>Memory with a focus on the different types of memory and benefits of music rehearsal</td>
<td>Memory (Section 0)</td>
</tr>
<tr>
<td>Music Education &amp; Language</td>
<td>Language with focus on examples of acquisition, syntax and use</td>
<td>Language (Section 3.1.5)</td>
</tr>
<tr>
<td>Music Education &amp; Executive Function</td>
<td>Definition of executive function, how it relates to learning and music with focus on Attention</td>
<td>Executive Function (Section 3.1.2)</td>
</tr>
<tr>
<td>Music Education &amp; Our Bodies</td>
<td>Physiological reactions to music with focus on explaining 'good' and 'bad' vibrations</td>
<td>Universal Effects of Music (Section 3.2.1), Brain and Body Connections (Section 3.2.3), Positive and Negative Reactions to Music (Section 3.2.2)</td>
</tr>
<tr>
<td>How Do We Understand Music?</td>
<td>Music processing with a focus on two models</td>
<td>Music Processing (Section 3.1.4), Music Processing Pathways (Section 3.3.1)</td>
</tr>
<tr>
<td>Musical Talent?</td>
<td>Current research and past thinking on the concept of musical talent</td>
<td>Musical Aptitude (Section 3.2.4)</td>
</tr>
<tr>
<td>Bigger, Better Brains</td>
<td>Summary of the neuromusical research findings</td>
<td></td>
</tr>
</tbody>
</table>

The information sheets used simple language, real-world connections, metaphors, visual reminders, different colour schemes and common structures to engage the reader. Each sheet had three sections: explanation, focus on neuromusical research and important concepts. The sheets formed a booklet and could be used individually or as a larger resource. Two example information sheets have been annotated in Figures 10 and 11 to illustrate the use of the above-mentioned techniques. The full series of information sheets can be found in Appendix 7 to 15.
Figure 10: ‘Music Education & Brain Development’ Information Sheet

Example
3.5 Definition of ‘Musician’ (Study A2)

Hodges (1996) regularly used the term ‘neuromusical research’ in the 1990s to describe the ‘study of the phenomenon of music in the human brain’ (p. 45). This term encompasses two interlinked fields: the uses of music as stimuli to better understand the workings of the brain, and the comparison of brain structures and functions of musicians and non-musicians. In terms of the types of experiments they would undertake, the former field may involve a study participant listening to musical excerpts to discern similarities and differences, and the latter field could be the completion of a common neurological task, followed by a comparison of the results between participant groups of musicians and non-musicians. The former field
reveals more about brain structures and functions; the latter field reveals how musical training may influence brain processing and development.

It became clear in the preliminary stages of the mapping process that I would need to focus on one of these fields, as an examination of both would cause confusion and compromise the validity of the thesis. I selected the latter field, focusing on comparisons between the brain functions and structures of musicians and non-musicians. This was due to a number of factors:

1. The field of music stimuli reveals little about the effects of musical training.
2. The field remains quite broad and the music used in the studies conforms to a less defined criteria that the latter field.
3. The musician/non-musician field has followed more defined parameters and narrowed the vehicle for music education to the act of learning a musical instrument.
4. The limited scope of the musician/non-musician field would serve as a valid basis for the exploration of the research questions.

3.5.1 Defining ‘Musician’ and ‘Non-musician’

As outlined in Section 3.5, a smaller satellite review was undertaken to define a comprehensive criterion for defining ‘musician’ from the studies. Again, this took on the process of a research project with a selection methodology, mapping, results and conclusions. The result was the criteria for ‘musician’ and ‘non-musician’ that would be used in Study B.

Fourteen studies were selected to contribute to the review. The studies all compared groups of musicians with non-musicians and provided sufficient detail on the criterion used for selection. A list of the studies can be found in Table 3. The central questions used within the review were:

1. What type of formal music training had an effect on brain development and processing?
2. When was the optimal age period in a child’s development to undertake this training?
3. How long did the training need to be undertaken for?
The studies (Table 3) were divided in two categories: studies involving adults (over 17 years of age) and studies involving children (under 17 years of age).

Table 3: Studies Included in Study A2

<table>
<thead>
<tr>
<th>Studies involving adult participants</th>
<th>Studies involving child participants</th>
</tr>
</thead>
</table>

The analysis focused on yielding appropriate boundaries for the musician and non-musicians criteria to be used in this thesis. The specific boundaries were as follows:

1. Type of music education experience;
2. Length of music education experience;
3. Age range in which the music education experience took place; and
4. Exclusion criteria.

Music education can occur in a broad range of environments, such as private or group instrumental lessons, classroom activities, specific methodologies such as Orff
or Kodaly and informal learning settings. The results from these various experiences could be vastly different in terms of brain structure and function, creating a significant variable within the experiment design. For this reason, 12 out of the 14 studies analysed used private or small group (no more than 6 students) instrumental lessons as the criteria for the style of music education the participants experienced. Two studies differed in the type of music education to which the participants were exposed. Study K included weekly Kodaly lessons and Study H included Orff lessons delivered by qualified practitioners. Study H did use Orff instruments but this was in conjunction with other Orff activities such as singing and games. The features of the type of music education that participants experienced were as follows:

1. Primary purpose of the lessons was to learn how to play a conventionally recognised musical instrument such as a string or keyboard instrument (all studies except H & K);
2. Weekly lessons during the school term (all studies);
3. Private lessons, defined as one teacher and one student (all studies except H & K);
4. Group lessons, defined as one teacher and no more than six students (Study K);
5. Group classes, defined as one teacher and more than six students (Study H).

This definition significantly narrows the variability of the findings and allows for comparison between studies. As Studies H and K by Marin (2009) and Schellenberg (2004) respectively represents criteria that are sufficiently outside the majority of studies included in this analysis, the criteria can be narrowed further to private, weekly lessons where the primary purpose is to learn a conventionally recognised musical instrument.

As mentioned previously, the studies were divided into two categories involving adults or children as participants:

1. The studies involving adults (Studies A–G) compared professional musicians, those drawing their primary income from musical performance or music education, with non-musicians, those who had no significant formal instrumental music education experience. These groups were defined by average hours of practice per day (Studies A, F & G), continuous music
learning from childhood through adolescence (>10 years, Study D) and/or training at a specified music school (Studies A, B, C & E).

2. The studies involving children (Studies H–N) between three and 11 years of age were compared those who undertook formal music training through instrumental music lessons.

The studies using adult participants found that there were significant differences between the brain function and structure of musicians and non-musicians. These included thicker myelination of the corpus callosum, the message bridge between the brain hemisphere that allows messages to travel around the brain at a greater volume and speed, as well as enlargement of specific areas of brain, depending on the instrument in which the musicians specialised.

The studies involving children sought, among other things, to determine the length of formal music education required to effect such structural and functional brain changes. Essentially, they were searching for a minimum period of music training required to change the brain. Studies I, J and N found that participants who underwent weekly instrumental lessons from between eight weeks and 15 months showed either structural or functional changes in brain activity, but not both. Studies L and M showed that both structural and functional changes in the brain occurred after a minimum of two years of formal instrumental music training.

The age at which this type of music education occurred is also an issue. The studies involving children only examined children in their primary school years (>11 years of age), whereas the studies involving adults examined a far longer span. Study F examined the average practice hours of professional musicians in three important periods during their childhood and adolescence, the age they began practising to 11 years of age, 12–16 years of age and 17 years of age until the time of test. The study found that the earlier the students began practising, the more significant the changes in the brain were. Study M echoed this finding, and Study D used the continuation of instrumental lessons through childhood and adolescence as a criteria for their musicians.
Several exclusionary criteria existed in each study. The most prominent was that all participants selected for the experiment were right handed, which was determined by the use of the Edinburgh handedness test (Oldfield, 1971). As these studies involved scientific testing, this is a commonly used criteria to limit variability in the results. Participants were excluded on a number of grounds, such as their medical history (hearing and vision problems, seizures, metal implants, pregnancy or head trauma with loss of consciousness) (Study D) and problems or delays with language acquisition or learning, or if they had started learning instrument but gave up playing (Study L). Again, such exclusions were unnecessary in Study B due to the study design.

Two interesting exclusions used in the studies analysed were those participants who learnt more than one instrument (Studies C & E) and learnt a foreign language before six years of age (Study L). While these criteria should not exclude participants from this study, they may serve as useful demographic information that could provide a richer picture of the musician participants as a group.

In order to further remove significant variables from the musician group, it will be necessary to exclude participants who derive their primary income from music-making activities, including performing, composing or teaching. Such participants would be likely to invalidate the data because their values of music education would be very high since their careers are based on this specific educational area.

The criteria used across the 14 studies for non-musician were generally based on gender and age matching with the musician group as well as no or minimal participation in formal music training. Within the Australian context, it could be assumed that most participants would have experienced a minimal level of experience in instrumental music training, albeit ten weeks of guitar or keyboard lessons in a class of more than 20 students. In most cases, these students would have been unable to practice these instruments outside of class time, due to access to the instruments, and would not have had private tuition.
3.5.2 Guiding Principles for Musician Criteria

Figure 12 illustrates the guiding principles that were developed from Study A2, which were then used to create specific questions to be included in the Study B survey instrument.

![Guiding Principles for Musician Criteria](image)

**Figure 12: Guiding Principles for Musician Criteria**

3.6 Conclusion

The results of the literature review answered thesis questions 3 and 4 (Figure 13).

![Research Questions by Study—Question 3 and 4](image)

**Figure 13: Research Questions by Study—Question 3 and 4**

The findings regarding cognitive abilities highlighted the various ways that formal music training has been found to develop, and in some cases enhance, brain structures and functions. Viewed as a collection of research, these findings could
have relevance on multiple levels for music educators and the field of music education. The apparent ability for formal music training to improve various numeracy and literacy capacities could change the current view on the value for music education within the broader curriculum. The findings that our bodies react in similar physiological ways could fundamentally challenge some of the ideas upon which music education is currently based. These findings could also change how we advocate and in some cases justify the place of music education. Finally, the emerging models detailing the neural processes involved in understanding music could provide new frameworks upon which music educators conceptualise musical development, understanding and design learning experiences. While many of these findings could be used by music educators to re-envision philosophy and strengthen advocacy, the impact they may have on music pedagogy is less clear.

An aspect of the field of neuromusical research that should be highlighted again at this point in the review is the various limitations of the studies that have been examined. Of the many areas of research within the neuromusical field, it was determined that studies that compared musicians and non-musicians would be the focus of this review, due to their somewhat common parameters. Due to the location of the research projects, which were almost entirely in Western, first world countries, and the availability of sufficient participants who could be credibly classed as “musicians”, the research findings at this time are limited in a number of ways. With a few exceptions, the majority of studies have been based on learning a musical instrument as the music education medium. Due to this focus, the findings could be easily misunderstood and misapplied to support the idea that only music education via an instrument results in enhanced brain development. The current body of research does not point to such a claim purely due to the fact that research into alternate music educations mediums, such as singing, has not been undertaken. Similarly due to the location of the research studies and the cultural context of the participants, research has not been undertaken into music education across non-Western cultures. Again, this deficiency in the research field as it currently stands should not be interpreted that Western music provides benefits beyond those of other cultures. For these reasons along with deficiencies highlighted in this chapter concerning study design and selection criteria, any neuromusical research findings
must be examined with full knowledge of the contextual and cultural issues that surround the field.

In addition to the contextual and cultural issues, it is important to discuss the focus and type of research that is missing from the neuromusical field. Soon after the emergence of this field, Eisner (1998) proposed several parameters for neuromusical research studies, parameters that would ensure validity and authenticity in terms of both neuroscience and music education. These include randomised assignment of groupings from the outset of formal music training rather than after it has begun as well as greater description of the form and content of the experiment treatment. To a large extent these parameters have not yet been used within the neuromusical studies and as such, music educators are still unable to reliably apply the findings to pedagogy and practice. If the neuromusical research findings are to advance not only the neuroscientific understanding of music but the understandings of music education, developments in study designs and participant criteria should be explored.

The field of neuromusical research is rich with findings, but even richer with questions. The dual discoveries of technology to observe real-time brain activity and the effects of music on brain development have revealed a new world where the parameters are only just beginning to be established. Hodge’s (2000) panel of experts could only speculate as to what they thought music educators should know about neuromusical research, let alone how this research may change music education pedagogy. Gruhn (2004) put forward a compelling position that we do not know enough within the field of neuromusical research to start making pedagogical decisions and that at that time it was too much of a leap to begin trialling pedagogical changes. This point of view was expressed some eight years ago and it is worthwhile to ask, ‘Are we ready now?’ Indeed, Hodges (2010) stated that he was ‘edging into the perhaps-we're-ready-to-begin-making-tentative-applications-to-music-teaching camp’ (p. 3). In considering this shift, it is important to explore what we know now that we did not know in 2004. The answer is that we know a great deal more about the effects of musical training than we do about the application specific learning methods or approaches to the teaching of music. Consequently, the above literature review has had an impact on the initial impetus and focus of this thesis. The findings,
and in some cases the gaps in the research, have caused the central focus of this thesis to evolve, refining the scope of the study to be undertaken.
Chapter 4: Study B–Application in the Classroom
(Literature)

After the completion of Studies A, the focus and design of Study B needed to be determined. As Study B consisted of a teaching intervention, it was important to consider the specific needs of the participant group and define the teaching philosophy, pedagogy and curriculum that would be appropriate for the study. This chapter outlines the relevant literature concerning primary generalist teacher education and describes the educational approach that was used in Study B.

4.1 Overview of Study B

Study B aimed to answer the main research question: Can recent findings in neuromusical research have an impact on the perceptions of music education held by pre-service teachers? The study took the form of a pre-test survey, teaching intervention and post-test survey. It used a quasi-experimental method, with a control and experiment group within which participants were divided into two categories, musicians and non-musicians. This method differs from a “pure” experiment method as the assignment of groups was not randomised (Bailey, 2008), due to the wish to examine the possibility that the participants own music education may influence their results. The criteria for the groups were determined by the research in Chapter 2.

The teaching intervention was in the form of a semester of learning in music education. This unit of learning was undertaken in a university environment and was part of the regular degree structure of a Bachelor of Education. The participants were enrolled in an undergraduate university degree qualifying them as an early childhood or primary teacher in Australia. These teachers are referred to as pre-service generalist primary teachers. The control and experiment groups both received the same music education curriculum, but the experiment group was exposed to neuromusical research findings that outlined the benefits of music education to brain development.
The pre-test and post-test surveys were identical (bar one question) and aimed to ascertain the specific values that participants hold towards music education for children. The surveys also included questions about teacher confidence, subject importance in relation to other school subjects and delivery of music education. The direction and degree of difference that participants indicated between pre- and post-tests, in light of their exposure to the neuromusical research and their own previous musical education, are the subject of Chapter 6 of this thesis.

In order to focus the purpose of Study B, it was important to situate the experiment in established theory and research. The following sections outline a philosophical basis for Study B, value theory, and the use of value theory in the field of music education. As Study B involved pre-service generalist teachers and music education, it was important to establish an understanding of the established research in this field.

4.2 Value Theory

To understand the concept of ‘value’ in a philosophical sense, it is also important to understand how values connect with attitudes. Within the field of social psychology, Thomas and Znaniecki (1918) proposed a definition for the difference between values and attitudes. Values are intersubjective, meaning they are held personally but by more than one person. Values are social in nature and as human beings within a society we create a range of values to which we collectively and personally subscribe. Attitudes are intrasubjective, meaning they are held and expressed by a single person.

Many decades later, Zimbardo and Leippe (1991) expanded on this definition. They proposed that attitudes are an evaluative disposition that is based on values. Additionally, attitudes are also influenced by how we think, respond and understand our past behaviours and how we plan to respond in the future. According to Zimbardo and Leippe (1991), attitudes are ‘predispositions to respond’ to a given situation, and vary in direction (positive or negative), degree (level of positiveness or negativeness) and intensity (how committed they are to the attitude). The measurement of these three predispositions in this study required careful design of
the experiment instrument in order to gain a clear picture of the participants’ values concerning music education.

The debate around values and attitudes, or the internal and external motivations and behaviours in human beings, has been explored extensively throughout the twentieth century. Rokeach (1973) proposed that there were two categories for values: terminal and instrumental. Terminal values are those that humans see as desirable end-states of existence, such as true friendship and mature love. Instrumental values are preferred modes of behaviour such as cheerfulness and ambition. Rokeach (1973) proposed that value change occurs through a connection between values, attitudes and behaviours, which results in a form of self-confrontation. The Rokeach Value Survey is based on these concepts and uses ranking as a valid method to measure individuals’ values. Study B of this thesis involves examining and confronting the current values that the participants place on music education. To maximise the positive outcomes of such confrontation, the teaching practices used within the study had to be carefully selected.

Study B aimed to detect and measure change in the value that participants assign to music education in relation to other discipline areas within the primary curriculum. In order to analyse this change, it was important to ascertain the degree or quality of change that occurs. The area of value theory that examines the quality of value is called axiology. Axiology is the assignment of ‘good’, ‘better’ and ‘bad’ values to a person, idea or object. Hartman’s (1967) Value Inventory provided a useful theoretical basis to view and measure the creation and changes of perceived value in this study. Hartman’s first axiom, or established proposition, is that ‘a thing has value in the degree that it fulfils the extension of its concept’ (Edwards, 1979, p. 133). Hartman (1967) outlined three levels of concept in terms of value: systematic (small), extrinsic (medium) and intrinsic (large). To translate, this means that items that we value at a systematic level correspondingly have a small value to us and items that we value at an intrinsic level have a high degree of value to us.

Hartman’s (1967) three levels of concept can also be applied to the research hypothesis proposed in this study. If the highest level of value is placed on concepts that hold intrinsic value for the participants, then it holds true that if participants
experience the neuroscience research through activities that focus on creating personal connection to the content, they will also develop an intrinsic motivation towards learning more about the area (Bandura, 1994). Therefore, in theory, participants should place a higher value on music education after the session than those in the control group.

Triandis’ (1995) concepts of individualism are also worthy of consideration in relation to this study. Triandis (1995) proposed that there are two types of values related to individualism: competence and intellectual/affective autonomy. Competence values relate to the need to be successful, capable, ambitious or independent. Autonomy values, which are both intellectual and affective in nature, relate to seeking variety, creativity and being curious and open-minded. Study B required the appropriate selection and implementation of teaching strategies to ensure that both types of individual values are catered for within a group-learning environment.

Gardner’s (2004) *Changing Minds* introduced a model of value theory that consisted of seven levels of mind change, condensed into three keys aspects: reason, research and resonance. Gardner’s (2004) model holds that in order to change a person’s mind, one must give them a reason to change it, produce research that supports that reason for change, and via the interaction of these two elements, create resonance within the person to enact real and lasting change in their view. This model could serve as an excellent basis for the construction of the experiment design, especially with the details of the two presentations.

Value and value change are complex human processes that are affected by multiple internal and external factors. The field of education has a significant interest in value and attitude development (Eagly & Chaiken, 1993; Jones, Howe & Rua, 2000; Jordan, 2011; Lindenberg, Thomas & Znaniecki, 1986), as it has direct connections to educational achievement and attainment. Within the scope of the study at the centre of this thesis, value theory informed both the design of the experiment instruments and the pedagogical and curriculum decisions during the teaching intervention.
4.3 Values and Music Education

It was important to examine how values towards music education had been measured in the past and which areas had been focused on. It became evident that there were two philosophical paradigms underpinning the research, which were the utilitarian rationale and aesthetic rationale for music education (Austin & Reinhardt, 1999). Prior to the 1960s, these studies were based on utilitarian themes, articulated extensively in a report entitled *Basic Concepts in Music Education* (Henry, 1958) by music education philosophers such as Madison, Mueller, McKay, Burmeister, House and Gaston. This report included such themes as the positive benefits of music education to physical health, mental alertness and self-discipline. However, almost simultaneously, the philosophical writings of Leonhard and House (1959) in *Foundations and Principles of Music Education* pointed to a shift in philosophy from utilitarian to aesthetic rationales for music education. This shift was captured in Reimer’s (1970) *A Philosophy of Music Education*, and tensions continue to exist between the two rationales, fuelled by changing concepts in broader educational philosophy and economic pressures. When Phillips (1993) articulated the view that completely ignoring the utilitarian rationales for music education ‘severely limited our argument for music’s importance in the curriculum, and we ignore the many and important contributions that music makes to life’ (p. 19), Reimer (1993) responded that utilitarian rationales should reside in the field of advocacy and not philosophy. These two rationales need to be considered when designing the research instrument for this study, as they could dictate one of three outcomes: findings based on only utilitarian rationales, only aesthetic rationales or findings based on both. Using the definitions establish in the research explored in this section, the neuromusical research findings would be considered a part or addition to the utilitarian rationales used for music education. The participant group brought their previous experiences and future directions to the study and must be considered in the decision.

A number of quantitative studies on the value of music education focused on values held concerning the nature and importance of music education. They examined values in music pedagogy (Bryant, 1986), values towards selected music education
philosophies (Hanley, 1987; Kacanek, 1982), values of the status of music education (Scarangella, 1993) within the curriculum and values held by school administrators (Greenwood, 1991; Liddell, 1977) towards music education. These studies were based on both utilitarian and aesthetic rationales and several compared and contrasted both rationales in the one study. The studies spanned participant groups including practising music teachers, classroom teachers and various types of school administrators. It is important to note that different values are indicated as important to different participant groups. Music teachers tend to support aesthetic values above utilitarian values, while non-musicians are generally of the opposite opinion. The implication for this study is that although the participant group is studying music they are not studying to be music teachers. This fact supported the choice to include both utilitarian and aesthetic values in the experiment instrument.

A notable exclusion from the previous studies is pre-service teachers as a participant group. Austin and Reinhardt (1994; 1996) highlight this gap in two of their studies into the philosophical beliefs of pre-service music teachers. These studies examined how the philosophical beliefs of this specific participant group develop through the course of undergraduate study. Austin and Reinhardt cited studies into the extent of value change and highlighted various opinions that are pertinent to Study B. While strong connections have been found between what teachers believe and how they behave in their classrooms (Brown & Rose, 1995; Kagan, 1992a; Nespor, 1987), studies have found that their values do not fundamentally change during their undergraduate study but do become more personalised, mature and refined (Eddowes, 1992; Richards & Killen, 1993). Gohlke (1994), Brand (1982), Krueger (1985) and Tabachnick and Zeichner (1984) supported this finding of value refinement rather than value change. Pajares (1992) added an important observation that the undergraduate study experience can affect the students underlying values if ‘they view teacher educators as respected authorities and are strongly challenged by new ideas that better explain their experiences’ (cited in Austin & Reinhardt, 1999, p. 19).

Research conducted by Welch (1995), Costantoura (2000) and Russell-Bowie (2002) has shown that the values related to the Creative Arts in Australian pre-service teachers are closely linked to teachers’ backgrounds. Biasutti (2010) found that there were significant differences between the values held by primary and secondary
teachers towards music education. Garvis and Pendergast (2010) found that the school culture and values expressed by experienced teachers influenced the pre-service teachers values towards music education.

These findings highlighted the need for a targeted approach to the introduction and delivery of the neuromusical research findings. If it was more likely that the study participants would refine their values, rather than change them unless strongly challenged, then the teaching strategies and resources being used needed to target the participants personally and be easily accessible initially while also challenging their established values over time. It would also perhaps be beneficial when examining the results of the post-test survey to note how far the values have moved on a given scale, and if there may be a significant difference in participants holding a very low value on particular items.

The instrument used by Austin and Reinhardt (1999) was a 75-item questionnaire examining the philosophical beliefs about music education. This questionnaire was based on a survey originally developed by Payne (1990) for a Q-sort study. Austin and Reinhardt (1994; 1996) have added their own rating scale and developed it across two studies. The instrument could serve as a valid basis for comparing established values of music education with the introduction of neuromusical findings to the participants.

The work by Austin and Reinhardt involved students training to be music teachers. Members of such a participant group would have personally studied music throughout high school and have chosen to continue to study music into their tertiary education. As music was their primary subject area, it would be expected that they would hold the art of music to be pivotal in any educational process. The participant group for this study was somewhat different. As they selected primary generalist training in education, the majority of them were unlikely to have significant formal music training. They have also chosen a career path that requires general education across numerous subject areas, rather than specific training in one. This participant group was likely to have significant broader views on the value of music education and consequently the experiment instrument needed to take other factors into account.
4.4 The Pre-Service Primary Generalist Teacher

Primary generalist teachers, also known as elementary classroom teachers, are a specialised group of educators. Typically, they spend the majority of their professional life catering to a class of students for a school year, teaching them across multiple subject disciplines. They are required to have a solid basis of knowledge in a plethora of areas as well as an extensive knowledge of educational pedagogy and psychology. Although requirements vary across school systems, primary generalist teachers may be required to deliver the music education curriculum to their class, or to assist the music specialist in the delivery and reinforcement. Universities in Australia include the arts in their curriculums in order to have their degrees accredited by state and national teaching authorities. Music education is not the principal focus for these pre-service teachers; general education is.

There has been extensive interest in the needs of this group of educators, and specific interest in their needs in the field of music education. The assumption that arts disciplines can be taught at the primary level by generalist teachers continues to cause division amongst music teacher educators, university administrations and government policy markers (Stevens-Ballenger, Jeanneret & Forrest, 2010). The restricted time available within a university degree to teach music education, coupled with the general low level of music education (Hocking, 2009) that the students enter the course with, compounds the problem. After 30 years of research into the content, pedagogy and focus of generalist teacher education courses in the music and arts education, three main areas have come to the fore: ‘lack of time given to arts teacher education; lack of confidence of pre-service teachers engaging with the Arts; and the influence of past experience on pre-service teacher engagement with Arts education’ (Garvis & Riek, 2010).

However, an additional area should be added to this list, that of the values that pre-service teachers hold towards music education, both before they enter any teaching degree and after any type of music education course. These values can be influenced by all of the areas mentioned above: if the students do not feel confident in their own
musical abilities, they may tend to value music education less. This situation can be compounded by limited contact time in their undergraduate degrees in which to gain that confidence. Finally, past experiences may influence the values that they bring into their undergraduate degrees and consequently the lack of time and confidence feeds into the lack of already low value that pre-service teachers place on music education (Austin & Reinhardt, 1999).

Teacher confidence is an important component within the area of values, as the level of perceived preparedness to teach music in their classrooms can have an impact on the value of music education held by this group. This is discussed in Section 4.5. Research into the source of this group’s values of music education found that the formation of their values happens long before they enter tertiary education. Hash (2010) described it as an ‘apprenticeship of observation’ that pre-service teachers obtain through their own primary and secondary schooling. With similarities to the research cited above, these values reflect those of their former teacher (Abril & Gault, 2005), are resistant to change (Anderson & Piazza, 1996; Kagan, 1992b) and are often unarticulated and unspecified (Pajares, 1992). For pre-service primary generalist teachers, this final finding is common across most subject areas (Hudson & Hudson, 2007; Stuart & Thurlow, 2000).

The learning experiences primary generalist teachers have during their pre-service training can influence their values, both positively and negatively. Stuart and Thurlow (2000) found that pre-service teachers’ negative beliefs towards music education can have a negative effect on their future students if not addressed during their teacher training. Conversely, effective pre-service (Berke & Colwell, 2004; Koops, 2008) and in-service (Colwell, 2008; Teicher, 1997) professional development can improve a teacher’s attitude towards the value of music education in the curriculum.

Previous studies into the values this group hold towards music education has yielded a complex set of connections between attitudes and confidence levels. In two studies (Berke & Colwell, 2004; Giles & Frego, 2004), music was found to be a valuable subject in the curriculum, but not necessarily as important as other disciplines (Abril & Gault, 2005; Krehbiel, 1990). When ranking the arts disciplines separately, music
was ranked first but teachers felt more comfortable teaching visual art than music or dance (Krehbiel, 1990). This lack of confidence has been found to accompany a lack of responsibility felt for delivery of music education (Byo, 1999; Giles & Frego, 2004; Koops, 2008; Wiggins & Wiggins, 2008). Interestingly, when a music specialist was not available, responsibility to teach music was only evident in 77% (Berke & Colwell, 2004) and 79% (Colwell, 2008) of the study participants. It would be interesting to know how the remaining 20+% believed music education would be provided for their students.

The question of preparedness to teach music within this group is a significant one and relate to values. As mentioned above, pre-service generalist primary teachers may hold to the value that music education is an important part of the curriculum, but other influences have been shown to affect the attitudes and behaviours that they exhibit towards music education. As Zimbardo and Leippe (1991) proposed that attitudes are an evaluative predisposition, pre-service teachers have been found to marginalise music education regardless of their perception of its value. Somewhere between their value creation and the attitudes and behaviours they exhibit towards music education, they have had experiences that, upon evaluation, have shaped their attitudes. Colwell (2008) found that this marginalisation was due to, among other aspects, a perceived lack of time to learn how to teach music and an inability to deliver the curriculum. Jeanneret (1997) found that there was a belief that ‘musical ability is inherited, not learned’ (p. 40) and building on this finding, Wiggins and Wiggins’ (2008) study found that due to its inherent nature, music education should not be necessary for all students to study in school.

It is evident that primary generalist pre-service teachers bring a unique set of values and attitudes to their study of music education in their degree. They may express socially formed views on the benefits of music education but their own experiences, positive and negative, may also influence their attitudes. These attitudes may in turn have an impact on their behaviours as teachers. This may be compounded by a lack of personal confidence to deliver music education effectively. The design and implementation of the experiment instrument needed to capture the broadest and most accurate data from this group. Similarly, the design of the learning experiences
within the intervention needed to take account of the specific needs of this participant group.

4.5 The Pre-Service Primary Generalist Teacher and Music Education

The field of music education and pre-service primary generalist teachers has been consistently researched during the past 30 years. It is an engaging field for tertiary music educators, and research has revealed personal, professional and systemic issues that influence effective education in the field. The research has included numerous large studies in Australia, the United Kingdom (UK) and the United States (US) and has included factors such as confidence, competence, past experience and self-efficacy. Within these factors, the influence of teaching strategies, curriculum models, content and time allocation have been examined and developed.

Confidence in the ability to teach music has been found to be a significant factor in the field of pre-service generalist teacher music education (Jeanneret, 1995; 1997; Hennessy, 2000; Holden & Button, 2006; Russell, 1996). Confidence can be affected by many factors, and researchers have worked to examine how these factors contribute to the overarching achievement of confidence in teaching music. Several researchers in the early 1990s explored the relationship between musical skill and confidence (Bresler, 1993; Gifford, 1991; 1993; Russell-Bowie, 1993). Musical skill, or a pre-service teacher’s judgement of their musical skill can affect confidence (Shuter-Dyson, 1999) and negative perceptions can arise from their past experiences in music education. Ruddock and Leong’s (2005) study found that such negative perceptions can be related to an unsuccessful attempt to make music in their past or a lack of understanding of music or ability to play an instrument.

Underlying beliefs can influence confidence. Hennessy (2000) found that pre-service generalist teachers held the belief that the ability to teach music required ‘gifts’ in instrumental performance and music reading, which led to low expectations for their future ‘non-gifted’ students. This is linked with Mills’ (1989) earlier work exploring the perceptions of music as a specialist discipline and Jeanneret’s (1997) survey of
Levels of confidence have been linked with a student’s concepts of competence and self-efficacy in the field of music education. Bartel, Cameron, Wiggins and Wiggins (2004) make the point that ‘confidence is meaningless if it is not accompanied by competence’ (p. 3). Mills’ (1991) study of 50 generalist teachers in the UK found that they rated their teaching competence lowest in music. Within pre-service generalist teacher training, pedagogical strategies and approaches to the acquisition of musical knowledge have been examined. This area of research has aimed to develop an understanding of the balance of learning about music while also learning about teaching music. Achieving competency in a subject area is made far more difficult if the student enters a course with a low level of subject knowledge and then receives minimum instruction in music education. In her report to the Music Council of Australia, Hocking (2009) surveyed 28 universities and found that on average only 16.99 hours were given to the study of music education in teacher-training programs. She found that ‘there is a general expectation that teachers need to know their content’ (Hocking, 2009, p. 4). Low levels of competence may come from pre-service teachers’ backgrounds in music. Russell-Bowie (2002) gathered information in multiple countries and found that students in Ireland were twice as likely to play an instrument than those in Australia, Namibia and South Africa. The impact of the lack of instrumental experience was understood further in Kane’s (2008) study in Australia’s largest state, New South Wales, where even many of those pre-service teachers who had learnt a musical instrument confessed they were no longer musically active and had forgotten much of what they had learnt. The implications of this context for music education for pre-service teachers are many. Bartel et al. (2004) described this inconsistency within teacher training well:

When prospective teachers study the art of teaching language, science, or mathematics, they receive comprehensive methods instruction at the post-
secondary level that builds on approximately twelve years of progressive study in each discipline. We would not allow someone who had stopped studying mathematics at the fifth grade level to teach mathematics. We would be appalled at the idea that someone could teach language arts if he or she had not read a book or written a word since the age of eleven. Yet we expect that generalist teachers can teach music when their last formal musical instruction, if any, may have occurred at that age or earlier. (pp. 3–4)

Various pedagogical and systemic approaches have been researched with the concepts of confidence, competence, past experience and self-efficacy in mind. Austin (1991) along with fellow researcher Reinhardt (Austin & Reinhardt 1994; 1996; 1999) conducted several consecutive studies to improve the attitudes of pre-service teachers towards music education and accompanied this approach with the inclusion of more time in the music classroom for these students during their professional experience component of the course. In a literature review, Jeanneret et al. (2006) found that the content of music education courses for pre-service generalist teachers was largely based on the professional judgement of lecturers. Furthermore, that judgement was based on what these professionals believe the teacher should know, rather than what they need to know (DeGraffenreid, Kretchmar, Jeanneret & Morita, 2004). This is an important distinction and may contribute to the findings in Gifford’s (1993) study where participants’ confidence lessened after a 12-week music course due to a perceived lack of relevance. Seddon and Biasutti (2008) explored the use of music technology, the remote facilitator and the 12-bar blues and found that it improved participant’s perceptions of their own musicality. Heyworth (2011) explored the use of loops and moving from acoustic to digital music with a view to ‘encourage and empower pre-service teachers to facilitate musical activities in their classrooms’ (p. 42). Heyworth (2011) found that while this teaching strategy did break down many attitudinal barriers for the students, it may be more effective when coupled with tradition music making experiences.

Researchers have also examined the impact of all of these factors on generalist teacher approaches to music education in schools, as teachers’ perceived beliefs, attitudes and self-perceptions can be seen to have a direct influence on how much
and how well particular subjects or activities are taught by teachers (Guskey, 1988). Barnes and Shinn-Taylor (1988) found that almost half of the teachers they surveyed wanted to be relieved of all responsibility for teaching music. In Krehbiel’s (1990) study, classroom teachers ranked the arts, including music, as the least important subject in the range of subjects they taught. In Bresler’s (1993) three-year study of music instruction in three US elementary schools, she found that music activities were scant and only occurred sporadically, but more alarmingly that the majority of teachers did not teach any music. The barriers Bresler (1993) identified to the greater inclusion of music activities included ‘teachers' lack of knowledge, resources, and appropriate structures within an overall climate of pressure for academics’ (p. 1). This final factor points to the devaluing of music education within the subjects that are viewed as being more ‘academic’ in nature. Garvis and Pendergast (2010b) examined the relationship between self-efficacy and arts education and found that:

there is a significant relationship between teacher self-efficacy [in the arts] and perceived support for subjects. . . . respondents in this study perceived a general lack of support for the teaching of the arts in their classroom, compared to English and maths. Many beginning teachers stated that schools provided greater financial support, assistance and professional development for the teaching of literacy and numeracy (typically described as English and maths), to increase school performance in national testing. (p. 18)

Currently, the research within the field of music education and the pre-service generalists is moving into the field in a number of directions. Wiggins and Wiggins (2008) completed a study investigating ‘what actually goes on in the classroom when generalist teach music’ (p. 4). One finding from this study was that generalist pedagogical knowledge contributed to some of the more effective learning experiences that the researchers observed. Garvis and Pendergast (2010a, 2010b) have continued to examine the issues of generalist teacher’s concepts of self-efficacy in music education and the relationship between their initial teacher training and the provision and support for music education in their initial years of teaching. The mix of learning experiences within a pre-service generalist teacher-training course continues to be refined. In Siebenaler’s (2006) study of a music fundamentals course
in the US, he evaluated a number of strategies using singing activities to increase confidence levels, reporting that:

While 96% of the students enjoyed singing along with the radio and 51% had some type of choral experience, only 25% considered themselves ‘good singers’ at the beginning of the semester. Although the percentage of students rating themselves as ‘good singers’ had increased to 39% by the end of the semester, the majority still lacked self-assurance in regard to a skill they had practiced consistently over the 15 weeks of the course. (p. 17)

Stevens-Ballenger et al. (2010) completed a study to put forward concrete recommendations about the knowledge and skills needed to teach music in the primary school. This study was in response to a series of reports and national reviews in Australia that highlighted ‘the need for the improvement of pre-service education in primary music but there is little in the way of concrete recommendations for this improvement’ (Jeanneret & Forrest, 2009, p. 85). The field is moving towards a greater understanding of how pre-service teacher training and the initial years of teaching are strongly connected with the standard and amount of music education that children are experiencing. With moves recently in Australia, the UK and the US for generalist teachers to deliver the majority of music education to children rather than specialists, this research is necessary to ensure the effectiveness and development of music education for pre-service teachers. In this environment, the effectiveness of music education courses for pre-service generalist teacher will have a direct impact on the levels of musicianship and aesthetic understanding of future generations.
Chapter 5: Study B—Application in the Classroom

(Method)

The purpose of this chapter is to outline the practical decisions and steps taken in terms of the study design. It includes the rationale for the quasi-experimental approach and details the construction of the experiment instruments. It concludes with the design principles for the curriculum, teaching resources and learning experience components of the study.

It is important during this chapter to maintain a clear distinction between the two large studies and two smaller studies that have been conducted within this thesis. The large studies are referred to as Study A and Study B, and the satellite studies as Study A1 and Study A2. Study A consisted of a review of the neuromusical literature to determine the appropriate design model and content for Study B. Study A1 consisted of a process of appropriately disseminating the outcomes of the literature mapping results (Chapter 3). Study A2 consisted of a smaller literature review to determine criteria for musician. The results from Studies A1 and A2 were used in Study B. Study B is a teaching experiment that used the findings from Study A. It focused on determining the potential impact of the neuromusical research findings, distilled in Study A, on the perceived value of music education held by pre-service teachers. A diagrammatic representation of the relationship between Study A, A1, A2 and B can be found in Figure 14.
5.1 Development of Experiment Instruments

5.1.1 Description of Research Site and Participant Group

The Faculty of Education, University of Canberra (UC) in the Australian Capital Territory (ACT), Australia, was the primary research site for this project. The participants for this study were students enrolled in the Bachelor of Primary Education or the Bachelor of Early Childhood Education. Typically, the students are in the first year of their degree when they undertake the semester unit called Arts Education 1. This unit includes study in the art disciplines of music and dance education. Students undertake ten weekly tutorials in both arts disciplines of 90 minutes in length. Experienced specialist tutors who teach through practically based learning experiences conduct these tutorials. Approximately 70% of the student cohort are school leavers (18 years of age) and 30% are mature age students (21
years and older). This unit uses a blended learning model of practical face-to-face teaching and online learning experiences and resources.

5.1.2 Survey Design

The study was a quasi-experimental method using a pre-test, treatment (intervention) and post-test model. The experiment instrument was a written survey that the participant groups would complete in the first and last tutorials of the semester. This study, known as Study B, examined the primary research question and sub-question 5. As detailed in Chapter 2, Study A examined the primary research question and sub-questions 2, 3 and 4 (Figure 15).

![Diagram of Research Questions by Study—Question 5](image)

Figure 15: Research Questions by Study—Question 5

The primary purpose of the survey was to quantify the values that the participants held towards music education at a set point in time. The scale allows for a comparison of the pre- and post-test surveys to determine the degree of change between those values. The secondary purpose of the survey was to determine how these values might have an impact on attitudes towards the delivery of music education in the school curriculum.

A search was conducted for a comparable research project upon which to base the Study B instrument. As the study design used a quasi-experimental method, this search aimed to find a quantitative survey that could be used as the instrument in Study B. Searches were conducted via various databases (ERIC, EBSCO, Google
Scholar) for studies on values and/or beliefs around music education. A similar or identical participant group (pre-service generalist primary teachers in Australia) was then added to the search criteria. As a study fitting all of these descriptors could not be located, a number of established surveys were used as the basis for the Study B survey design.

Sections of three research studies were used as the basis to create the survey instrument for Study B. Austin and Reinhardt’s (1994; 1996) survey on values (hereafter, the Austin/Reinhardt survey), which was based on Payne’s (1990) earlier survey, was used as the basis for measuring the values and beliefs that the participants held towards music education. Hash’s (2010) survey served as the basis for the section on the delivery of music education. Jeanneret’s (1995) study was the basis for the questions on confidence and importance in music education. Study A2 created the criteria for measuring the musical background of the students and focused two of the open response questions (Table 4). After the various sections were designed, they were created into one survey instrument to check for length and continuity.

### Table 4: Survey Parts

<table>
<thead>
<tr>
<th>Part</th>
<th>Theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Identity Code (researcher designed)</td>
</tr>
<tr>
<td>B</td>
<td>Demographic Information (researcher designed)</td>
</tr>
<tr>
<td>C</td>
<td>Musical Background (based on Study A2)</td>
</tr>
<tr>
<td>D</td>
<td>Value of Music Education (based on Austin and Reinhardt’s (1994; 1996) surveys)</td>
</tr>
<tr>
<td>E</td>
<td>Importance of Subjects (based on Jeanneret’s (1995) study)</td>
</tr>
<tr>
<td>F</td>
<td>Delivery of Music Education (based on Hash’s (2010) survey)</td>
</tr>
<tr>
<td>G</td>
<td>Confidence in Teaching (based on Jeanneret’s (1995) study)</td>
</tr>
<tr>
<td>H</td>
<td>Confidence in Teaching the Arts (based on Jeanneret’s (1995) study)</td>
</tr>
<tr>
<td>I</td>
<td>Open Response Questions (based on Study A2 and researcher designed)</td>
</tr>
</tbody>
</table>

The following sections outline the processes used to select and create the various parts, including consideration of the use of different scales and statistical measures.
5.1.3 Parts A and B: Demographic Information

Due to the pre- and post-test design of the experiment, it was important to ensure that participant responses could be paired. A unique code was created by each participant using the name of the first street they lived on and their first pet’s name. The first three letters of each name was then used to create a six-letter code for each participant. For example Wattle St and Kitty would become WATKIT.

The demographic information in Part B included age, gender and highest qualification obtained to date. The latter question allowed for the examination of the effect that varying levels of educational qualifications may have on values and beliefs. It was assumed that as the participant group were undertaking an undergraduate degree, most would have only a Year 12 certificate. However, due to past exposure to this cohort of students, a small number had obtained tertiary qualifications in a field other than education before undertaking a career change.

5.1.4 Part C: Musical Background

It was important to identify the type and level of musical training of the participants. This information was deemed to be critical, as it allows for a comparison of how past training may affect views and value on music education. This data acts not only as baseline but also as a potential factor that may influence the level of value change over time. This comparison could then be compared with the findings of other studies on value such as Hargreaves and Marshall (2003); this study found that undergraduate and postgraduate music education students value the social and cultural outcomes of music education above the development of musical skill. However, it did not shed light on the views held by pre-service teachers who are not training primarily in music education and are also unlikely to have significant levels of formal music education themselves. As the varied musical background of the participants could have a significant impact on the findings, it was important that the survey be able to capture this data.
The criteria for this section of the survey was taken from the satellite review outlined in Section 3.5. Fourteen studies in the field of neuromusical research were examined and three conclusions were synthesised from the review (Figure 16).

![Guiding Principles for ‘Musician’ Criteria](image)

**Figure 16: Guiding Principles for ‘Musician’ Criteria**

These criteria were then converted into a series of questions to quantify the participant’s musical experience. In addition to this, three questions were added to this section of the survey concerning the number and type of musical instruments learnt and whether they had studied a second language before the age of six.

Studies by Slevc and Miyake (2006) and Wong, Perrachione and Parrish (2007) formed the basis for the language question. These studies explored the connections between musical training and learning a second language. They have found that musicians use their enhanced skills in pitch recognition to more effectively learn a second language. Pitch processing in music requires ‘high cognitive demands and auditory acuity’ (Wong, Skoe, Russo, Dees & Kraus, 2007, p. 2), which has been found to be utilised when learning a second language. Bidelman, Gandour and Krishnan (2010) had convergent findings with both of Wong et al.’s (2007) studies when they found that music training and learning Chinese lead to higher levels of brain plasticity and processing of pitch information. The significant difference in the brain functions and structures of bilingual participants (Friederici & Wartenburger, 2010) has led to the need for this group to be identified as possible outliers within a research cohort. Figure 17 shows the exact answers required to classify a participant as a musician. For the purposes of this study, any deviation from this response resulted in the participant being deemed a non-musician. If a participant answered ‘yes’ to Question 9, their responses were excluded from the study. Participants who
have engaged in a professional musical career fell outside the desired demographic group due to their extensive musical training.

<table>
<thead>
<tr>
<th>Have you ever learnt a musical instrument?</th>
<th>Yes ✓</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Were you between 4 and 17 years of age when you learnt this musical instrument?</td>
<td>Yes ✓</td>
<td>No</td>
</tr>
<tr>
<td>Did you have weekly lessons on this instrument?</td>
<td>Yes ✓</td>
<td>No</td>
</tr>
<tr>
<td>Were your weekly lessons in a one-to-one format (one teacher and one student only)?</td>
<td>Yes ✓</td>
<td>No</td>
</tr>
<tr>
<td>Did you have weekly lessons for more than two years?</td>
<td>Yes ✓</td>
<td>No</td>
</tr>
<tr>
<td>Prior to commencing this degree, have you had a career as a musical performer, music composer or music educator?</td>
<td>Yes ✓</td>
<td>No</td>
</tr>
</tbody>
</table>

**Figure 17: Inclusionary Criteria For a Musician**

The results of Part C allowed the participants to be placed into four possible groups as seen in Figure 18.

**Figure 18: Division of Participant Groups**

5.1.5 Part D: Value of Music Education

The work of Austin and Reinhardt (1994; 1996; 1999) on the values of music education provided a basis for Section D of the survey. Their experiment instrument was a survey based on the work of Payne (1990) around the philosophical beliefs towards music education held by undergraduate music education students based in the US. The majority of Payne’s (1990) study was retained in the development process undertaken by Austin and Reinhardt (1994; 1996). The notable changes were the elimination of several double-barrelled statements and the inclusion of a small
number of new statements in light of new educational research, as well as the use of their own six-point rating scale (Definitely False to Definitely True), which differed from Payne’s (1990) modified Q-sort technique that aimed to obtain the relative value of the 27 statements used in her survey.

Payne’s (1990) survey aimed to discover the most important values that the participant groups held about music education. The survey was based on the premise established by Smith (1964) and Paul (1988) that educational sub-groups, other than music educators, would not accept aesthetic justifications for music education. Her study found this premise to be true.

Austin and Reinhardt’s (1994; 1996) development of the instrument added to the picture of values of music education. They divided the statements into three themed groups and with their additional statements moved to a ranking method. These themed groups were Quality Of Life benefits, Social-Emotional benefits and Aesthetic benefits.

The Austin/Reinhardt survey provided a strong basis for the measurement of the value that teachers place on music education. Their survey has been used and refined over a number of interrelated studies and provided an excellent starting point for Study B, which focused on the potential impact that neuromusical research findings have on the perceived value of music education. Using the statements and themed groups from the Austin/Reinhardt survey, an additional group of questions was added to the list. These statements formed the neuroscience benefits group. During the analysis of the survey data, the four themed groups—Quality Of Life benefits, Social-Emotional benefits, Aesthetic benefits and Neuroscience benefits—were compared to reveal if the neuroscience (neuromusical) benefits had an impact on the participants’ perceived value of music education. A complete list of the statements can be seen in Table 5.
Table 5: Statements in Themed Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Question number and description</th>
</tr>
</thead>
</table>
| **Group 1 - Quality of Life Benefits (QL)** | 13. Prepares students for a career in music  
20. Instils students with wholesome ideals of conduct  
22. Enables students to find meaning in the real world  
56. Helps students to develop good citizenship habits |
| | 60. Improves the general intelligence of students  
63. Enhances the physical well-being of students  
68. Helps students to develop good work habits  
73. Enables students to improve their quality of life  
75. Facilitates the development of a student’s personality |
| **Group 2 - Social-Emotional Benefits (SE)** | 17. Provides opportunities to improve self-esteem  
26. Helps students improve their motor-coordination skills  
27. Gives students relief from more structured classes  
32. Helps to develop students’ self-confidence |
| | 52. Teaches students how to work together as a team  
55. Provides success experiences for students who struggle  
57. Allows students to have fun  
59. Provides for a more well-rounded education  
72. Prepares students to participate in social events |
| **Group 3 - Aesthetic Benefits (AE)** | 24. Enhances students’ aesthetic awareness and sensitivity  
39. Enables students to develop their music potential and talents  
54. Increases satisfaction students derive from music  
62. Encourages students to use their imagination  
65. Enables students to understand more complex music |
| | 66. Exposes students to a different form of intelligence  
69. Increases students’ awareness of mankind’s cultural heritage  
70. Encourages students to be creative  
76. Helps students to appreciate music as a historical force |
| **Group 4 - Neuroscience Benefits (NS)** | 15. Helps students to think more flexibly  
16. Improves maths skills  
18. Improves reading level  
21. Helps students learn faster  
23. Helps students manage their emotions more effectively  
25. Speeds up the acquisition of language at a young age  
29. Improves students brain functions  
31. Helps students excel academically  
33. Improves skills in science  
34. Helps students resolve conflict |
| | 36. Helps students learn the rules of language  
38. Improves students’ memory  
40. Improves students social skills  
53. Improves students awareness of objects around them and their place in relation to those objects  
58. Improves specific numeracy skills  
61. Improves fine motors skills  
64. Improves a students’ ability to integrate new knowledge  
71. Help students think faster  
74. Improves students spatial awareness |
The selection of the statements for the neuroscience benefits group were based on the significant findings arising from the literature review in Chapter 2. These included the benefits of formal music training on reading skills, language acquisition, executive function, spatial awareness and social skills.

The writing style used for the questions needed to align with the existing style of the questions, including the clause rhythm, clause length, placement of object and subject and use of similar adjectives and adverbs. The statements were then compared with De Vaus’ (2002) Question Wording Checklist (pp. 97–99) to ensure their consistency. After the statements were completed, they were placed in a non-grouped order so that participants would not be able to identify the themes. In completing this task, it was important to follow better practice models of question sequencing by placing easier and enjoyable questions at the beginning and sensitive or abstract questions towards the end (De Vaus, 2002).

5.1.6 Parts E, F & G: Importance, Delivery and Confidence of Music Education

As Rokeach (1973) outlined, values are not fixed but can change as a result of the connection between them and our attitudes and behaviours. Study B needed to explore how the presentation of scientific data may influence the participants’ educational decisions about the place of music education within the arts and broader curriculum. The body of research into pre-service generalist teachers tells us that personal confidence (Bresler, 1993; Kritzmire, 1991; Mills, 1989; Paterson, 1992; Russell-Bowie, 1993) to deliver music education could also affect attitudes towards the perceived place/benefit of music education.

Two significant studies in this area by Jeanneret (1995) and Hash (2010) informed the design of this section of the survey. Jeanneret’s (1995) study focused on the
effects that different teaching methods had on the confidence levels of pre-service teachers in music education. Jeanneret (1995) developed a set of ranking questions to measure participants’ confidence levels in the delivery of all subject areas, including Music. These questions served as a model for Parts E and G of the Study B survey.

Participants were asked to rank 15 subject areas in terms of perceived importance (Part E) and their own confidence to teach those subjects (Part G). The data collected from this question will outline the number of students who ranked Music as most important (1) and the mean ranking for Music compared with the other subject areas.

Gifford (1991) showed that pre-service music education courses had little impact on the students’ confidence and actually decreased the value they placed on music education. The ranking questions in Parts E, G and H served as a measure of the effectiveness of both the neuromusical research findings and the teaching pedagogies and strategies used in the experiment to affect the values participants place on music education.

Hash’s (2010) study focused on the attitudes of pre-service classroom teachers towards music education in the elementary curriculum. This study was based in Michigan, US, and examined participants’ musical abilities, beliefs around the delivery of music education, their comfort (confidence) level in teaching music, the importance of music in relation to other subjects and the importance of outcomes from music education. Hash (2010) reported:

- Data indicated that most of these respondents do not feel comfortable teaching music as a subject, believe music should be taught by a specialist, and disagree that classroom teachers should be capable of teaching music. Results also suggest that participants regard music as less important than other subjects and nonmusical outcomes of music instruction as more important than musical outcomes. The majority of respondents, however, agree that music can improve achievement in other disciplines and are supportive of music integration. (p. 6)

The above statement demonstrates the complexity of the values and attitudes held by this particular participant group. The findings revealed that pre-service teachers did
not believe they were responsible or capable of delivering quality music education. These two aspects are important to consider together, as they may act on one another. If pre-service teachers do not believe they should be responsible for the delivery of music education (unlike English or Science, then they have no impetus to improve their capacity to teach it. Conversely, lack of confidence in their own music education skills could be masked by the educational belief that it should not be the responsibility of the generalist teachers. This aspect of Hash’s (2010) survey served as a basis for Part F of the Study B survey. Eight statements were chosen from the Hash survey for incorporation into the Study B survey. These statements allowed participants to express their attitudes towards the delivery of music education and the integration of music into other subject areas (Table 6).

<table>
<thead>
<tr>
<th>Group</th>
<th>Question number and description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generalists’ role in delivering music education</td>
<td>43. A K-6 classroom teacher should be able to teach music.</td>
</tr>
<tr>
<td></td>
<td>44. Music should be taught by a teacher qualified specifically in music education.</td>
</tr>
<tr>
<td></td>
<td>45. Music should be taught by a teacher who has an interest in music education.</td>
</tr>
<tr>
<td></td>
<td>47. A K-6 classroom teacher should be capable of supporting a specialist music teacher in teaching music.</td>
</tr>
<tr>
<td></td>
<td>48. Music education should be delivered to your students by external music specialists.</td>
</tr>
<tr>
<td>Music and other subject areas</td>
<td>42. Music should be integrated into other subject areas.</td>
</tr>
<tr>
<td></td>
<td>46. Other subject areas should be integrated into music education.</td>
</tr>
<tr>
<td></td>
<td>49. Music education should not be compulsory in the school curriculum.</td>
</tr>
</tbody>
</table>

The findings on the importance of music education may reveal a number of important insights into this participant group. The support of non-musical outcomes above musical outcomes of music education echoes the findings of other studies outlined in Section 0. These findings are further supported in Hash’s (2010) study by the preference for the integration of music into other subjects, rather than the study of music for its own aesthetic sake. Similar to previous studies by Abril and Gault (2005) and Berke and Colwell (2004), Hash (2010) found that study participants who valued music education for its aesthetic outcomes were influenced by their own musical abilities and childhood experiences (p. 16).
In light of the above finding by Hash (2010), it was important to create the opportunity within the Study B survey to identify musical abilities (Part C, Section 0) and the quality of those experiences (Part I). The qualitative questions were the only two questions to vary from the pre-test to the post-test. Question 77 established the qualitative aspects of the participant’s musical experiences, while Question 78 gave the participant the opportunity to reflect on the learning during the teaching intervention (Table 7).

Table 7: Qualitative Questions on Musical Experience

<table>
<thead>
<tr>
<th>Pre-test survey</th>
<th>Personal experience of music education</th>
<th>41. What do you believe is the value of learning a musical instrument?</th>
<th>77. What are your positive and/or negative experiences from learning a musical instrument?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-test survey</td>
<td>Personal experience of music education</td>
<td>41. What do you believe is the value of learning a musical instrument?</td>
<td>78. What are the most valuable things you have learnt in the 10 weeks about music education?</td>
</tr>
</tbody>
</table>

5.2 Choice of Statistical Scales and Formatting

The choice of statistical scales was largely determined by the various surveys that Study B was based on. In order to compare findings from Study B with the original surveys (Austin & Reinhardt, 1999; Hash, 2010; Jeanneret, 1995), the same scales were used. Part D of the Study B survey was based on the Austin/Reinhardt (1994; 1996) survey, which in turn was based on a survey by Payne (1990). The most significant development in the Austin/Reinhardt survey was the use of a six-step statistical scale, which ranged from definitely true to definitely false and was heavily based on the work of Perry’s (1970) Model of Intellectual and Ethical Development. This model was developed through his work with college students as they progress through stages of cognitive and ethical development. Perry’s (1970) model outlined the nine stages or positions he found that tertiary students went through as they learnt to construct and reconstruct new information and knowledge. The Austin/Reinhardt scale aims to obtain statistically viable data from tertiary students who would be spread across these nine stages or positions. As no neutral opinion is provided, survey participants must choose if each statement is false or true and the degree of
that belief. Part F of the Study B survey was based on the Hash (2010) survey that uses the standardised seven-step Likert scale.

Due to the use of two different scales within the Study B survey, recognition of the different scales needed to be highlighted in the survey itself. Two tools were used: a diagram at the beginning of Parts D and F and the exclusion of specific lines to allow for a visual reinforcement of the scale (See Figure 19 to Figure 22).

<table>
<thead>
<tr>
<th>Definitely False</th>
<th>False</th>
<th>More False than True</th>
<th>More True than False</th>
<th>True</th>
<th>Definitely True</th>
</tr>
</thead>
</table>

**Figure 19: Austin/Reinhardt Scale Diagram (Part D)**

<table>
<thead>
<tr>
<th>Music education …</th>
<th>Definitely False</th>
<th>False</th>
<th>More False than True</th>
<th>More True than False</th>
<th>True</th>
<th>Definitely True</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. Prepares students for a career in music</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Broadens student horizons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 20: Austin/Reinhardt Scale Visual Reinforcement (Part D)**

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>No Opinion</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

**Figure 21: Hash Scale Diagram (Part F)**

<table>
<thead>
<tr>
<th>42. Music should be integrated into other subject areas</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>No opinion</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>43. A K-6 classroom teacher should be able to teach music</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 22: Hash Scale Visual Reinforcement (Part F)**

The length of the Study B survey was of concern, as it is generally recognised that long surveys are to be avoided (De Vaus, 2002). By combining the Austin/Reinhardt
value statements with an additional set of neuroscience statements, the survey now contained 53 statements. Originally, these statements were all in one section, which was thought to look quite daunting and lead to survey fatigue, which would in turn have an impact on the quality and validity of the results. However, it was important to retain all of the statements that were taken directly from the Austin/Reinhardt (1994; 1996) surveys. This issue was resolved through the reorganisation of the questions to make the experience as pleasant and rewarding as possible (Dillman, 1978). Closed-format, ranking and open-format questions were interspersed so that the experience of completing the survey was appropriately varied. The structure and content of the survey would then be tested via a pilot study.

5.3 Validity and the Pilot Study

Study B is based on the quasi-experimental design that included a pre- and post-test and an intervention. This type of design was the most suitable for the experiment as the researcher had access to appropriate groups of participants and such a design could reliably measure the intention of the experiment, which was to identify if there is a causal relationship between the uses of neuromusical research to alter the values that pre-service teachers hold towards music education. Quasi-experimental designs have three requirements: 1) there must be a treated and untreated group, 2) there must be pretreatment and posttreatment measures, and 3) there must be an explicit model that projects over time the difference between the treated and untreated group (Kenny, 1975).

The first two requirements were easy to create for this experiment as the researcher had access to groups of students enrolled in the same tertiary degree and unit of learning. The treatment was restricted to exposure to the neuromusical research findings and the pre- and post-tests were largely based on survey questions used in previous studies. The third requirement in any quasi-experimental study ensures the internal validity of the experiment (Campbell, 1957; Kirk, 1982; Shadish, Cook & Campbell, 2002). Therefore, it was important to document the explicit model that was used during the teaching intervention and this can be found in Section 5.5. Quasi-experimental design has a significant number of internal and external factors
that can influence the results. Consequently, the internal and external validity of the study design needed to be considered to ensure that the results were valid and that any causal relationship that emerged could be verified.

5.3.1 Internal Validity

There are two significant threats to the internal validity of the study: diffusion of the experiment and the statistical validity of the experiment instrument. Diffusion of the experiment occurs when one group is aware of the conditions of the other group (Gall, Gall & Borg, 2010, p. 113). In this study, this would involve the sharing of information about the neuromusical research between students from the experiment and control groups. To minimise this threat, students in the experiment group were asked to sign a confidentiality agreement along with the study participation agreement. This agreement asked students to refrain from sharing tutorial materials with students outside their class group, with an understanding that all materials would be made available to all students after the completion of the post-test.

To minimise the threat to the internal validity of the experiment instrument, the survey was based on sections of existing surveys that were as close as possible to the participants’ group and learning intervention that was undertaking for Study 2. The surveys had all been conducted with tertiary students (adults), were all based on measuring values and beliefs in statements, and were all conducted on students studying music education in some way. The statistical scales used in these surveys were retained to provide continuity and maximum validity. The data analysis was based on the most reliable techniques for the sample number; therefore, means, mean differences, analysis of covariance and analysis of covariance with reliability correction were used (Kenny, 1975). Results without a strong internal statistical validity were either omitted or commented upon with reservations. The internal validity of the Study B survey was further strengthened through a pilot study.

Following De Vaus’ (2002) pilot testing model (pp. 116–118), a small number of participants volunteered to complete and evaluate the pre-test survey. The volunteers were enrolled in the same degree and undertaking the same arts education unit as the target participants. Due to logistical issues, only a small number (5) could be
involved, but the survey conditions were recreated as closely as possible. After completing the survey, volunteers were interviewed by myself as the survey designer and focused on four elements of the survey: flow, question skips, timing and respondent interest and attention. Six evaluation questions by McMillan and Schumacher (2010, p. 204) were also included in the interview:

- Were the items clearly worded?
- Was the meaning of the items clear?
- Was there any difficulty understanding the items?
- Were there any spelling or grammatical errors?
- Were the response scales appropriate?
- What suggestions are there for making improvements to the items?

The results were recorded in both written and recorded audio form during and after each volunteer had completed their interview. The pilot study revealed that:

- The flow of the survey was sound and maintained the engagement of the volunteers.
- All questions and instructions were worded clearly.
- The diagrammatical representation and visual reinforcement of the two statistical scales was helpful and the volunteers experienced no confusion.
- A small number of typographical errors were detected. The section headings included both the part reference and the subject reference, e.g., Part F: Delivery of Music Education. The volunteers found this confusing and suggested that the part reference be removed.
- The ranking questions were enjoyable but challenging to complete, as volunteers began to question the difference between what they felt was educationally important and what they felt they could teach confidently.
- There was enough space provided to answer the open-format questions and no question skipping was evident.
- Some volunteers provided equal rankings on Parts E and G, and as this would invalidate their responses from a statistical perspective the phrase no equal ranking please was added to the section instruction.
• All participants took between 18 and 22 minutes to complete the survey that matched the estimated 20-minute completion time included on the Plain Language Statement.

See Appendix 5 for the final pre-test survey and Appendix 6 for the varying pages in the post-test survey.

5.3.2 External Validity

Two threats to the external validity of the experiment were in the areas of population validity and personological validity. The number of participants completing the post-test survey would naturally decrease due to the withdrawal of students from the university course. In previous years, this has been approximately 10% of the cohort. The number of participants who would be classified as a musician for the purposes of this study may have varied significantly from group to group. There would also be two control groups and two experiment groups, and there was the possibility that personal characteristics of individual participants may strongly affect the statistical data. If one or more participants displayed strong negative values towards music education this may have influenced the other participants’ views.

An additional threat to the external validity of the study could have come from my dual role of researching as well as delivering of the teaching intervention. In this thesis, I proposed a number of questions that I have an interest in finding either false or true. It is understandable that I would favour a positive result, which may lead to, in some subconscious way, the application of more energy, time and focus into the experiment group’s teaching intervention. Alternatively, in my role as teacher, I may have delivered a more reserved and less engaging teaching intervention to the control group. With this possibility in mind, I included the use of a researchers’ journal in the study design. This journal consisted of a reflection and evaluation at the end of each teaching week. It reflected on the differences and similarities in the teaching experiences between the control and experiment. It also recorded any notable or surprising events or insights that occur during the teaching intervention.
5.4 Ethics

Ethics approval for the study was granted. Participation in the study was voluntary, and all participants received a letter of introduction (plain language statement) and signed a consent form prior to completing the pre-test. As printed resources would be included as part of the teaching experiment, students in the experiment groups (Groups 3 and 4) were also asked to sign a confidentiality form that asked students to keep the resources confidential until after the completion of the unit. This was included in an attempt to maintain the integrity of the teaching experiment and results. See Appendix 1 for the Ethics Approval, Appendix 2 for the Consent Form, Appendix 3 for the Confidentiality Form and Appendix 4 for the Plain Language Statement.

A number of ethical considerations needed to be resolved through the application process. Participants in the survey came from a larger cohort of students enrolled in a semester-long university course. All students selected a tutorial time for the music education component of the unit, of which there were 13 possible times. Four of those tutorial groups were involved in Study B but were unaware of this fact until the first tutorial. Therefore, provision was made for students who did not wish to participate in the study or who were below 18 years of age to be reallocated to a different tutorial time and tutor.

Another consideration was the equity of the learning materials across the study participant groups. The participants in both the control and experiment groups received the same content during the semester but those in the experiment group received additional resources on the neuromusical research. To maintain equity between the two groups, these resources were made available to the control group participants as well, via the unit’s intranet site, after the post-test had been administered.

Study B was a combination of the effective presentation of the neuromusical findings and an effective instrument to measure the changing values held by the participants. Within a ten-week teaching intervention, many unexpected situations and realisations
can occur. For this reason, I kept a researcher’s journal in order to record my experiences throughout the experiment.

5.5 Development of Teaching Intervention

This thesis explored the possibility that the presentation of neuromusical findings on the benefits of music training for brain development would increase the value pre-service teachers place on music education. The experiment design included a teaching intervention with a control group experiencing the standard unit of learning and an experiment group experiencing the standard unit of learning plus exposure to the neuromusical research findings. The participants’ values and beliefs were measured before and after the intervention to ascertain if the neuromusical research findings influenced their beliefs about music education.

In order to maintain the validity of the experiment and results, the general content and teaching approach of the teaching intervention needed to remain as consistent as possible across the tutorial groups. This was accomplished in two ways: a single educator (myself) delivered the teaching intervention to all groups, and the educational philosophy, pedagogy and curriculum design was comprehensively documented. The following sections outline the educational philosophy that underpins my teaching; the pedagogical choices that were made in light of the specific needs of the adult learners included in the experiment; and a model for the effective inclusion of the neuromusical research in the teaching intervention. This process ensured that the possibility of bias on my part as both teacher and researcher were minimised.

5.5.1 Educational Philosophy and Practice

At the time of this study, I had been a teacher of secondary school music for 15 years and had also concurrently been teaching tertiary students for seven years. I base my practice on the philosophies of Eisner (2002a), including ‘education is a process of learning how to become the architect of your own experience and therefore learning
how to create yourself” (p. 24). My role as the teacher is to give the students the cognitive and emotional tools to function independently. This ability is developed through the social constructivist approach to learning (Vygotsky, 1978). The development of a student, regardless of their age or life experience, is achieved in my music classroom through social interaction. Students are provided with an environment where they can engage practically in music making and acquire knowledge through social negotiation and interaction before internalising that knowledge as an individual (Greeno, Collins & Resnick, 1996; Van Meter & Stevens, 2000).

Through my experience teaching both children and adults, independence does not come solely through age. It requires highly developed skills in reflective thought. Dewey (1910) outlined reflective thought as the basis of learning and characterised the difference between thinking so and knowing so. He proposed that reflective thought had two parts, feeling and thinking. Feeling is the sensory experience of a given phenomenon and thinking is the logical and imaginative exploration of that phenomenon. Dewey (1910) uses an example of rain; we experience the cooling of temperature and rain on our skin and create a felt understanding of the phenomenon. To think through the consequences of that rain on future events, such as garden party, or extend our imagination to seeing our face in the darken clouds, creates a cognitive understanding of the phenomenon. Dewey (1910) proposed that both understandings must be present to know the phenomenon.

Dewey’s (1910) concepts of reflective thought, or the making of knowledge, are the basis of experiential learning. This is the concept of making meaning through direct experience, or learning through doing. Eisner (2002a) expressed it as ‘experience is the medium for education’ (p. 3), while Dillon (1995) preferred ‘through making we make ourselves’ (p. 70). Eisner (2002a) built on Dewey’s work with the idea that experiential learning is the basis of creating an imprint (or learning) in our mind. He pointed out that our first experience of new knowledge is always sensory, from which we create personal meaning and then combine the two to make an imprint (Eisner, 2002a). As a teacher of one of the arts, this theme runs strongly through my practice. Music is ephemeral and exists only while musicians or a stereo device is playing it. Therefore, music cannot be taught without the creation of music. In my
teaching practice, this leads to learning experiences that are sensory (students are singing, dancing and playing music) and logical (musical concepts are made explicit and I use traditional musical languages and symbols).

In relation to the established philosophical standpoints in music education, my practice is based on music in action, the praxial approach stemming from *Music Matters* by Elliot (1995) and the multi-layered learning experience from Swanwick’s (1979) *A Basis for Music Education*. Elliot’s (1995) focus on music as a cognitive activity aligns with the experiential learning philosophies of Eisner (2002a) and Dewey (1910). Elliot (1995) contended that music is intentional, contextual, multidimensional and diverse and that music listening and making revolve around a form of procedural, situated knowledge called musicianship. Elliot (1995) defined musicianship as the simultaneous listening and making of music upon which musical understanding is formed:

the connection between listening and musicing is therefore intimate, to say the least. Music listening and music making are mutually interdependent; they are two sides of the same coin. (p. 103)

The practices I employ in the planning and delivery of music education are very much based on the concepts that music must be experienced, but experience is not solely physical/sensory in nature; it includes simultaneous cognitive activities. As Swanwick (1988) warned, ‘doing things without thinking can be profitless, even hazardous’ (p. 6).

Complementary concepts can be found in Swanwick’s (1979) list of hierarchical educational objectives for music. Underpinned by four categories, Swanwick (2001) believed that ‘music is a multi-layered human experience, where layers not only interact vertically but also laterally, as minds assimilate and accommodate to musical processes’ (p. 234). The four categories are skill acquisition, recognising and producing expressive gestures, identifying and displaying the operation of norms and deviations and aesthetic response (Swanwick, 1979). In the development of the theory, Swanwick (2001) condensed these categories to materials, expression, form and value. These categories can operate simultaneously as well as in a hierarchical order, and the fact that it begins with skill acquisition sits well with my experience of
music education as a starting point. However, the multi-layered nature of this philosophy is also important to my practice, as it links well with the social constructivist approach where groups and individuals make meaning from all aspects of an experience, and not in a common or prescribed order.

An additional element of my teaching practice is based on a series of principles that form a practice of intuitive or artistic teaching. This approach to teaching has been explored by a number of researchers, including Eisner (2002b), who describes the practice as follows:

Artistry requires sensibility, imagination, technique and the ability to make good judgments about the feel and significance of the particular. . . . Good teaching depends on artistry and aesthetic considerations. . . . Artistry is most likely when we acknowledge its relevance to teaching and create the conditions in schools in which teachers can learn to think like artists. (pp. 382–4)

Sawyer (2004) contended that teaching was improvisational, rather than over-scripted, performance. Prendergast (2008) built on this model when depicting the teacher as someone who demonstrates concern with ‘artistic process’ in interpreting curriculum and acts as a critically interactive spectator of their students’ learning. In my practice, the work of Rubin (1985) in his book *Teaching Artistry* and subsequent writings (1986; 1989) has been a guide to developing my own teaching artistry. His principles allow me as a practitioner to realise the concepts of cognitive and emotional independence, reflective thinking and experiential learning in a dynamic way in my classroom. Rubin (1985) suggested that ‘all artists, whatever their art, have the ability to conceive and execute their tasks with exceptional taste, judgment, and imagination’ (p. 15). He proposed that teaching can be approached in the same way, using the characteristics of artistry such as originality, flair, dexterity, ingenuity and virtuosity. This approach sits well with my teaching practice, as through my musical training I have come to see how these characteristics can be embodied in any pursuit. Rubin provided 12 teaching principles that I use as touchstones in my teaching practice as well as curriculum design:

- Focus on subtleties
- Use intuition and hunch
• Use temporary digression to enrich lessons
• Take advantage of opportunities to reinforce and clarify ideas
• Set high expectations for you and your students
• Find efficient and expedient ways to get things done
• Improve tactics to reach objectives
• Concentrate on a few dominant goals
• Base your control of learning on student behaviour
• Take pride in what you do and your students’ achievements
• Respect your convictions
• Devote as much time as you can to what you love to teach

The educational philosophy and practices outlined above are common to every teaching context I work within, irrespective of the students’ age, developmental or musical levels. However, in order to tailor the teaching intervention effectively to the learners and their context, it was important to consider the specific characteristics, knowledge, structures and psychological motivations at play. The following section outlines the specific curriculum choices and individual approach the teaching intervention employed to cater to pre-service generalist teachers.

5.5.2 The Curriculum and the Learners

The learners in this context are adults from a variety of age groups and social and educational backgrounds enrolled in an undergraduate early childhood or primary education degree. As outlined in Chapter 4, a body of research exists around the specific issues and needs of pre-service generalists teachers in music education. The main themes found in this research are a lack of confidence, competence, past experience and self-efficacy experienced by the students. This research informed two interlinked areas of the teaching intervention: the curriculum structure and content and the personal development of the students during the teaching intervention.

The overarching themes present in the research into pre-service generalist teachers’ music education highlights issues closely linked with the emotional and physiological well-being of the students. In my experience of teaching these learners,
I have observed all of the issues present in the research in varying degrees. The overriding lack of confidence that a significant proportion of the students display is fuelled by a lack of knowledge and experience, leading to a lack of perceived effectiveness in the delivery of music education. This situation often results in a heightened emotional and psychological state, which the students consequently bring through the door with them at their first tutorial. As Jeanneret (1995) puts it, ‘negative attitudes towards music in the classroom come as part of the musical baggage these preservice teachers bring to their tertiary music classes and that the tertiary instructor has a part to play in consciously countering these negative attitudes’ (p. 20). This counteraction took the form of a curriculum and teaching approach in Jeanneret’s (1995) study, and formed the basis for this teaching intervention. In addition to this approach, it was important to address the negative emotional and psychological state that some of the students brought into the classroom.

Jeanneret’s (1995) doctoral thesis focused on developing pre-service generalist teachers’ confidence to teach music through a specific tertiary course. Her study encompassed two teaching sites in the US and Australia and yielded a model of delivery (Figure 23) that was shown to improve the confidence these students felt towards teaching music. This model served as the basis for the curriculum design for this teaching intervention.

Jeanneret’s (1995) study found that the development of basic skills and knowledge in music did improve pre-service generalist teachers’ ability to teach music. This finding was similar to previous studies by (Bennett, 1992, D’Ombrain, 1974; Gerber, 1992; Gifford, 1991). However, Jeanneret’s (1995) study also found that the capacity for the tertiary music instructor to develop a positive self-concept in the students, and to act as a model for both music and general teaching, was a vital element to improving confidence, and had been previously neglected in the research field. Jeanneret’s (1995) model (Figure 23) outlined the complex interactions between three areas, curriculum, competencies and teaching strategies, in developing confidence to teach music. Specific elements in each area were then outlined with an overarching concept that the instructor was the model for what and how to teach in both music and general education.
The curriculum area outlined the need for a balance of instruction and encounter within the learning experience. Gifford (1991) found that the music curriculum may have been too heavily based on instruction and musical achievement and that this did not develop the students’ confidence. The opportunity needed to be made for sensory experience through encounter during the learning experience (Jeanneret, 1995), and that a balance between instruction and encounter improved levels of confidence (Gifford, 1991; Swanwick, 1988). Therefore, in the teaching intervention in the experiment for this thesis, opportunities need to be made for both instructional teaching and sensory encounters with music and music education. Consequently, the curriculum is divided into two parts. Tutorials one to five are based on teacher-led instructional learning with teacher-led sensory encounters. Tutorials six to ten are based on student-led instruction with student-led sensory encounters.

The competencies area outlined the need for competencies in music as well as teaching. Competencies in teaching come from multiple experiences within the curriculum, as the instructor provides a model for teaching in general (Jeanneret, 1995). Competencies in music come from scaffolded activities and experiences that develop students’ musical vocabulary and skills (listening and practical). Both musical and teaching competencies are developed during the ten-week teaching intervention; however, the balance changes as the intervention progresses. In
tutorials one to five, the focus is on developing musical competencies. This is based on the purpose-designed workbook *Bedrock: Foundations of Music* (Collins & Edmonds, 2007), which is designed to aid students in revising and/or learning the musical knowledge required by a generalist teaching up until Year 6 in the New South Wales Board of Studies curriculum. The students complete required chapters prior to the tutorials, and the tutorial experience is based on practical applications and reinforcement of those musical concepts. The instructor uses a small number of teaching strategies through these five tutorials, which they repeat using slight variations. Through this experience, students come to understand the basis of effective teaching strategies in music. In tutorials six to ten, students are assigned three topics in rhythm, melody and song, and teach a three-minute activity to the class. This allows the students to apply their music competencies in a teaching environment and experiment with their general teaching competencies as well.

The teaching strategies utilised in the teaching intervention are required to develop both musical participation and confidence. This is in response to previous research (Cassidy, 1988; 1993; Tunks, 1973; Verrastro, 1976) that found that a lecture mode format and a focus on musical achievement rather than development did not improve pre-service generalist teachers’ confidence in the ability to teach music (Jeanneret, 1995). Consequently, in the teaching intervention in the experiment for this thesis, the teaching strategies were based around experiential learning (Eisner, 2002a; Elliot, 1995; Swanwick, 1979) with a consistent cycle of reflective thought (Dewey, 1910; 1934). In conjunction with increasing levels of music and teaching competencies and an engaging balance of instruction and encounter, these teaching strategies complete the model for confidence to teach music for pre-service generalist teachers.

In addition to the teaching strategies mentioned above, I believed it was important to acknowledge the heightened emotional and psychological state that many of the students bring to the initial tutorials. Jeanneret’s (1995) study highlighted that apart from one study there ‘appears to be little recognition of the role of teacher effectiveness and teaching strategies which aim at developing positive academic self concepts and self-efficacy in music might play in the development of confidence to teach music’ at the time (p. 198). In my experience, there are a significant proportion of the students who express and display apprehension and fear about not only
teaching music, but learning about music. At least one student greets me in our first tutorial with the statement, ‘You are not going to make us sing, are you?’ When I tell them they will be singing and dancing in the next ten minutes, many of them display outward signs of emotional discomfort. These responses have also been identified in Vannatta-Hall’s (2010) study of pre-service generalist teachers and self-efficacy in music education. This study recognised that heightened physiological and emotional states affected pre-service generalist teachers’ ability to accurately assess their self-efficacy in music education. Thus, through recognition and adjustment of these reactions, pre-service teachers’ perception of their ability to deliver music education effectively was raised.

Such displays of apprehension and fear towards music education not only has an effect on the individual, but also has the capacity to significant hinder the social dynamic of the class and the willingness of many students to take intellectual, emotional and physical risks. For this reason, I chose to employ the teaching and physiotherapeutic strategies of Rogers, predominantly *Freedom to Learn* (Rogers, 1969) and *The Foundations of the Person-Centred Approach* (Rogers, 1979). Rogers (1959) outlined six conditions that were necessary for psychological change within a counselling environment:

1. Two persons are in psychological contact.
2. The first, whom we shall term the client, is in a state of incongruence, being vulnerable or anxious.
3. The second person, whom we shall term the therapist, is congruent or integrated in the relationship.
4. The therapist experiences unconditional positive regard for the client.
5. The therapist experiences an empathic understanding of the client’s internal frame of reference and endeavours to communicate this experience to the client.
6. The communication to the client of the therapist’s empathic understanding and unconditional positive regard is to a minimal degree achieved. (p. 95).

These conditions related to both the therapist’s position within the counselling relationship and the subsequent perception that the client had of the therapist’s
position in the relationship. Holosko, Skinner and Robinson (2008) described the foundation of Rogers’ (1959) person-centred theory as follows:

The Rogerian mandate of counsellor authenticity, empathy, and unconditional positive regard allow for counsellor transparency and promote a model for clients, which culminates in their regarding the counsellor as having their best interest in mind. (p. 315)

Psychological change shares many common aspects across the therapeutic and educational environment. It is about the relationship between teacher and student and the conditions the teacher creates and how the student interprets those conditions. Ultimately, psychological safety in either environment is a prerequisite for the effective exploration of new ideas. The students under my instruction need to feel safe to take intellectual, social and physical risks in order to learn and change.

The educational philosophy of my practice is based on the concepts of Eisner (2002a), Dewey (1910; 1934), Vygotsky (1978), Elliot (1995) and Swanwick (1979; 2001). In heeding Jeanneret’s (1995) warning that a music course ‘can have significant effect on students’ confidence to teach music [and] tertiary music instructors should give careful consideration to the curriculum design and implementation’ (p. 197), I carefully select the curriculum content, activities, resources and teaching strategies to maximise the learning experience for this specific group of students. In circling back to the work of Eisner (2002a) and enabling students to be the architecture of their own experiences and learn to create themselves, I maintain a learning trajectory (Figure 24) in my mind for each student. Through careful curriculum choices, and all that this term entails, I aim to move the students from a dependent to an independent state of learning. As they exit the unit of learning, they will not be experts in music education but will be confident and skilled to a degree that they can both deliver effective musical education to their students and identify areas and options for development.
7.4.2 Entering the Learning Experience

Participants walk into the tutorial room for the first time in a myriad of emotional states. Some are literally terrified and this can manifest itself physically in increased heart rate, shaking limbs, raised temperature or guarded body language. These are physiological reactions to uncertainty and what the unit entails, what they will be asked to do and fear of humiliation of failure. Some participants are intrigued and both open and cautious about what lies ahead. Some participants are buoyed with enthusiasm, and this is typical fuelled from a positive past experience in music education. However, the majority of participants will enter the room in a frightened or uncertain state. The vulnerability of their emotional state needs to be acknowledged and catered for from the moment they enter the room.

This is the point where the Rogerian (1959; 1979) model of facilitation, used originally in the psychotherapy setting, comes to the fore in the pedagogical approach. These participants need to feel an immediate sense of safety and structure within the student/facilitator relationship. Consequently, the opening remarks need to be targeted to elevate initial concerns and establish the relationships parameters and expectations. As with a psychotherapy relationship, the initial session is only the establishment of the relationship and the understanding that both parties have volunteered to take this journey together and it may well include periods of difficulty.
The Rogerian relationship is only effective when the participants are provided with a structure of learning that they can see will allow them to progress and succeed. This is the point where the Jeanneret (1995) model is utilised. This model is based on the principle that meaningful music learning cannot take place without first addressing the confidence levels in the students. The model constantly interacts between three spheres (teaching strategies competencies, and curriculum) to imbibe the student’s with the confidence to teach music. In the initial session with the participants in this study these three spheres are introduced as the model that will lead to independence as learners in music education.

The model is briefly outlined to the participants in the following manner. Only the broad brushstrokes are included at this point for two reasons. The first is that participants are often in an emotional state that does not allow for large amount of information to be processes effectively. Their apprehension prevents them from taking in finer details. The second reason falls in line with Rubin’s (1985) factors leading to Teaching Artistry. This model values the intentional design and delivery of learning experiences that allow for digressions, opportunities for reinforcement and for student behaviour to lead learning. Following this model has led me to include less detail in unit outlines and descriptions to allow for flexibility and less of a focus on content. It has also forced a focus on a few dominant goals that all activities and explanations continue to reinforce.

7.4.3 Progression Through the Dependent Stages of Learning

After the initial tutorial with the participants, Jeanneret’s (1995) model and Rubin’s (1985) teaching practice combine to support the participants through the first five weeks of the unit of learning. This is the period when the activities are facilitator focused and the learners are dependent on the facilitator for understanding and development. The Rogerian (1959; 1979) relationship underpins each experience, as different participants will need various levels of emotional support as they undertake this stage.

Jeanneret’s (1995) model qualifies the teaching strategies as musical participation and confidence. This description echoes the concepts of experiential learning
outlined by Eisner (2002a) and Dewey (1910; 1934). Arts education, and in this case music education, is best understood through practical learning experiences or learning through doing. Therefore, the teaching strategies utilised throughout the unit of learning are practical. In a 90-minute tutorial session, students will typically learn new songs, move using both choreographed and free movements to music, revisit an activity from last session in a new way, play xylophones, boomwhackers and percussion instruments and listen actively to short pieces of music and identify and define musical concepts. The auditory level of music making is so consistent that classes in the adjoining area are often moved out of earshot of the music making. Although participation is voluntary, an expectation (Rubin, Artistry in teaching, 1985) is set in the initial session for high levels of participation. Any apprehension is placated by the use of activities that are fast-paced and demand high levels of energy. Through the experience of success in music making through multiple formats and vehicles, the participants gradually gain confidence in their musical abilities. It is important at this point to draw attention and show pride in individual participant’s achievements (Rubin, Artistry in teaching, 1985).

Along with physical confidence in their music making abilities, participants need a strong intellectual understanding of music as a language and system. Jeanneret (1995) describes this as competencies in both music and teaching. Music competency begins in this unit of learning with the ability to read music. It would be safe to assume that a unit of learning in music education for pre-service teachers would consistent predominantly of teaching techniques and structures for the delivery of music activities. The ability to read and understand music would be assumed in this description. However, this has not always been my experience of pre-service music education for generalist teachers. The significant proportion of the participants entering the unit is unable to read music or speak confidently and correctly about the concepts of music. In my experience, this has also been true across the fields of Drama, Dance and Visual Arts as well, but the level of competency in music appears to be significantly lower. Before participants are able to learn how to teach music, they need to learn about music itself.

In direct response to this issue, participants begin by learning the language of music. This is aided by Bedrock (Collins & Edmonds, 2007), a workbook specifically
designed for pre-service generalist teachers. Participants prepare selected chapters (layers) prior to each tutorial, and the activities in the tutorial reinforce those theoretical concepts. Participants are encouraged to practise using the musical terms when discussing music and this allows for errors of grammar to be highlighted for all and corrected. As the participants progress through the first five weeks and this period of dependent learning, the facilitator includes activities where participants need to notate music and this allows for identification and correction of musical grammar. All of these activities improved the participants’ confidence in their verbal, written and conceptual competencies in music and thus heightened their confidence in their personal abilities.

Jeanneret’s (1995) model highlights the need for a balance of instruction and encounter in the curriculum. This is the most important aspect in the participant’s trajectory towards the independent stages of learning. The level of instruction is high in the initial weeks of the unit of learning but then small changes are made to allow participants to try out minor leadership and teaching roles. It is important to note that the trajectory of the participants learning is made explicitly to them in the initial session; they are aware that they will become the teacher in the second five weeks of the unit of learning. This provides incentive and motivation for the participants to actively engage in the activities and modelling of teaching practices, as they know it will directly and immediately benefit them. This small point has made a notable difference to the levels of engagement of the participants. While they are aware that they may be teaching music in their own classroom one day, that day may be over four years away. This lack of immediacy causes participants to lower their level of engagement in the teaching practices. By placing teaching activities designed and directed by students within the unit of learning, their engagements levels have risen significantly.

There are two types of encounter that are built into the unit of learning. The first begins in the initial session. Participants are asked about their own musical background and ability to read music. Within a tutorial group there are typically four to six participants who can read music. These participants are designated as Maestros. Students are asked to sit with a Maestro and they are all informed that when they enter the room next week that they are to go and sit with their Maestro and show
them the chapters of Bedrock that they have prepared for that week. This model of
encounter allows for students to form collegial bonds with peers that they are
unlikely to know and also allows for a support structure for the competency aspect of
the unit. The second type of encounter occurs in the second five weeks of the unit of
learning when the role of facilitator is exchanged and the participants become the
teachers.

7.4.4 Progression Through the Independent Stages of Learning

The second stage of the curriculum is aimed at allowing participants to progress
towards a state of independence. This independence consists of several factors:
independence in their basic knowledge of music, independence in their ability to
design and deliver educationally sound music activities, independence in their ability
to interpret the requirements of a music curriculum correctly, independence in their
ability to identity their own deficits in terms of their musical skills and knowledge
and independence to identify where and how they can address those deficits. In short,
this trajectory leads them towards the ability to deliver music education to their
students independently. Only a small percentage of participants may reach a state of
complete independence at the end of the ten-week unit of learning. These
participants usual enter the unit with a medium to high level of personal music
education. However, it is just as vital in this pedagogical approach to lead students to
a position where they can understand their own deficits in this area of education and
have the confidence to actively address those deficits.

Although the roles are reversed at this point in the unit of learning, the role of
facilitator (Alao, Kobiowu & Adebowale, 2010; Rhodes & Bellamy, 1999) must be
handed over gradually for it to be successful for all participants. The progression
towards independence consists of three exercises based around teaching rhythm,
pitch and a song. All students are randomly assigned a musical concept to teach.
These concepts stem directly from the content of the Bedrock (Collins & Edmonds,
2007) workbook and are very simple: for example, ‘teach the difference between a
crotchet and two quavers’. The activity must be no longer than three minutes in
length. The participants are given strategies to scaffold them through the design
process. They are allowed to copy a potion of any activity the facilitator has
modelled in class, particularly in the first activity. The primary purpose of the first activity is to allow participants to feel comfortable moving from the role of student to the role of teacher. The participants are also given a short mantra for their design process: ‘make it verbal, make it visual, make it physical’. This allows participants to move away from their preferred style of learning or the mental models they carry of music education, and design learning experiences that will cater for different learners.

The delivery of the activities, in particular the first one, can trigger the re-emergence of the apprehension that participants exhibited during the initial session. Again the Rogerian (1959; 1979) model is utilised in order to acknowledge and examine the participant’s emotional reactions to the activity, and allow the participants space to try out their ‘teaching legs’. Flexibility and intuition (Rubin, Artistry in teaching, 1985) is key at this point of the unit of learning as participants can be highly vulnerable. However, it is at this point that positive group dynamics begin to work as a learning tool and the trajectory towards independence begins.

The structures of the sessions in the second half of the unit of learning remain consistent. This decision is based on the maintenance of high expectations (Rubin, Artistry in teaching, 1985) for the participants. The participants receive no assessment mark for the delivery of the activity, but must present a written activity plan to the facilitator at the start of the session. The facilitator uses this lesson plan during the activity to record feedback and suggest alterations. The participant then collects this activity plan at the end of the session and incorporates the suggestions and feedback into the revised activity plan, which is submitted for assessment.

A timer is used during the activities so the participants get a sense of how time moves when they are delivering an activity. At the conclusion of the activity there is a round of applause to provide a clear ending, sense of achievement and group support for the participant. Verbal feedback is always sort from the participants first, followed by feedback from the facilitator. Rather than an appraisal of the activity, sometimes questions are asked such as ‘Which part of that activity do you think the class responded to best?’ or ‘Can anyone spot the minor mistake with the stems on the whiteboard?’ This approach further encourages the participants to move to a state of independence. As participants progress through the activities it is important to
focus on the subtleties such as verbal delivery style, physical demeanour and non-verbal communications that will be used in their general teaching practice, not just music education. This connection provides further motivation for the participants to invest their emotional and intellectual energies into the activities as they can see a direct impact on their chosen career.

As a result of the structure remaining consistent throughout this stage, a remarkable change occurs within each group. The participants become very familiar with the process and at some stage take over running of the class. When an activity is completed, they applaud without prompting and volunteer feedback, correct errors and suggest amendments without deferring to the facilitator. Part of the structure is the deliberate choice for the facilitator to sit at the back of the room and one of the important indicators of this change is when the participants no longer turn around to seek visual reassurance or clarification. This change depends heavily on the group dynamics and size—smaller groups tend to take longer to reach independence—but it is usually in the ninth or tenth session. Again, explicitly highlighting participants’ achievements and showing pride in the developments they have made (Rubin, Artistry in teaching, 1985) is a useful tool at this stage.

The results from this study have shown that this pedagogical approach has a positive effect on the values that pre-service generalist teachers hold towards music education. This approach has effectively created the sense of resonance that Gardner (2004) highlighted as the essential ingredient to changing minds (Error! Reference source not found.). Across all of the statement groups in Section D of the survey, the positive change in values was statistically significant (Table 17). These positive changes may have been effected by or contributed to a statistically significant rise in the level of importance (Table 38) of music education and confidence (Table 40) to teach music across all groups after the teaching intervention. The participant group indicated a high level of ability and responsibility for the delivery of music education (Section 6.6) at the pre-test, and this did not alter significantly after the teaching intervention. This may have been a type of ceiling effect, where the establishing result was already high and had little room to improve after the teaching intervention.
5.5.3 Incorporating Neuromusical Research into the Teaching Intervention

The educational philosophy and practices outlined in the previous section were common to all groups involved in the experiment. The only variable between the control and experiment groups was exposure to the neuromusical research findings. Four tutorial groups were involved in the study and taught by me as the facilitator. Two tutorial groups were nominated as the control groups and two tutorial groups were nominated as the experiment groups. The control groups were both taught on a Tuesday, while the experiment group were both taught on a Thursday. All four groups experienced the same content, learning activities, learning outcomes and assessment. The only difference between the groups was that the experiment group discussed music education in terms of the aesthetic and neuromusical benefits of music education and received printed information sheets about the neuromusical research. The control group only discussed the benefits of music education in terms of the aesthetic benefits and received no printed information about the neuromusical research findings.

In Chapter 3, the neuromusical findings were summarised in Sections 3.1, 3.2 and 3.3. However, in order to be as informative as possible, the findings needed to be
presented in such a way as to appeal and be understood by the audience. This step was important as the accessibility of the neuroscience information to educators was rated as highly important in Howard-Jones et al.’s (2007) study. The audience was made up of pre-service teaching students who are not neuroscientists, may not have a Year 12 level of scientific understanding, may have no interest in scientific discoveries and are unlikely to understand the scientific nomenclature used in the findings. A balance needed to be struck between maintaining the authenticity, complexity and preliminary nature of the scientific findings with the need to be as informative as possible. This was the focus of Study A1.

In considering the most effective strategies for incorporating the neuromusical research findings into the teaching intervention, it was helpful to consider Gardner’s (2004) Changing Minds model. This model was useful as it highlighted the role of research in a larger context, including a number of interconnected elements that can exist in any experience. Gardner’s (2004) research can be traced back to Dewey (1910), who outlined the very crux of the mind change problem, arguing that in order to answer a question there are two avenues, one easy and the other difficult. To accept the answer to a question is easy and requires no further thought on the person’s behalf. To reject the answer to a question is difficult, as it requires a person to search for evidence to support that rejection. Gardner’s (2004) model outlines when and how that search for evidence can be used to effectively change a person’s mind on a given topic. This model assisted in the pairing of the information sheets from Study A1 with the most appropriate tutorial topic and directed the discussion topics and incidental connections that were made during each tutorial.

Gardner (2004) chose to represent his model in a sequential list, but I felt that a list did not highlight the interdependencies present in the model. Consequently, I chose to interpret that model in a diagrammatical format (Figure 25).

To change a person’s mind Gardner (2004) suggested that there are two minds that need changing and that these two minds are interlinked. He expresses them as the ‘logical’ and ‘emotional’ minds. When both of these minds are convinced, it creates a resonance within the person. This resonance is necessary for the person to choose to change their mind about a given concept, idea, viewpoint or opinion. ‘Research’
and ‘reason’ create ‘resonance’, and these two areas must convince both the Logical and Emotional minds. Once this resonance is created, ‘redescription’, ‘reward’ and ‘real-world events’ strengthen that resonance.

![Diagram of Gardner’s (2004) Changing Minds Model by Researcher](image_url)

### Figure 26: Diagram of Gardner’s (2004) *Changing Minds* Model by Researcher

The process begins with reason and research. Reason is the logical or rational approach to considering an idea. It involves weighing factors and assessing the pros and cons. Research is the collecting of relevant data, both formal and informal, to support the logical approach. Resonance occurs when these two aspects ‘fit’ together, and the approach we have to the idea matches in terms of logical thought and tangible facts to support it. We have an affective reaction when these areas come together, and it feels right on an unconscious level.

This resonance is an experience we like to have as often as possible. Therefore, there are three things that strengthen that feeling of resonance that Gardner (2004) referred to as redescription, reward and real world events. Redescription is explaining the idea in a different way, such as with a diagram or using a metaphor. Gardner (2004) highlighted that ‘multiple versions of the same point constitute an extremely powerful way in which to change minds’ (p. 14) and ‘the more familiar a concept the easier it is to think of it in various ways’ (p. 10).

Resources and rewards are grouped together. Gardner (2004) explained the resources element of the model using Pareto’s 80/20 rule. While the word ‘resources’ to a teacher might mean books or musical instruments, in this context it applies to the
amount of effort—physical or mental—it takes to achieve a desired result. Gardner (2004) argued that we mistakenly think that effort and reward are balanced at a 50/50 ratio, whereas the way to change minds is to create a situation where participants feel they are getting 80% reward with only 20% effort. Gardner (2004) also described reward as positive feedback for a given idea or behaviour, such as others agreeing with your point of view or praise from a teacher for choosing to behave in a particular way.

Real-world events are experiences and similar ideas that come from outside our immediate sphere of experience and influence. Gardner (2004) gave examples of natural disasters, terrorist attacks or economic depressions. Significant events that a large number of people experience can change our minds. Recent examples would be the ‘alert but not alarmed campaign’ to bring public awareness to seemingly innocuous events that could be related to potential terrorist threats. This heightened sense of personal and national threat could be traced back to the large real-world event of 9/11 in New York.

Resistance to change is the one aspect that stops the act of changing our minds from happening easily and frequently. Resistance can be created by age, the emotion that the topic creates or the public stand previously taken on a topic (Prewitt, 2004). Change also requires work, as outlined by Dewey (1934) above. Gardner (2004) suggested that the ‘hassle’ of change can affect the other six areas significantly:

mind changing is most likely to come about when the first six factors operate in consort and the resistances are relatively weak. Conversely, mind changing is unlikely to come about when the resistances are strong, and the other factors do not point strongly in one direction (p. 18)

To counter the significant influence of resistance on mind changing, Gardner (2004) believes that we must work to change both the logical and emotional mind. In the setting for this teaching intervention, the curriculum needed to contain sufficient logical reasoning and accessible research to develop resonance with the participants. This resonance was created through a combination of written resources, verbal delivery, modelling, discussions and sensory activities to cater to both the logical and emotional minds.
The clarification of the educational philosophy, pedagogy and curriculum design of the teaching intervention was important to maintain the consistency of the learning experience across all groups in the experiment. Similarly, it was important to consider the nature of the inclusion of the neuromusical research findings to ensure that the experiment yielded clear and reliable results. Section 5.5.4 is an overview of the unit of learning, including the unit description, outcomes, aims, structure and activities.

5.5.4 The Teaching Intervention

In line with university policy, the unit description, outcomes, aims and structure were listed in a unit outline. These elements, along with contextual information are listed in Figure 26.

**Figure 27: Unit Description, Outcomes and Learning Aims**

At the conclusion of the unit, students need to have sufficient theoretical and practical knowledge to independently deliver the music education components of their curriculum to their students. This means they need to have an appropriate level of musical literacy, understand how to plan and deliver effective music learning experiences and the appreciate the benefits of music education for their students.
A specialised workbook, *Bedrock: Foundations of Music* (Collins & Edmonds, 2007), which was written specifically for pre-service undergraduate generalist teachers supported their music literacy development. It is an interactive text that includes music reading, writing and theory requirements for students up to Year 6 in the Queensland and New South Wales K-6 curricula. Students completed a prescribed chapter prior to each week’s tutorial.

The unit was divided into two equal halves. The first five weeks focused on the development of each student’s personal musical skills and level of literacy. During this period, the priority was to raise the students’ confidence in music, acquaint or reacquaint them with musical language and terminology and model basic music education practices. The teaching model during this period focused on the facilitator as leader. In the second five weeks, the focus shifted to the students as leaders. They designed short learning activities around a musical concept (such as the difference between a crotchet and a crotchet rest) and took the role of the teacher. The facilitator was not part of the class but observed the activity, provided written and verbal feedback and allowed peers to also comment on the activities. During the five weeks, the facilitator gradually removed themselves from the feedback loop to encourage independent reflection and evaluation (Figure 27).

![Figure 28: Overview of Weekly Tutorials](image)
Each tutorial was based on the theoretical learning in the prescribed Bedrock workbook. For example, students completed the chapter on rhythms up to Year 3, and the tutorial reinforced those concepts through practical activities. The musical content was dependent on the specific tutor but with one guiding principle; musical choices had to be appropriate for use in an early childhood or primary classroom. Students participated in five weeks of classes that focus on the development of their personal music skills. The remaining six weeks of tutorials saw the students trade places with the teacher and practice delivering small musical activities to the class. The tutor provided feedback to the students on their teaching skills.

Throughout the learning experiences, students were prompted to examine their present ideas and values on music education, both for themselves and for their future students. This aspect of the course was supported by research and online activities where students charted the development of their concepts of arts education. The combination of these experiences and the initial focus on the students’ personal music skills and values have been moderately successful in changing the students’ values of music education. As Gardner (2004) reminds us, ‘mind change most often results from a slow, almost unidentifiable shift of viewpoint rather than by virtue of any single argument or sudden epiphany’ (p. 4).
### Table 8: Teaching Intervention Outline

<table>
<thead>
<tr>
<th>Week</th>
<th>Tutorial Description</th>
<th>Knowledge, Understandings and Skills</th>
<th>Common Musical Content &amp; Activities</th>
<th>Control Group Traditional</th>
<th>Experimental Group Traditional + Neuroscience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Musical Knowledge, Understandings and Skills</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td><strong>Focus</strong> Introduction to the unit/Rhythm</td>
<td>Knowledge</td>
<td>Administrator Survey 1</td>
<td>Benefits of Music Education (Traditional)</td>
<td>Benefits of Music Education (Traditional)</td>
</tr>
<tr>
<td></td>
<td><strong>Preparation Required:</strong> Bedrock Layer 1</td>
<td>Rhythms including</td>
<td>Introduction:</td>
<td>o Crossing the midline</td>
<td>o Crossing the midline</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o crochet, quaver pairs, minim, semibreve, all associate rests</td>
<td>o Bedrock requirements</td>
<td>o Muscle memory</td>
<td>o Muscle memory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o bar, bar lines, rhythm maths</td>
<td>o Create Maestro groups</td>
<td>o Concentration</td>
<td>o Concentration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o 4/4, 3/4, 6/8 time signatures</td>
<td>o Music is Creating, Performing, Understanding</td>
<td>o Team work</td>
<td>o Team work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o dotted rhythms</td>
<td>o Symbol recognition</td>
<td>o Symbol recognition</td>
<td>o Symbol recognition</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o syncopation</td>
<td>o Creating</td>
<td>o Creating</td>
<td>o Creating</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o ostinatos</td>
<td>o Maths concepts</td>
<td>o Maths concepts</td>
<td>o Maths concepts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Understanding</td>
<td>Warm-up: <em>A Ram Sam</em> Sam</td>
<td>Benefits of Music Education (Traditional)</td>
<td>Benefits of Music Education (Traditional)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The basic concepts of musical rhythm</td>
<td>Rock Passing Game (Beat)</td>
<td>o Teamwork</td>
<td>o Teamwork</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o how rhythms are constructed and composed</td>
<td>French Time Names</td>
<td>o Peer learning and teaching</td>
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<td>o parts of rhythms (stem, note heads, beams),</td>
<td>Introduction (Vocalisation)</td>
<td>o Complex rhythms</td>
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<td>o pulse and beat</td>
<td>Say, Say/Clap, Think/Clap sequence</td>
<td>o Selective listening</td>
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<td>Skills</td>
<td>Rhythm Circles (Visualisation)</td>
<td>o Concentration</td>
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<td>Vocalising rhythms using French time names</td>
<td>Class Rhythm composition (Creating)</td>
<td>o Maths concepts</td>
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<td>Composing rhythms</td>
<td>Pair Rhythm Composition (Creating)</td>
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<td>Basics of teaching rhythms</td>
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<td>Using voice and body to teach rhythms</td>
<td>Class Ostinato Performance</td>
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<td>Tempo and counting in</td>
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<td><strong>Focus</strong> More Rhythm and Teaching Rhythm.</td>
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<td><strong>Preparation Required:</strong> Bedrock Layer 2</td>
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<td>o Maestro group revision of Bedrock</td>
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<td>o Questions</td>
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<td>Warm-up: Ostinatos, introduce new rhythms</td>
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<td>Big Rhythm Card Game</td>
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<td>Small Rhythm Card Game</td>
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124
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<tr>
<th>Week</th>
<th>Tutorial Description</th>
<th>Knowledge, Understandings and Skills</th>
<th>Common Musical Content &amp; Activities</th>
<th>Control Group Traditional</th>
<th>Experimental Group Traditional + Neuroscience</th>
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</thead>
</table>
| 3    | **Focus** Pitch, Dynamics and Tone Colour  
**Preparation Required:** Bedrock Layer 3, 5 & 7  
**Activity allocation:** Students are allocated their rhythm concept for Weeks 6 & 7 exercises | **Knowledge**  
- Grand, treble and bass stave  
- Reading notes on and in the lines of the treble stave  
- Ledger lines  
- Major intervals  
- Tone row of a major scale  
- Pentatonic scale in various keys  
- 12 bar blues structure  
- Triads, chords and note roles  
- Basic solfa  
**Introduction:**  
- Maestro group revision of Bedrock  
- Questions  
**Warm-up:** Bee Bee Bumble Bee song 3 ways introducing Dynamics  
**Notes & Lollies:** note reading game  
**Exploring the xylophone**  
- Intro to instruments  
- Call and response to C, D, E  
- Improvisation on C  
- Pentatonic scale (Creating)  
- Writing and performing a melody in pairs (Creating/Performing)  
**Tone Colour, ID the instrument, eyes closed game with 1, 2, 3 instruments**  
**Using recorded music in your teaching (guided/active listening activities)**  
**Benefits of Music Education (Traditional)**  
- Understanding sounds around us  
- Speech and singing  
- Vocal volume  
- Confidence in public speaking  
- Active listening  
- Stimulus for Imagination  
**Benefits of Music Education (Neuroscience)**  
- Music Education & Memory (use of tone colour exercise for spatial awareness and audition)  
- Music Education & Executive Function (attention) | | | |
| 4    | **Focus** More Pitch and Teaching Pitch.  
**Preparation Required:** Bedrock Layer 4  
**Activity allocation:** Students are allocated their pitch concept for Weeks 9 & 10 exercises | Same as Week 3  
**Introduction:**  
- Maestro group revision of Bedrock  
- Questions  
**Warm-up:** Rounds, Twinkle Twinkle, A Ram Sam Sam, Rain Rain Go Away  
**Solfa and hand signals**  
**Freedom is Coming**  
12 bar blues on xylophones, triads, pentatonic scales, improve | | | |
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<tr>
<th>Week</th>
<th>Tutorial Description</th>
<th>Knowledge, Understandings and Skills</th>
<th>Common Musical Content &amp; Activities</th>
<th>Control Group Traditional</th>
<th>Experimental Group Traditional + Neuroscience</th>
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<td>5</td>
<td>Focus</td>
<td>Teaching a Song &amp; Structure</td>
<td>Knowledge &amp; Understandings</td>
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<td>○ How the concepts of music come together to make a song</td>
<td>○ Maestro group revision of Bedrock</td>
<td>○ Musical 'Talent'? (musical genes, nature vs nurture)</td>
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<td>○ Song structure</td>
<td>○ Questions</td>
<td>○ Music Education &amp; Idea Creation (generation of creative ideas)</td>
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<td>○ Vocal range</td>
<td>Warm-up: Bee Bee</td>
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<td>○ How to choose an appropriate song for a given age group</td>
<td>Bumble Bee song</td>
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<td>○ Purpose of teaching songs</td>
<td>A Ram Sam Sam (leaving phrases out)</td>
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<td>Preparation Required: Bedrock Layer 6 &amp; 9</td>
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<td>Skills</td>
<td>Good Morning Song (actions, beat and creation)</td>
<td>Benefits of Music Education (Traditional)</td>
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<td>Bedrock Test: Layers 1 &amp; 2.</td>
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<td>○ Confidence in your own voice</td>
<td>Rain Rain Go Away (actions, sounds and music)</td>
<td>○ Community activity</td>
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<td>Activity allocation: Students select a children’s song to teach to the class in Weeks 11 &amp; 12</td>
<td></td>
<td>○ Modelling good singing practices</td>
<td>Strawberry Ice-cream, Huckleberry Finn (movement, beat, months)</td>
<td>○ Class collegiality and harmony</td>
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<td>○ Vocal warm-ups</td>
<td>Hey Ho Nobody’s Home (cut common time, language syntax and meaning)</td>
<td>○ Leadership</td>
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<td>○ Using the ready not</td>
<td>Shoo fly don’t follow me exercise (speed swapping)</td>
<td>○ Personal confidence</td>
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<td>○ Teaching rhythm, pitch and words in songs</td>
<td>Benefits of Music Education (Traditional)</td>
<td>○ Using a song to teach content (months)</td>
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<td>○ Developing songs through games and constructive repetition and variation</td>
<td>Benefits of Music Education (Neuroscience)</td>
<td>○ Language acquisition (sentence structure)</td>
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<td>Week</td>
<td>Tutorial Description</td>
<td>Common Musical Content &amp; Activities</td>
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<td><strong>Skills in Teaching Music</strong></td>
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<td>6</td>
<td>Focus Teaching Rhythm</td>
<td>Warm-up: Square rhythm running game</td>
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<td>Students teach a rhythm activity to the class</td>
<td>10 students teach their rhythm activity to the class, 3-minute activity, 1-minute debrief</td>
<td>Revisit the benefits from Weeks 1–5</td>
<td>Revisit the benefits from Weeks 1–5</td>
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<td>Revision of Bedrock Layer 1 &amp; 2 and Age &amp; Stage levels</td>
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<td>7</td>
<td>Focus Teaching Rhythm</td>
<td>Warm-up: Bee Bee Bumble Bee song and actions</td>
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<td>Same as Week 6</td>
<td>10 students teach their rhythm activity to the class, 3-minute activity, 1-minute debrief</td>
<td>Revisit the benefits from Weeks 1–5</td>
<td>Music Processing (how we establish and develop our musical understanding)</td>
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<td>Warm-up: Old MacDonald had a zoo song and actions</td>
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<td>Class free week</td>
<td>10 students teach their pitch activity to the class, 3 minute, activity, 1 minute debrief</td>
<td>Revisit the benefits from Weeks 1–5</td>
<td>Music Education &amp; Executive Function (solving problems, analysing [separately and as a whole] logical and emotional content, problem solving and positive group work behaviour)</td>
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<td>9</td>
<td>Focus Teaching Pitch</td>
<td>Warm-up: Rock passing game with classroom items</td>
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<td>Students teach a pitch activity to the class</td>
<td>10 students teach their pitch activity to the class, 3 minute, activity, 1 minute debrief</td>
<td>Revisit the benefits from Weeks 1–5</td>
<td>Music Education and Learning (Bigger, Better Brains)</td>
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<td>Revision of Bedrock Layer 3 &amp; 4 and Age &amp; Stage levels</td>
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<td>10</td>
<td>Focus Teaching Pitch</td>
<td>Warm-up: Rock passing game with classroom items</td>
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<td>Same as Week 9</td>
<td>10 students teach their pitch activity to the class, 3 minute, activity, 1 minute debrief</td>
<td>Revisit the benefits from Weeks 1–5</td>
<td>Music Education and Learning (Bigger, Better Brains)</td>
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<td>11</td>
<td>Focus Teaching a Song</td>
<td>Administer Survey 2</td>
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<td>Benefits of Music Education (Neuroscience)</td>
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<td>Students will teach a song to the class</td>
<td>Students teach their song activity to the class, 3-minute activity, 1-minute debrief</td>
<td>Your questions</td>
<td>Your questions (each student will prepare one question on the benefits of music education to ask after their song)</td>
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Chapter 6: Study B—Application in the Classroom
(Results)

The pre-test and post-test data were analysed in several ways within the nine sections of the survey. For the quantitative scaled data, paired t-tests were performed and the mean difference, standard deviations, t and p values were calculated. The mean difference showed the change in the mean between the pre- and post-tests, while the standard deviation indicated the distribution of the data set. The t and p values provided indicators of a statistical significance change in the mean difference in the data (p value).

The data was reported on three groups: all groups, control and experiment. The internal validity of the data was tested using two tests: a Levene’s Test to assess the equity of variance and a McNemar test to compared binary measures. In some cases, descriptive statistics were used because the participant numbers meant that statistical analysis was not useful. The qualitative questions were analysis used three methods (comparative, thematic and text-analytics) appropriate to the content. Each survey section concludes with a summary of results with directions for discussion.

During data entry, it was observed that some participants did not answer all the questions on the survey. This resulted in a smaller number of responses for some questions and is indicated in the tables or text by the n result. There were 52 paired surveys from which there were 27 in the control group and 25 in the experiment group. The statistical package used for this analysis was SPSS.

6.1 Identity Code

It was anticipated that a maximum of 96 participants would complete the pre-test and that the drop-off rate would be between 15% and 20% for the post-test returns. The anticipated participant numbers were based on the maximum class sizes and previous experience with the difference in commencing and completing students in the unit. It was also expected that approximately five per cent of the participants would be
excluded from the survey data due to their age (>18 years) and previous paid employment as a musician or music teacher. It was anticipated that between 70 and 80 paired surveys would be available for the data analysis.

The number of paired surveys was lower than expected due to a number of factors—a lower number of commencing students enrolled in the unit, a significant number of students who moved into and out of the classes after the pre-test was administered, a larger than expected percentage of students failing to complete the unit and the post-test and significant illness in the week that the post-test was administered. The result was that 79 participants completed the pre-test, 74 participants completed the post-test, and of these participants 52 paired surveys (control \( n=27 \), experiment \( n=25 \)) were generated (Table 9).

<table>
<thead>
<tr>
<th>Table 9: Survey Return Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Pre-test</td>
</tr>
<tr>
<td>Post-test</td>
</tr>
<tr>
<td>Paired tests</td>
</tr>
</tbody>
</table>

There were two possible ways to analyse the data that was collected. The first option was to use the total number of pre- and post-test surveys. The second option was to only analyse data from the paired surveys. Although the number of paired surveys was considerably lower than the total number of surveys, the analysis results from the paired surveys would be stronger. Therefore, the second option was considered the most suitable for analysis. The following data and analysis is based on the paired surveys only.

### 6.2 Demographic Information

Demographic information has been represented in a frequency distribution table (Table 10). The number of participants in the control and experiment groups was similar, as was the division of male and female participants. The gender division within the participant group is similar to that of the larger student cohort of 300 with a large percentage of female students. The age division of the participant groups was
similar and as the participants were enrolled in an undergraduate tertiary degree, it was expected that majority would be between 18 and 25 years of age.

Table 10: Frequency Distribution of Demographic Information

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Experiment</th>
<th>All Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Students Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>24</td>
<td>88.88</td>
<td>23</td>
</tr>
<tr>
<td>Male</td>
<td>3</td>
<td>11.11</td>
<td>2</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–25</td>
<td>22</td>
<td>88.48</td>
<td>23</td>
</tr>
<tr>
<td>26–35</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>36–45</td>
<td>5</td>
<td>18.51</td>
<td>0</td>
</tr>
<tr>
<td>46+</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

6.3 Musical Background

The musical background of the participants was ascertained through their history of instrumental music education. This focus came from Stage 3 of the literature mapping exercise (Section 2.7). Using the criteria outlined in Figure 17, participants were classified as a musician or non-musician (Table 11). The percentage of musicians in the control group (25%) was more than in the experiment group (12%). Participants were excluded from the study by two factors: if they were under the age of 18 at the time of the survey and if they had a previous career as a professional performer, composer or educator. After the pre-test, five participants were excluded, one for being under 18 years of age and four for their previous professional music careers. The number of excluded participants was higher than anticipated but may be explained by the presence of a large conservatorium situated in the city.

Table 11: Frequency Distribution of Musicians and Non-Musicians

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Experiment</th>
<th>All Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Students</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Musicians</td>
<td>27</td>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>Musicians</td>
<td>20</td>
<td>74.07</td>
<td>22</td>
</tr>
</tbody>
</table>

The division of instruments learnt by the students revealed some interesting results (Table 12). Across the group of participants, 75% had learnt a musical instrument in some way during childhood. The instrument most participants learnt was the piano,
followed by wind and string instruments. Very few participants learnt brass, percussion or guitar, and no participants learnt voice. This outcome may be influenced by the significant gender bias across the sample group, with 90% of the participants being female. Research into the gender stereotyping of musical instruments has found that most wind and string instruments are seen as instruments to be played by girls (Abeles & Porter, 1978; Green, 1997; O’Neill & Boulton, 1996; Conway, 2000; Sinsabaugh, 2005). Results on gender stereotyping of the piano has been mixed. Brass and percussion instruments have been consistently preferred as instruments to be played by boys.

Table 12: Frequency Distribution of Musical Instruments

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th></th>
<th>Experiment</th>
<th></th>
<th>All Groups</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Strings</td>
<td>3</td>
<td>13.64</td>
<td>2</td>
<td>10.00</td>
<td>5</td>
<td>11.90</td>
</tr>
<tr>
<td>Wind</td>
<td>4</td>
<td>18.18</td>
<td>7</td>
<td>35.00</td>
<td>11</td>
<td>26.19</td>
</tr>
<tr>
<td>Brass</td>
<td>1</td>
<td>4.55</td>
<td>0</td>
<td>0.00</td>
<td>1</td>
<td>2.38</td>
</tr>
<tr>
<td>Percussion</td>
<td>0</td>
<td>0.00</td>
<td>1</td>
<td>5.00</td>
<td>1</td>
<td>2.38</td>
</tr>
<tr>
<td>Guitar</td>
<td>4</td>
<td>18.18</td>
<td>1</td>
<td>5.00</td>
<td>5</td>
<td>11.90</td>
</tr>
<tr>
<td>Voice</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Piano</td>
<td>10</td>
<td>45.45</td>
<td>8</td>
<td>40.00</td>
<td>18</td>
<td>42.86</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0.00</td>
<td>1</td>
<td>5.00</td>
<td>1</td>
<td>2.38</td>
</tr>
<tr>
<td>None</td>
<td>5</td>
<td>18.52</td>
<td>5</td>
<td>20.00</td>
<td>10</td>
<td>19.23</td>
</tr>
</tbody>
</table>

A comparison of the instrumental musical background of the participants revealed some interesting findings. Only ten participants met the inclusionary criteria for the musician group; however, 75% of participants had learnt a musical instrument and 55% had learnt a musical instrument but did not meet the criteria for musician in this survey (Table 13). The criteria were derived from evidence in the neuromusical research concerning the type, amount and period of formal musical training that corresponded with changes in brain development (Study A2).

Table 13: Frequency Distribution of Instrumental Music Background

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th></th>
<th>Experiment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Musicians (as per the survey criteria)</td>
<td>7</td>
<td>25.92</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Learnt a musical instrument (but did not meet the survey criteria for Musician)</td>
<td>21</td>
<td>77.77</td>
<td>18</td>
<td>72</td>
</tr>
<tr>
<td>Learnt more than one musical instrument</td>
<td>5</td>
<td>18.52</td>
<td>4</td>
<td>16</td>
</tr>
</tbody>
</table>

This result deserved further investigation and the results from the participants classified as non-musician was examined (Table 14). When examining the data from
this group, it appeared that 84% of the non-musician group had been between the ages of four and 17 when they learnt the instrument. In the non-musician group, 77% had participated in weekly lessons and 52% had participated in one-to-one lessons. The most notable finding was that only 16% of the non-musician group learnt a musical instrument for more than two years.

Table 14: Non-Musicians’ Instrumental Music Background

<table>
<thead>
<tr>
<th>Answered YES to the following questions</th>
<th>All Groups</th>
<th>Non-Musicians</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Were you between 4 and 17 years of age when you learnt this musical instrument?</td>
<td>26</td>
<td>84</td>
</tr>
<tr>
<td>6. Did you have weekly lessons on this instrument?</td>
<td>24</td>
<td>77</td>
</tr>
<tr>
<td>7. Were your weekly lessons in a one-to-one format (one teacher and one student only)</td>
<td>16</td>
<td>52</td>
</tr>
<tr>
<td>8. Did you have weekly lessons for more than two years?</td>
<td>5</td>
<td>16</td>
</tr>
</tbody>
</table>

During the research and design phase of the study, it was anticipated that participants with a significant musical background might display different values towards music education. Therefore, it was important in the survey instrument to create a mechanism for identifying musicians and non-musicians. The outcome of the data collected was a 75/25 division of non-musicians to musicians in the control group and an 88/12 division of non-musicians to musicians in the experiment group. The small percentage of musicians within the participant group had an impact on the results and meant that trends could not be identified confidently. However, in the following sections, results that display interesting differences and similarities between groups of musicians and non-musicians are highlighted.

6.4 Value of Music Education

The Value of Music Education (Section D) part of the survey consisted of 53 statements to measure each participant’s belief in each statement. This section used a six-point rating scale from Definitely False, which was allocated a value of ‘1’, to Definitely True, which was allocated a value of ‘6’. The results were expressed in a number of ways: mean results from pre- and post-tests were reported, statistical significance through t-test and p values were highlighted where it was confidently measured and descriptive statistics were used where statistical significance was not
confidently measured. The statements were divided into five groups by their central theme for the benefits of music education. Four of the themed groups were based on a previous survey by Austin and Reinhardt (1994; 1996), which was based on an earlier survey by Payne (1990):

- Quality of Life (QL) benefits,
- Social-Emotional (SE) benefits,
- Aesthetic (AE) benefits and
- Non-Factored (NF) benefits.

In order to determine if findings from neuromusical research had any impact on these beliefs, a fifth group of statements was added to the Austin/Reinhardt survey:

- Neuroscience (NS) benefits.

The results of these themed statement groups were then compared using a series of paired sample tests. The tests were conducted using three configurations; by the participant group (N=52), by comparing control (n=27) and experiment (n=25) groups and by comparing musician and non-musicians within the control and experiment groups.

The paired sample test on the participant group found that levels of truth and/or validity in all statement groups went up (Table 15). The term ‘truth and/or validity’ was the focus of the question posed to the participants in the survey and came directly from the Austin/Reinhardt survey (1994). All statement groups showed a statistically significant gain and returned a $p$ value of 0.000 (with the exception of the Aesthetic statement group that returned a result of 0.001). The 95% confidence interval supported this result with all results showing a positive change. Interestingly, the Neuroscience statement group showed the highest confidence interval of the five statement groups.

<table>
<thead>
<tr>
<th>Table 15: Pre- and Post-Test Means for Statement Groups (All Groups)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of Life</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>Pre</td>
</tr>
<tr>
<td>Post</td>
</tr>
</tbody>
</table>
The differences between the pre- and post-test means also showed a consistent positive change across all of the statement groups (Table 16). Again, it is interesting to note that the Neuroscience and Quality of Life statement groups were close to 0.5 degree of difference, indicating that beliefs in these statements rose by one point within the six-point rating scale. The 0.5 degree difference is important because a large difference was seen across all groups even though only the experiment group were exposed to the neuromusical research.

**Table 16: Mean Difference for Statement Groups (All Groups)**

<table>
<thead>
<tr>
<th></th>
<th>Mean Difference</th>
<th>SD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of Life Benefits</td>
<td>0.49</td>
<td>0.60</td>
<td>6.01</td>
<td>0.000</td>
</tr>
<tr>
<td>Social-Emotional Benefits</td>
<td>0.35</td>
<td>0.48</td>
<td>5.29</td>
<td>0.000</td>
</tr>
<tr>
<td>Aesthetic Benefits</td>
<td>0.22</td>
<td>0.46</td>
<td>3.52</td>
<td>0.001</td>
</tr>
<tr>
<td>Neuroscience Benefits</td>
<td>0.52</td>
<td>0.55</td>
<td>6.82</td>
<td>0.000</td>
</tr>
<tr>
<td>Non-factored Benefits</td>
<td>0.31</td>
<td>0.59</td>
<td>3.85</td>
<td>0.000</td>
</tr>
</tbody>
</table>

A *t*-test showed that in all five statement groups the experiment group returned higher mean results than the control group (Table 17). The two highest statement groups were again the Neuroscience and Quality of Life groups; however, the Neuroscience group was noticeably higher in the experiment group. The difference between the mean of the control and experiment group in these two statement groups was also noticeably different. The control group ranked the Quality of Life statements above the Neuroscience statement by just 0.01, whereas the experiment group ranked the Neuroscience statements group above the Quality of Life statements group by 0.07. There was only a difference of 0.03 between the control and experiment group result on the Social-Emotional benefits. In both control and experiment group the Aesthetic statement group ranked the lowest.
Table 17: Mean Difference for Statement Groups (Control & Experiment Groups)

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th></th>
<th>Experiment</th>
<th></th>
<th>All Groups</th>
<th></th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td>t</td>
<td>p</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>difference</td>
<td></td>
<td>difference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality of Life Benefits</td>
<td>0.43</td>
<td>0.63</td>
<td>0.57</td>
<td>0.56</td>
<td>0.85</td>
<td>0.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social-Emotional Benefits</td>
<td>0.34</td>
<td>0.49</td>
<td>0.37</td>
<td>0.48</td>
<td>0.19</td>
<td>0.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aesthetic Benefits</td>
<td>0.16</td>
<td>0.48</td>
<td>0.30</td>
<td>0.43</td>
<td>1.08</td>
<td>0.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neuroscience Benefits</td>
<td>0.42</td>
<td>0.65</td>
<td>0.64</td>
<td>0.41</td>
<td>1.49</td>
<td>0.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-factored Benefits</td>
<td>0.23</td>
<td>0.60</td>
<td>0.40</td>
<td>0.58</td>
<td>1.01</td>
<td>0.32</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.4.1 Quality of Life Benefits

The Quality of Life statement group consisted of the items listed in Table 18.

Table 18: Quality of Life Statements

<table>
<thead>
<tr>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. Prepares students for a career in music</td>
</tr>
<tr>
<td>20. Instils students with wholesome ideals of conduct</td>
</tr>
<tr>
<td>22. Enables students to find meaning in the real world</td>
</tr>
<tr>
<td>56. Helps students to develop good citizenship habits</td>
</tr>
<tr>
<td>60. Improves the general intelligence of students</td>
</tr>
<tr>
<td>63. Enhances the physical well-being of students</td>
</tr>
<tr>
<td>68. Helps students to develop good work habits</td>
</tr>
<tr>
<td>73. Enables students to improve their quality of life</td>
</tr>
<tr>
<td>75. Facilitates the development of a student’s personality</td>
</tr>
</tbody>
</table>

The Quality of Life statement group showed a gain in both the control and experiment group, with the experiment group gaining a further 0.14 above the control group (Table 19). At the pre-test, participants in both groups believed the Quality of Life statement group to be ‘More True than False’ although in the pre-test the level of truth and/or validity in both groups was at the lower end of this range, and at the post-test they were at the higher end of the range. It should be noted that the experiment group was 0.01 away from the ‘True’ range, meaning that the vast majority of participants in this group answered ‘True’ or above for this statement.
The individual statements within the Quality of Life group were examined and the notable results highlighted. At the pre-test, the majority of the statements returned a result in the ‘More True than False’ range. Notable exceptions were Item 22 (enables students to find meaning in the real world), which both the control and experiment group rated as ‘More False than True’, and Item 56 (helps students to develop good citizenship habits), which the control group also rated as ‘More False than True’. In the post-test, both groups rated both statements in the ‘More True than False’ range. Also in the post-test, the experiment group rated Items 60, 68, 73 and 75 in the ‘True’ range. These were the highest rating items within this statement group:

60. Improves the general intelligence of students

68. Helps students to develop good work habits

73. Enables students to improve their quality of life

75. Facilitates the development of a student's personality

Across the nine items in this statement group, all but one question returned a statistically significant gain within the participant group. The only question to return a statistically insignificant gain was Item 75 (facilitates the development of a student's personality). This may be due to the perception that personality or character development occurs due to failure or through experiencing hardship, and the learning experiences in the teaching intervention were specifically designed to avoid failure and mask difficulty.

A comparison of the mean differences between the control and experiment groups for each question yielded a variety of results. The notable differences have been included in (Table 20). In Item 13 (prepares students for a career in music) and Item
20 (instils students with wholesome ideals of conduct), the mean difference was equal to or above one rating and the control group showed a larger gain than the experiment group. In the case of these statements, the control group placed a higher level of truth and/or validity on the ability of music education to prepare students for a career and instil wholesome ideas of conduct in the students. In Items 22, 56 and 68, both groups showed a gain of close to or above one rating, but in all cases the experiment group returned a larger gain. Of most interest were the wide mean difference gains in Items 60 and 73. In both cases, the experiment group showed appreciably higher mean gains than the control group. After the teaching intervention, the experiment group felt that music education improves general intelligence and quality of life far more strongly than the control group.

<table>
<thead>
<tr>
<th>Statement Description</th>
<th>Control Mean difference</th>
<th>Control SD</th>
<th>Experiment Mean difference</th>
<th>Experiment SD</th>
<th>All Groups Mean difference</th>
<th>All Groups SD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepares students for a career in music</td>
<td>0.81</td>
<td>1.14</td>
<td>0.72</td>
<td>0.98</td>
<td>0.78</td>
<td>1.06</td>
<td>5.24</td>
<td>0.000</td>
</tr>
<tr>
<td>Instils students with wholesome ideals of conduct</td>
<td>0.67</td>
<td>0.88</td>
<td>0.50</td>
<td>0.88</td>
<td>0.58</td>
<td>0.88</td>
<td>4.80</td>
<td>0.000</td>
</tr>
<tr>
<td>Enables students to find meaning in the real world</td>
<td>0.67</td>
<td>1.21</td>
<td>0.76</td>
<td>1.05</td>
<td>0.71</td>
<td>1.13</td>
<td>4.56</td>
<td>0.000</td>
</tr>
<tr>
<td>Helps students to develop good citizenship habits</td>
<td>0.48</td>
<td>0.96</td>
<td>0.60</td>
<td>1.00</td>
<td>0.54</td>
<td>0.97</td>
<td>3.92</td>
<td>0.000</td>
</tr>
<tr>
<td>Improves the general intelligence of students</td>
<td>0.23</td>
<td>0.99</td>
<td>0.80</td>
<td>0.96</td>
<td>0.51</td>
<td>1.01</td>
<td>3.61</td>
<td>0.000</td>
</tr>
<tr>
<td>Helps students to develop good work habits</td>
<td>0.46</td>
<td>1.17</td>
<td>0.56</td>
<td>0.92</td>
<td>0.51</td>
<td>1.05</td>
<td>3.48</td>
<td>0.001</td>
</tr>
<tr>
<td>Enables students to improve their quality of life</td>
<td>0.03</td>
<td>0.87</td>
<td>0.52</td>
<td>0.71</td>
<td>0.27</td>
<td>0.83</td>
<td>2.37</td>
<td>0.002</td>
</tr>
</tbody>
</table>

6.4.2 Summary of the Quality of Life Statement Group

The participants surveyed in Study B entered this unit of learning with a belief that music education benefitted the quality of their students’ lives. Exposure to the neuromusical research findings appeared to increase that belief. With a generally positive belief in this type of benefit of music education, it is worthwhile exploring the small number of statements that the participants did not find to be true. This was the concept that music education helps find meaning in the real world and develops good citizenship skills. Both of these benefits are not directly related to the primary
activities participants would have perceived music education to involve: singing, playing a musical instrument and reading and writing music. However, the teaching intervention as well as the neuromusical research findings influenced both the control and experiment groups to alter their values from false to true concerning these benefits to music education. These findings show that the teaching intervention broadened the participants’ view of the benefits of music education to learning beyond the discipline of music itself, and into the holistic development of the child.

The other notable finding from the individual statements was that the teaching intervention had a statistically significant impact on pre-service generalist teachers’ belief in the benefits of music education for general intelligence. The information sheets (Study A1) about the neuromusical research findings highlighted specific cognitive areas that have been found to be improved by formal music training, such as memory and language acquisition, and only touched on the idea of general intelligence. However, the participants in the experiment group took the various research findings and came to believe that music education was not only beneficial for specific cognitive functions (outlined in Section 6.4.7) but for general intelligence. Exposure to neuromusical research findings heightened the participants’ value of music education in the development of general intelligence.

When viewed as a whole, the Quality of Life statements were the most valuable benefits of music education for the control group, but only narrowly ahead of the Neuroscience benefits. This was the reverse for the experiment group, where the Neuroscience benefits were noticeably higher than the Quality of Life benefits. However, these concepts—that music education is valuable because it improves a child’s quality of life as well as various cognitive, emotional and physiological capacities—were the most important to the group as a whole. It was interesting that though the control group was exposed to the neuromusical research findings, the concept that music education had value for a child’s general development beyond learning how to sing, play and read music, was just as important. For the experiment group, exposure to the neuromusical research findings heightened the value of music education overall. This finding could have implications for teacher education programs and music education advocacy, in that the combination of the quality of
life and neuroscience benefits generates stronger values towards the benefits of music education to a child’s development.

6.4.3 Social-Emotional Benefits

The Social-Emotional statement group consisted of the items listed in Table 21.

Table 21: Social-Emotional Statements

<table>
<thead>
<tr>
<th>Statement</th>
<th>17. Provides opportunities to improve self-esteem</th>
<th>26. Helps students improve their motor-coordination skills</th>
<th>27. Gives students relief from more structured classes</th>
<th>32. Helps to develop students’ self-confidence</th>
<th>52. Teaches students how to work together as a team</th>
<th>55. Provides success experiences for students who struggle</th>
<th>57. Allows students to have fun</th>
<th>59. Provides for a more well-rounded education</th>
<th>72. Prepares students to participate in social events</th>
</tr>
</thead>
</table>

The Social-Emotional statement group showed an almost identical gain in both the control and experiment groups (Table 22). The pre-test results showed a slight difference in the groups, as the control group rated the truth and/or validity of the statement group as ‘More True than False’, whereas the experiment group rated the statement group as ‘True’. Both groups’ post-test results showed a rating of ‘True’ to this statement group.

Table 22: Pre- and Post-Test Results Within the Social-Emotional Statement

<table>
<thead>
<tr>
<th>Group</th>
<th>Control</th>
<th>Experiment</th>
<th>All Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Social-Emotional</td>
<td>Social-Emotional</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean  SD</td>
<td>Mean  SD</td>
<td>Mean  SD</td>
</tr>
<tr>
<td>Pre</td>
<td>4.94  0.40</td>
<td>5.01  0.59</td>
<td>4.98  0.50</td>
</tr>
<tr>
<td>Post</td>
<td>5.28  0.51</td>
<td>5.38  0.55</td>
<td>5.33  0.53</td>
</tr>
<tr>
<td></td>
<td>t    p</td>
<td>t    p</td>
<td>t    p</td>
</tr>
<tr>
<td></td>
<td>5.29  .000</td>
<td>5.29  .000</td>
<td>.000</td>
</tr>
</tbody>
</table>

The individual statements within the Social-Emotional group were examined, and the notable results are highlighted below. In the pre-test, the majority of the statements returned a result in either the mid ‘More True than False’ range to the mid ‘True’ range. At the pre-test, all ratings were consistently in the same range between the
control and experiment groups with two notable exceptions: in Item 27 (gives students relief from more structured classes) the control group rated the statement as ‘More True than False’ while the experiment group rated it as ‘True’. In Item 59 (provides for a more well-rounded education) the experiment group rated the statement as ‘More True than False’, while the control group rated it as ‘True’. At the post-test, both groups rated both statements in the ‘True’ range, and in both cases the experiment group had a higher mean than the control group.

Across the nine items in this statement group, six returned a statistically significant gain within the participant group. The questions that did not return a statistically significant gain were Item 17 (provides opportunities to improve self-esteem), Item 32 (helps to develop students' self-confidence) and Item 57 (allows students to have fun). The first two questions concerning self-esteem and self-confidence may be related to the participants’ own levels of confidence in music education, as they may find it difficult to see the benefits for esteem and confidence for children if their own confidence is low. The result for the statement about ‘fun’ was intriguing. When I had asked pre-service generalist teachers to describe their ideal music learning experience in previous years, one of the top answers was usually ‘it should be fun’. When asked if they would include ‘fun’ on a list for mathematics or science, they often said no. This could point to a perception that learning and fun may not be mutually inclusive. Both groups rated this question in the middle of the ‘True’ range in the pre- and post-tests, and nothing occurred in the intervention to change their minds. Conversely, at the pre-test, the experiment group believed this statement to be ‘More True than False’, whereas after the teaching intervention they had moved close to an entire rating into the mid ‘True’ range.

A comparison of the mean difference between the control and experiment groups for each question yielded a variety of results. The notable differences have been included in Table 23. In Item 26 (helps students improve their motor-coordination skills), the control group made a gain of over a rating while the experiment group made a much smaller gain. In Item 27 (gives students relief from more structured classes), the control group made a much larger gain than the experiment group and displayed a stronger belief in the ability for music education to provide relief from more structured classes. In Item 52 (teaches students how to work together as a
team) and Item 55 (provides success experiences for students who struggle), both groups made a gain but in both cases the experiment group made a larger gain and showed a strong belief in the ability for music education to teach teamwork and success to struggling students. The final statement in this group pointed to some interesting results. In Item 59 (provides for a more well-rounded education), the experiment group increased their value by almost one rating while the control group did not alter their view at all after the teaching intervention. As the only difference between the groups was exposure to the neuromusical research findings, it is possible that this research could have broadened the participants’ view of the value of music education in light of the development of the whole child.

### Table 23: Mean Differences for Individual Social-Emotional Statements

<table>
<thead>
<tr>
<th></th>
<th>Control Mean difference</th>
<th>Control SD</th>
<th>Experiment Mean Difference</th>
<th>Experiment SD</th>
<th>All Groups Mean difference</th>
<th>All Groups SD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>26. Helps students improve their motor-coordination skills</td>
<td>0.63</td>
<td>1.18</td>
<td>0.40</td>
<td>1.08</td>
<td>0.52</td>
<td>1.07</td>
<td>3.48</td>
<td>0.001</td>
</tr>
<tr>
<td>27. Gives students relief from more structured classes</td>
<td>0.74</td>
<td>0.98</td>
<td>0.12</td>
<td>0.72</td>
<td>0.44</td>
<td>0.91</td>
<td>3.48</td>
<td>0.001</td>
</tr>
<tr>
<td>52. Teaches students how to work together as a team</td>
<td>0.42</td>
<td>0.81</td>
<td>0.64</td>
<td>0.95</td>
<td>0.53</td>
<td>0.88</td>
<td>4.29</td>
<td>0.000</td>
</tr>
<tr>
<td>55. Provides success experiences for students who struggle</td>
<td>0.50</td>
<td>0.99</td>
<td>0.60</td>
<td>0.82</td>
<td>0.55</td>
<td>0.90</td>
<td>4.35</td>
<td>0.000</td>
</tr>
<tr>
<td>57. Allows students to have fun</td>
<td>0.03</td>
<td>0.44</td>
<td>0.04</td>
<td>0.79</td>
<td>0.39</td>
<td>0.63</td>
<td>0.44</td>
<td>0.659</td>
</tr>
<tr>
<td>59. Provides for a more well-rounded education</td>
<td>0.03</td>
<td>0.72</td>
<td>0.48</td>
<td>0.87</td>
<td>0.25</td>
<td>0.82</td>
<td>2.22</td>
<td>0.031</td>
</tr>
</tbody>
</table>

#### 6.4.4 Summary of the Social-Emotional Statements

The different values that the groups chose to focus on in this statement group were interesting. The control group focused on benefits that were more directly related to the activities that they would experience in a music classroom, such as the development of motor-coordination skills through playing musical instruments and body percussion. The experiment group focused on the benefits that were more generic education experiences and applicable both in and beyond the music classroom. These included learning teamwork skills and successful learning experiences. It could be concluded that exposure to the neuromusical research findings expanded the scope for the benefits of music education beyond the music
classroom. This is certainly supported by the experiment group’s belief in the ability of music education to provide a well-rounded education, in comparison to no change in belief in the control group.

6.4.5 Aesthetic Benefits

The Aesthetic statement group consisted of the items in Table 24.

<table>
<thead>
<tr>
<th>Table 24: Aesthetic Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>24. Enhances students’ aesthetic awareness and sensitivity</td>
</tr>
<tr>
<td>39. Enables students to develop their music potential and talents</td>
</tr>
<tr>
<td>54. Increases satisfaction students derive from music</td>
</tr>
<tr>
<td>62. Encourages students to use their imagination</td>
</tr>
<tr>
<td>65. Enables students to understand more complex music</td>
</tr>
<tr>
<td>66. Exposes students to a different form of intelligence</td>
</tr>
<tr>
<td>69. Increases students’ awareness of mankind’s cultural heritage</td>
</tr>
<tr>
<td>70. Encourages students to be creative</td>
</tr>
<tr>
<td>76. Helps students to appreciate music as a historical force</td>
</tr>
</tbody>
</table>

The Aesthetic statement group showed a gain in both the control and experiment groups, with the experiment group gaining a further 0.14 above the control group (Table 25). Throughout the study, participants in both the control and experiment groups rated this statement group as ‘True’ and moved closer to the middle of the range after the teaching intervention. This high pre-test result indicated the probability of a value ceiling or ceiling effect, where it was unlikely to return a statistically significant change at the post-test due to the high starting point. This also occurred with the Non-Factored statement group.

| Table 25: Pre- and Post-Test Results Within the Aesthetic Statement Group |
|-----------------------------|-----------------------------|-----------------------------|
|                             | Control Aesthetic          | Experiment Aesthetic        | All Groups Aesthetic       |
|                             | Mean    | SD    | Mean    | SD    | Mean    | SD    | t  | p  |
| Pre                         | 5.12    | 0.37  | 5.09    | 0.47  | 5.11    | 0.42  | 3.51|     |
| Post                        | 5.28    | 0.41  | 5.39    | 0.47  | 5.34    | 0.44  | .001|     |

The individual statements within the Aesthetic group were examined, and the notable results were highlighted. At the pre-test, more than half of the statements returned results in the ‘True’ range and this increased in the post-test to over 75%. The control
and experiment group participants shared a high level of belief in the truth and/or validity of the majority of statements.

Across the nine questions in this statement group, only two returned a statistically significant gain within the participant group. This is to be expected when the pre-test results are consistently high. The notable statements were Item 24 (enhances students’ aesthetic awareness and sensitivity) and Item 54 (increases satisfaction students derive from music). In both cases, the larger gains occurred in the experiment group (Table 26), where the difference was almost double in Item 24 but much closer in Item 54. It should be noted that in Item 24 the gain in the control group was below one rating, whereas the gain in the experiment group was closer to two ratings. The experiment group showed a strong change in belief about the ability of music education to enhance aesthetic awareness and sensitivity.

Two additional statements from this group should be considered. There was very little change between the control or experiment group’s belief that music education encourages students to use their imagination. The pre and post means are well into the ‘True’ range, which could account for the lack of change. Importantly the only statistical loss of the entire survey occurred in this statement group. At the post-test, the control group rated the validity of music education to help students appreciate music as a historical force lower than they did at the pre-test. This may be due to misconceptions about the purpose and focus of music education in the early childhood and primary context. Interestingly, the experiment group mean at the pre-test was below the control groups, but this was reversed by the post-test.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Control</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td>t</td>
<td>p</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24. Enhances students’ aesthetic awareness and sensitivity</td>
<td>0.44</td>
<td>0.89</td>
<td>0.88</td>
<td>1.05</td>
<td>4.77</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>54. Increases satisfaction students derive from music</td>
<td>0.50</td>
<td>0.76</td>
<td>0.64</td>
<td>1.07</td>
<td>4.40</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>62. Encourages students to use their imagination</td>
<td>0.00</td>
<td>0.75</td>
<td>0.08</td>
<td>0.64</td>
<td>0.40</td>
<td>0.69</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>76. Helps students to appreciate music as a historical force</td>
<td>-0.11</td>
<td>0.91</td>
<td>0.12</td>
<td>0.93</td>
<td>0.00</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.4.6 Summary of Aesthetic Statements

The majority of participants entered the unit of learning with high values towards the aesthetic benefits of music education. This belief remained after the teaching intervention and exposure to the neuromusical research findings. There are two notable outcomes. Exposure to the neuromusical research findings appears to have an impact on the value of music education in the enhancement of aesthetic awareness and sensitivity. This may be connected with the overall heightening of the value of music education seen in the experiment group, but the gain was close to two ratings, which indicates an important shift. The second outcome is the decrease in belief in music as a historical force. This may be due to the structure of the question, which could be easily misinterpreted, and was originally written with tertiary music major students in mind. It may also be because the unit of learning did not look explicitly at music history or musicology due to lack of time.

6.4.7 Neuroscience Benefits

The Neuroscience statement group consisted of the items in Table 27.

Table 27: Neuroscience Statements

| 15. Helps students to think more flexibly | 36. Helps students learn the rules of language |
| 16. Improves maths skills | 38. Improves students’ memory |
| 18. Improves reading level | 40. Improves students’ social skills |
| 21. Helps students learn faster | 53. Improves students’ awareness of objects around them and their place in relation to those objects |
| 23. Helps students manage their emotions more effectively | 58. Improves specific numeracy skills |
| 25. Speeds up the acquisition of language at a young age | 61. Improves fine motors skills |
| 29. Improves students brain functions | 64. Improves students’ ability to integrate new knowledge |
| 31. Helps students excel academically | 71. Help students think faster |
| 33. Improves skills in science | 74. Improves students’ spatial awareness |
| 34. Helps students resolve conflict |  |
As expected, the Neuroscience statement had the largest gain in the experiment group (Table 28). Exposure to the neuromusical research findings was the only variable between the two groups. Both groups rated this statement group very similarly in the pre-test near the middle of the ‘More True than False’ range. At the post-test, the ratings remained in the same range for the control group but entered the ‘True’ range for the experiment group. Across the five statement groups, the Neuroscience statement group saw the highest gain (0.64) within the experiment group (Table 17) in comparison to the second highest gain (0.42) in the control group, a difference of 0.22. The experiment group also rated the Neuroscience statement group 0.07 above the next statement group (Quality of Life), where as the control group rated the Neuroscience group 0.01 below their highest statement group (Quality of Life).

### Table 28: Pre- and Post-Test Results Within the Neuroscience Statement Group

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th></th>
<th>Experiment</th>
<th></th>
<th>All Groups</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Neuroscience</td>
<td></td>
<td>Neuroscience</td>
<td></td>
<td>Neuroscience</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>4.42</td>
<td>0.51</td>
<td>4.46</td>
<td>0.67</td>
<td>4.44</td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post</td>
<td>4.48</td>
<td>0.51</td>
<td>5.10</td>
<td>0.58</td>
<td>4.96</td>
<td>0.55</td>
<td></td>
</tr>
</tbody>
</table>

The individual statements within the Neuroscience group were examined and the notable results are highlighted below. At the pre-test, all but two of the 19 statements returned a result in the ‘More True than False’ range. Notable exceptions were four statements that both control and experiment group rated as ‘More False than True’:

16. Improves maths skills
21. Helps students learn faster
33. Improves skills in science
34. Helps students resolve conflict

At the post-test, all these statements made a ratings gain to ‘More True than False’ except for the control group in Item 33, which remained in the ‘More False than True’ range. It is also interesting to note that the highest post-test mean for the experiment
group was Item 15 (*helps students to think more flexibly*), whereas the highest post-test mean for the control group was Item 38 (*improves students’ memory*). This is interesting because the experiment group was the only group to have explicit exercises and printed materials on the benefits of music education for memory.

Across the 19 questions in this statement group, all but one question returned a statistically significant gain within the participant group. The only question to return a statistically insignificant gain was Item 36 (*helps students learn the rules of language*). This was interesting as one of the information sheets was specifically dedicated to music and language and the benefits of music for understanding syntax. It could be concluded that the participants in the experiment group did not fully understand or did not connect that information sheet and research to this specific statement in the survey.

A comparison of the mean difference between the control and experiment groups for each question yielded three different types of results: statements that showed gains of more than two ratings, statements that showed similar gains in ratings and statements where the control group showed greater gains than the experiment group. These are detailed in separate comparison tables (Tables 29, 30 and 31).

Three statements reveal significant gains, particularly for the experiment group. The three statements listed in Table 29 revealed notable gains in the control group and significant gains in the experiment group. All three statements had a mean that differed by two ratings between the pre- and post-tests. It should be noted that these were three statements out of the four statements that were rated ‘More False than True’ in the pre-test. This gain could be explained by an alignment of these statements to the majority of statements in the post-test. However, it is the only occurrence in the survey results where a gain of two ratings has been observed.
Of the group of results that showed similar gains in ratings, there are two notable trends. The first showed a gain of one full rating by the experiment group above the control group. The second showed a gain of a rating in both the control and experiment group. The first group is outlined in Table 30, and it is interesting to note that the statements focus on a range of cognitive abilities and skills. The experiment group believed it to be ‘True’ that music education helps students think faster and more flexibly, improve their spatial awareness and reading skills and manage their emotions more effectively. This rating changed from ‘More True than False’ at the pre-test. It is interesting to note that Item 53 (improves students’ awareness of objects around them and their place in relation to those objects) and 74 (improves students’ spatial awareness) cover the same skill, commonly labelled spatial awareness. Due to misconceptions of the term in previous experiences with similar students, it was important to see if use of the term spatial awareness and an explanation of the skill itself yielded different results. The mean differences using the term (0.16) and the explanation (0.25) are too small to comment on.

Table 30: Individual Neuroscience Statements With One Rating Gain By Experiment Group

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Experiment</th>
<th>All Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean difference</td>
<td>Mean difference</td>
<td>t</td>
</tr>
<tr>
<td>15. Helps students think</td>
<td>0.29</td>
<td>0.60</td>
<td>1.06</td>
</tr>
<tr>
<td>more flexibly</td>
<td>1.03</td>
<td>1.04</td>
<td></td>
</tr>
<tr>
<td>18. Improves reading level</td>
<td>0.19</td>
<td>0.52</td>
<td>1.02</td>
</tr>
<tr>
<td>23. Helps students manage</td>
<td>0.44</td>
<td>0.64</td>
<td>0.75</td>
</tr>
<tr>
<td>their emotions more</td>
<td>1.08</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td>effectively</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>53. Improves students’</td>
<td>0.31</td>
<td>0.56</td>
<td>0.84</td>
</tr>
<tr>
<td>awareness of objects</td>
<td>0.97</td>
<td>1.16</td>
<td></td>
</tr>
<tr>
<td>around them and their</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>place in relation to those</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>objects</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The second group of statements is outlined in Table 31. These statements revealed a similar gain across both control and experiment groups. It is interesting to note that the most obviously related statement to neuroscience, Item 29 (improves students’ brain functions), did not see a large gain from the experiment group. Conversely, it should be noted that the question concerning the ability to excel academically resulted in a rating gain for both groups, with the experiment group approaching a two-rating gain.

Table 31: Individual Neuroscience Statements With Similar Rating Gains Across Control and Experiment Groups

<table>
<thead>
<tr>
<th>Statement</th>
<th>Control Mean difference</th>
<th>Control SD</th>
<th>Experiment Mean difference</th>
<th>Experiment SD</th>
<th>All Groups t</th>
<th>All Groups p</th>
</tr>
</thead>
<tbody>
<tr>
<td>25. Speeds up the acquisition of language at a young age</td>
<td>0.59</td>
<td>1.08</td>
<td>0.80</td>
<td>0.86</td>
<td>0.76</td>
<td>0.452</td>
</tr>
<tr>
<td>29. Improves students’ brain functions</td>
<td>0.26</td>
<td>0.71</td>
<td>0.46</td>
<td>0.83</td>
<td>0.92</td>
<td>0.362</td>
</tr>
<tr>
<td>31. Helps students excel academically</td>
<td>0.59</td>
<td>0.84</td>
<td>0.92</td>
<td>0.77</td>
<td>1.42</td>
<td>0.161</td>
</tr>
<tr>
<td>61. Improves fine motor skills</td>
<td>0.65</td>
<td>0.98</td>
<td>0.64</td>
<td>1.07</td>
<td>0.48</td>
<td>0.962</td>
</tr>
</tbody>
</table>

Finally, two statements resulted in larger gains from the control group than the experiment group (Table 32). Both of these statements comment on personal skills rather than areas of the brain, which are the traditional focus when discussing neuroscience.

Table 32: Individual Neuroscience Statements With Larger Mean Gains in Control Group

<table>
<thead>
<tr>
<th>Statement</th>
<th>Control Mean difference</th>
<th>Control SD</th>
<th>Experiment Mean difference</th>
<th>Experiment SD</th>
<th>All Groups t</th>
<th>All Groups p</th>
</tr>
</thead>
<tbody>
<tr>
<td>34. Helps students resolve conflict</td>
<td>0.81</td>
<td>0.92</td>
<td>0.71</td>
<td>0.99</td>
<td>0.39</td>
<td>0.694</td>
</tr>
<tr>
<td>40. Improves students’ social skills</td>
<td>0.51</td>
<td>0.97</td>
<td>0.37</td>
<td>0.97</td>
<td>0.53</td>
<td>0.601</td>
</tr>
</tbody>
</table>
6.4.8 Summary of Neuroscience Statements

The pre-test showed that the participant group as a whole entered the unit of learning with a similar level of belief in the Neuroscience benefits of formal music training to Quality of Life Benefits. These benefits were below the other statement groups on Aesthetic and Social-Emotional development. In short, the participants believed that music education provided a child with an understanding of the music discipline and of the broader aesthetic concepts of the arts as well as an avenue for the development of social skills and emotional well-being. The ability for music education to benefit the cognitive development of a child was less important or applicable to the participants at the beginning of the teaching intervention.

These results display a marked change in those values and beliefs after the teaching intervention, predominantly for the experiment group but also to a lesser extent for the control group. It is very interesting that although the control group was not exposed explicitly to the neuromusical research findings, the results show that they absorbed many of the general concepts. The most notable changes for the experiment group were in the improvement of skills in maths and science. This is interesting, as many students commented during the rhythm activities about the very direct connections they could see between maths and music. However, this was not the case with science, and it is interesting to speculate about what this significant change may be based on. Certainly the mathematical skills that are inherent in science are easy to connect, but it may also be related to greater levels of analytical thinking, creative experimentation and memory capabilities. The neuromusical research findings appeared to focus the experiment group participants on the cognitive capabilities that music education could develop and then relate those to specific subject areas.

The differing results for two of the statements were intriguing: the ability for music education to help students learn faster (Item 21) and think faster (Item 71). In both the control and experiment groups, the learn faster statement ranked far higher than the think faster statement. The connection between thinking and learning is cyclic: understanding arises from thinking then learning and learning then thinking. This result may indicate an underdeveloped understanding of different theories of the
learning process and may be worthy of further discussion on a faculty level of how the understanding of the learning process occurs for our students.

It is interesting to examine the implications of the two statements in the group that the control group rated above the experiment group. These statements were based on the ability of music education to assist in conflict resolution and social skills. Lack of exposure to the neuromusical research findings appears to have maintained the focus that the control group entered the teaching intervention with, which was the inter- and intra-personal benefits of music education. In contrast, the experiment group appear to have moved their initial focus, which was the same as the control group, far more into the broader benefits of music education within and beyond the arts classroom.

6.4.9 Non-Factored Benefits

The Non-Factored statement group consisted of the items in Table 33.

<table>
<thead>
<tr>
<th>Table 33: Non-Factored Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>35. Cultivates use of a unique symbol system</td>
</tr>
<tr>
<td>37. Is valuable in itself and needs no justification</td>
</tr>
<tr>
<td>30. Teaches teamwork</td>
</tr>
<tr>
<td>19. Offers opportunities for self-expression</td>
</tr>
<tr>
<td>14. Broadens student horizons</td>
</tr>
</tbody>
</table>

The Non-Factored statement group showed a gain in both the control and experiment groups, with the experiment group gaining a further 0.16 above the control group (Table 34). At the pre-test, the control and experiment groups were very close, with the former towards the bottom of the ‘True’ range and the latter at the very top of the ‘More True than False’ range. At the post-test, both groups rated the statement group towards the middle of the ‘True’ range. The high pre-test result pointed to a possible ceiling effect, similar to the Aesthetic statement group finding, where the initial high results in the pre-test left little room for positive statistical change at the post-test.
Table 34: Pre- and Post-Test Results Within the Non-Factored Statement Group

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Experiment</th>
<th>All Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Factored</td>
<td>Non-Factored</td>
<td>Non-Factored</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Pre</td>
<td>5.06</td>
<td>0.49</td>
<td>4.99</td>
</tr>
<tr>
<td>Post</td>
<td>5.30</td>
<td>0.49</td>
<td>5.39</td>
</tr>
</tbody>
</table>

A Levene’s test was applied to the five themed statement groups (Table 35). This test determines whether equal variance should be assumed or not assumed. The Levene’s test found that in the Quality of Life, Social-Emotional, Aesthetic and Non-Factored statement groups, the F test was between 0.13 and 0.00. This result indicated that equal variance could be assumed, meaning that the variances across all groups were consistent. In the Neuroscience statement group the Levene’s test returned an F test result of 5.71, which indicated that this group’s equal variance cannot be assumed and that the variances across all groups were inconsistent. This result was expected—as the only group to be exposed to the neuromusical research was the experiment group, there can be no equal variance across the participant group (N=52). Therefore, when comparing the results from the t-test for equality of means, the equal variance assumed results were used for the Quality of Life, Social-Emotional, Aesthetic and Non-Factored statement groups and the equal variance not assumed result was used for the Neuroscience statement group.

Table 35: Levene’s Test for Equality of Variance

<table>
<thead>
<tr>
<th></th>
<th>All Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
</tr>
<tr>
<td>Quality of Life Benefits</td>
<td>0.08</td>
</tr>
<tr>
<td>Social-Emotional Benefits</td>
<td>0.08</td>
</tr>
<tr>
<td>Aesthetic Benefits</td>
<td>0.00</td>
</tr>
<tr>
<td>Neuroscience Benefits</td>
<td>5.71</td>
</tr>
<tr>
<td>Non-factored Benefits</td>
<td>0.13</td>
</tr>
</tbody>
</table>

This test showed through the p value that none of the results were statistically significant. The Social-Emotional statement group showed the largest positive change in the group where equal variance was assumed and the Aesthetic statement group showed the smallest positive change. The Neuroscience statement group returned the lowest p value, indicting the largest change within the five statement groups, although the result did not show statistical significance. This may be a result
of the fact that only half of the participant group was exposed to the neuromusical research, thus the \( p \) value was weakened within the whole participant group. This was echoed in the confidence level result for the Neuroscience statement group, where the upper result was the closest to 0 at 0.78, meaning the exact measure of the change is difficult to establish.

The same statistical tests were applied to the data for a second time but using the additional division of musician and non-musician in the control and experiment groups. It was in this set of tests that the effect of the small sample size, particularly of musicians, became evident. The results were statistically different to the previous findings and resulted in wide confidence intervals. For example, in Table 36 it is evident that the musicians in the experiment \( (n=3) \) and control groups \( (n=7) \) have notably different results and although not as extreme, the wide differences are also evident between the non-musicians in both groups. These tests show that the results, when divided in this manner, are statistically uncertain.

**Table 36: Non-Musicians’ and Musicians’ Results Within the Neuroscience Statement Group**

<table>
<thead>
<tr>
<th>Control Neuroscience</th>
<th>Experiment Neuroscience</th>
<th>All Groups Neuroscience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Musician ( n=20 )</td>
<td>Musician ( n=7 )</td>
<td>Non-Musician ( n=22 )</td>
</tr>
<tr>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Pre</td>
<td>4.31</td>
<td>0.48</td>
</tr>
<tr>
<td>Post</td>
<td>4.81</td>
<td>0.54</td>
</tr>
</tbody>
</table>

**6.4.10 Summary of Value of Music Education Results**

Regardless of the teaching intervention and exposure to neuromusical research findings, it is evident that the participant group increased the value that they believed music education brought to children’s lives and education. In a large number of cases, when examining both statement groups and individual statements, the experiment group’s value towards music education increased more than the control group’s. The two statement groups that showed the greatest increases were the Quality of Life and Neuroscience groups. In the Quality of Life statement group, the highest rating statements focused on general intelligence, good work habits, increased quality of
life and student personality. The control group focused on music education as a path to a musical career, while the experiment group focused on the benefits to intelligence and finding meaning in the world.

The Neuroscience statement group returned the most important results in relation to the focus of this study. The experiment group showed a statistically significant change in their value of music education in this area, in some cases increasing their values by two or more ratings. The largest changes for the experiment group were in the individual statements about the capability of music education to improve skills in maths and science and the ability to learn faster. Marked increases also occurred on the statements highlighting general learning skills such as reading, spatial awareness, management of emotions and flexible thinking.

It was interesting that the control group also showed increases in their beliefs within the Neuroscience statement group, even though they had received no verbal or printed material highlighting these aspects of music education. The control group participants must have gained an understanding of these aspects from the teaching intervention alone, or possibly from individual research or speaking with the experiment group participants. Importantly, they connected the tutorial experiences with general learning principles, but their value change was less marked than that of the experiment group. It could be deduced from these results that the teaching intervention succeeded in changing the participants’ minds in a positive way about the value of music education. Furthermore, the change was increased by the explicit connection of the benefits of music education to the neuromusical research findings.

6.5 Importance of Subjects

In this section of the survey, participants were asked to rank 15 subjects taught in the primary school curriculum for their importance (Figure 29). It should be noted that during the pilot survey, participants struggled between ranking the importance of the subjects and ranking them in order of their own personal preference. Similar struggles were observed from a small number of participants during the pre- and post-test sessions and recorded in the researcher’s journal.
After completing a paired sample test on the participant group of 52, it was found that the level of importance of music education rose and showed a statistically significant gain and returned a \( p \) value of 0.000 (Table 37). The 95% confidence interval was the second narrowest of all the tests performed on Value of Music Education, Confidence in Teaching and Confidence in Teaching the Arts sections, at 1.72. The mean of the paired difference was almost two full rankings (1.98).

<table>
<thead>
<tr>
<th>Importance of Music Education</th>
<th>Mean difference</th>
<th>SD</th>
<th>( t )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Groups</td>
<td>1.98</td>
<td>3.04</td>
<td>4.65</td>
<td>0.000</td>
</tr>
</tbody>
</table>

A further paired sample test was conducted on the control and experiment group mean. This test highlighted a wide difference between these two groups. The control group mean was close to one ranking place (1.15), whereas the experiment group’s mean was closer to three (2.84) ranking places (Table 38).

<table>
<thead>
<tr>
<th>Importance of Music Education</th>
<th>Control Mean</th>
<th>Control SD</th>
<th>Experiment Mean</th>
<th>Experiment SD</th>
<th>All Groups Mean</th>
<th>All Groups SD</th>
<th>( t )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>7.88</td>
<td>2.87</td>
<td>8.76</td>
<td>2.96</td>
<td>8.31</td>
<td>2.92</td>
<td>4.65</td>
<td>0.000</td>
</tr>
<tr>
<td>Post</td>
<td>6.70</td>
<td>2.41</td>
<td>5.92</td>
<td>2.66</td>
<td>6.33</td>
<td>2.57</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The independent sample test resulted in the strongest statistically significant change of 0.47 amongst all of the \( t \)-test results from Sections D, E, G and H (Table 39). This was the only independent sample test result that returned a statistically significant
finding. The F test found that equal variance could be assumed but the confidence interval was very wide, with a lower result of 0.02 and an upper result of 3.35. This displayed that the results were spread reasonably widely. The comparison of musician and non-musician groups did not yield meaningful results.

<table>
<thead>
<tr>
<th>Table 39: Levene's Test for Importance of Music Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Groups</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>Importance of Music Education</td>
</tr>
</tbody>
</table>

6.5.1 Summary of the Importance of Music Education Results

The importance of music education in comparison to 14 other subject areas increased in both the control and experiment group, but in a similar fashion to the Value of Music Education results, the experiment group made a more marked positive change in their values. While the participant group saw the ranking of music education rise by two places, the mean difference in the control group was closer to one ranking, while the mean difference in the experiment group was closer to three rankings.

Examined in light of the results from the Value of Music education section, it appears that the teaching intervention had a positive impact on the participants. However, the benefits that the experiment group found in the general learning capabilities for their students may have caused them to place more importance on music education in the overall education of children. The experiment group placed music education in the top 40% of subjects, and while this is similar to the control group at the top 45% of subjects, the experiment group began with music education ranked far lower than the control group, at the bottom 40% of subjects. Again the teaching intervention appears to have positively altered the participants’ value of music education, but the inclusion of the neuromusical research has increased that change.
6.6 Delivery of Music Education

In this section of the survey, participants were asked to provide the level of agreement on a seven-point scale to questions in two areas: the role of a generalist teacher in music education and the integration of music with other subject areas. In the survey, the questions were not presented in sets but mixed together. The results are given in the topic groups. They were analysed at a participant group level as well as control and experiment group level. Some notable results from a comparison between musicians and non-musicians are included. Due to the small sample size, these results are presented using predominantly descriptive statistics, but there are also statistically significant results that will be reported. Similarly, due to the small sample size, results were collapsed into ‘agree’ and ‘disagree’ responses. There were no ‘no opinion’ responses. A McNemar test was conducted on all results to determine if there was a statistically significant change. A small number of participants did not complete this section or skipped questions. Consequently, cohort numbers have been included in this section.

6.6.1 The Role of the Generalist Teacher in the Delivery of Music Education

This area consisted of five questions as follows:

43. A K-6 classroom teacher should be able to teach music.
44. Music should be taught by a teacher qualified specifically in music education.
45. Music should be taught by a teacher who has an interest in music education.
47. A K-6 classroom teacher should be capable of supporting a specialist music teacher in teaching music.
48. Music education should be delivered to your students by external music specialists.

The results from these five questions returned consistently stable results after the teaching intervention. In Question 43 (A K-6 classroom teacher should be able to teach music), within the participant group (N=51), five participants moved from
disagree to agree. Of those five, one participant in the control group changed their view in comparison to four participants in the experiment group. There was a consistently high level of agreement with this statement, moving from 43 out of 51 participants in the pre-test to 48 out of 51 participants at the post-test. The McNemar test found that there was no statistically significant change (0.063) in the agreement with this statement, although the control group returned a high result (1.0). This result means that 94% of participants agree that the K-6 classroom teacher should be able to teach music and a larger number of those came from the experiment group. Of those in disagreement, slightly more were in the control group (Figure 30).

The results from Question 44 (Music should be taught by a teacher qualified specifically in music education) are similar to those from Question 43. Within the participant group (N=49), three participants moved from disagree to agree after the teaching intervention. This was a result of a small difference in the movement between disagree and agree. Four participants moved from disagree to agree in the experiment group, while one participant in the control group moved from agree to disagree. There was a reasonably high level of agreement with this statement, moving from 34 out of 49 participants at the pre-test to 37 out of 49 participants at the post-test. The McNemar test found that there was no statistically significant change (0.58) in the agreement with this statement, although the control group returned a high result (1.0), while the experiment group showed a higher level of statistical significance (0.29). This result means that 75% of participants agree that music should be taught by a teacher qualified specifically in music education, and the level of agreement is consistent across both control (n=18) and experiment (n=19) groups. Of those in agreement, slightly more were in the experiment group (Figure 30).

The results from Question 45 (Music should be taught by a teacher who has an interest in music education) are similar to those from Questions 44 and 43, although with slightly less agreement at the post-test. Within the participants’ group (N=51), two participants moved from agree to disagree after the teaching intervention. This was a result of a small difference in the movement between disagree and agree. Three participants moved from disagree to agree in the experiment group, while one participant in the control group moved from agree to disagree. There was a high level
of agreement with this statement, moving from 43 out of 51 participants at the pre-test to 45 out of 51 participants at the post-test. The McNemar test found that there was no statistically significant change (0.68) in the agreement with this statement, although again the control group returned a high result (1.0), while the experiment group showed a higher level of statistical significance (0.37). This result means that 90% of participants agree that music should be taught by a teacher who is interested in music and slightly more participants in the control group (n=24) agree with this statement than the experiment group (n=21). The levels of agreement are virtually the same across the control and experiment groups (Figure 30).

The results from Question 47 (A K-6 classroom teacher should be capable of supporting a specialist music teacher in teaching music) returned the only neutral result from the survey. At the pre- and post-tests, 46 out of 51 participants agreed with the statement. As the responses were collapsed into agree and disagree, it is unknown if the agreement moved upwards by one or more ratings. Three participants changed their views after the teaching intervention from either agree to disagree or vice versa. As these changes cancelled each other out, the McNemar test found that there were no statistical changes in either the control or experiment group. This result means that 90% of participants agree that the K-6 classroom teacher should be capable of supporting a specialist music teacher in teaching music and that their views have not changed significantly from the start of the teaching intervention. Of those in agreement, slightly more were in the experiment group (Figure 30).

Question 48 (Music education should be delivered to your students by external music specialists) yielded the second highest level of disagreement towards any of the eight statements in this section, with slightly more disagreement at the post-test. Within the participant group (N=51), one participant moved from agree to disagree in the experiment group and three participants moved from disagree to agree in the control group. At the post-test, 33 out of the 51 participants disagreed with the statement with a slightly higher number in the control group (n=19) than in the experiment group (n=16). The number of participants agreeing with the statement was identical in each group. The results mean that 65% of participants disagreed with the statement that music education should be delivered by external music specialists. Of those in disagreement, slightly more were in the control group (Figure 30).
higher number of participants in the control group changed their minds to disagree with the statement.

**Figure 30: Level of Agreement/Disagreement With Statements on Generalist Teachers’ Role**

### 6.6.2 Summary of the Role of the Generalist Teacher Results

The results were generally consistent across the participant group and were either very high or very low in their level of agreement or disagreement. The participants believe that music should be able to be taught by generalist teachers such as themselves, meaning their own education and university training should enable them to do so. In two almost contradictory statements, participants also agree strongly that a practitioner specifically qualified in music education and/or interested in music should deliver the subject to children. This could be interpreted as a desire from the participants to display both their skill and interest in teaching music. Alternatively, it could be interpreted as a belief that if they do not possess the skills or interest in teaching music, then another member of staff who does should deliver the music education components of the curriculum. However, 90% of participants believed that if they did not deliver music education to their students, they should have the capacity to support that teacher. This final statement leads into the participants’ strong disagreement with the idea that music education should be delivered by external practitioners. These results reveal that the participants believe that the permanent school staff should deliver music education and that they should have the
capability to either deliver and/or support a specialist or interested teacher in music education. The teaching intervention and neuromusical research findings either raised or confirmed these beliefs.

6.6.3 Music Education and Other Subject Areas

This topic consisted of three questions as follows:

42. Music should be integrated into other subject areas.
46. Other subject areas should be integrated into music education.
49. Music education should not be compulsory in the school curriculum.

The results from these three questions returned several significant results. In Question 42 (Music should be integrated into other subject areas), within the participant group ($N=51$), eight participants moved from disagree to agree after the teaching intervention. Of those eight, 75% of the control group changed their view in comparison to 100% of the experiment group. The McNemar test found that there was a statistically significant change ($0.039$) towards agreement with this statement with a slightly higher result in the experiment group ($0.62$) than in the control group ($0.63$). This result means that more participants agreed that music should be integrated into other subject areas after the teaching intervention, and of those participants a large proportion of the change occurred in the experiment group. At the post-test, 92% of participants agreed with this statement. Of those in agreement, slightly more were in the control group (Figure 31).

The results for Question 46 (Other subject areas should be integrated into music education) displayed the largest number of participants changing from disagree to agree within all eight questions in the section. Within the participant group ($N=51$), 15 participants moved from disagree to agree after the teaching intervention. Of those 15 participants, more came from the control group ($n=9$) than the experiment group ($n=6$). The McNemar test found that there was a strong statistically significant change ($0.001$) towards agreement with this statement, with a higher result in the control group ($0.12$) than the experiment group ($0.70$). This results means that 29% of the participants changed their mind after the teaching intervention and joined the
90% who agreed that other subject areas should be integrated into music education. Of those in agreement, more were in the control group (Figure 31).

Question 49 (Music education should not be compulsory in the school curriculum) yielded the largest level of disagreement towards any of the eight statements in this section. Within the participant group (N=51), only two participants moved from disagree to agree after the teaching intervention. At the pre-test, 40 out of the 51 participants disagreed with the statement, and this only changed by two participants to 38 out of 51 at the post-test. The change in agreement was also interesting, with three participants from the control group moving to agree and five students from the experiment group moving from agree to disagree. The McNemar test found that this change was not statistically significant (0.79) and that the change of view towards this statement was higher for the experiment group (0.12) than the control group (0.45). This result means that 75% of participants disagreed with the statement that music should not be compulsory in the school curriculum and while the majority of participants maintained their level of disagreement towards this statement, more participants in the experiment changed their view from agree to disagree. Of those in disagreement, slightly more were in the control group (Figure 31).

![Figure 31: Level of Agreement/Disagreement With Music and Other Subject Statements](image)

6.6.4 Summary of Music and Other Subjects Results
In all three questions, the experiment group showed a lower level of agreement or disagreement than the control group. The pre-test saw higher levels of disagreement with the concepts of integration and music education, which could have come from a lack of understanding of the forms, value and dangers of integration. Interestingly, the control group changed their values on the integration of music into other subjects while the experiment group changed their values on the integration of other subjects into music. This could be due to a focus in the experiment group on the neuromusical research into the improvement of skills such as maths, reading and language through music education. The final question on whether music education should be compulsory showed a high level of disagreement, but the overall results did not change markedly between the pre- and post-tests. What is of interest is that three participants from the control group moved to agree while five participants from the experiment group moved to disagree. The teaching intervention seems to have failed to change the majority of the participants’ values in this area. However, the neuromusical research findings in conjunction with the teaching intervention swayed 20% of the experiment group participants to value musical education as a part of a child’s educational development.

6.6.5 Compulsory Music Education

Question 50 was a stand-alone question within this section, which was aimed at determining how a change in the value held towards music education could manifest itself in a curriculum structure. Participants were asked to select the educational year level they believed music education should be deemed compulsory. There was a notable change between the pre- and post-tests for the participant group. The number of participants who believed music should be compulsory until Year 6 decreased by 11%. The number of participants who believe music should be compulsory until Year 8 increased by eight per cent. The number of participants who believe music should be compulsory until Year 10 remained consistent between pre- and post-tests. Overall, at the post-test, 79% of participants believed that music education should be compulsory into secondary school in comparison to 21% in primary school, and the highest result was for Year 8 at 38%.
Within the control group, the trend showed a higher number of participants believing music should be compulsory until Year 6 than at the pre-test. At the pre-test, 89% believed music should be compulsory into secondary school with the highest result of 78% at Year 8 or Year 10. At the post-test, compulsory music education in secondary school decreased by 12% in favour of compulsory music ceasing in primary school at Year 6 (Figure 32).

**Figure 32: Frequency Distribution for Compulsory Music Education (Control)**

In the experiment group at the pre-test, the highest results was at Year 6 with almost half the participants (48%) believing music should be compulsory until the completion of Year 6. At the post-test, the participants indicated a sizable shift in their beliefs. Responses to Year 3 decreased by 300% in favour of a 36% increase in the belief that music education should be compulsory into secondary school. This was highest in Years 8 and 10 with 72% (Figure 33).
6.6.6 Summary of Compulsory Music Education Results

In the pre-test, the participants’ group was reasonably divided on the educational year they believed that music education should be compulsory until. This could have been influenced by school structures and the participants’ personal music education experiences. There were an almost equal number of participants who believed music education should be compulsory to Year 6, Year 8 or Year 10. However, these results mask a notable difference between the control and experiment groups. The control group leaned towards the secondary school years, whereas the experiment group trended towards the end of primary school. These differences made the post-test results more interesting in that more participants in the control group leaned towards the lower years in education, while the experiment group transferred their beliefs to the upper ends of secondary education. It is unclear what impact the teaching intervention had on the participants’ beliefs in this area, but the neuromusical research findings appear to have influenced the experiment group towards the idea that more compulsory music education should be afforded to children. This may be due to the general education benefits that the experiment group highlighted as beneficial in the Value of Music Education section of the survey.
6.6.7 Confidence in Teaching

In this section of the survey, participants were asked to rank their confidence levels in teaching 15 subjects in the primary school curriculum using the same instrument as the Importance of Subjects (Figure 29). It should be noted that in a similar approach to the Importance of Subjects section, participants in the pilot study struggled between ranking the importance of the subjects and ranking them in order of their own personal preference. Similar struggles were observed from a small number of participants during the pre- and post-test sessions.

After completing a paired sample test on the participant group of 52, it was found that the level of confidence in teaching music went up and showed a statistically significant positive change, returned a $p$ value of 0.000 (Table 40). The 95% confidence interval showed a genuine level of confidence with a lower and upper result separated by 2.3 within the positive range. The mean of the paired difference was the most significant of the entire survey, being closer to five rankings (4.67).

<table>
<thead>
<tr>
<th>Table 40: Pre- and Post-Test Means, Standard Deviation and $t$ Values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Confidence to teach music</strong></td>
</tr>
<tr>
<td>Mean difference</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>4.67</td>
</tr>
</tbody>
</table>

A further paired sample test was conducted on the control and experiment group mean. This test highlighted a small difference between these two groups with the experiment again returning a higher result. The control group mean was close to four ranking places (4.11), whereas the experiment group’s mean was comfortably above five (5.29) ranking places (Table 41).

<table>
<thead>
<tr>
<th>Table 41: Comparison of Pre- and Post-Test Results of the Control and Experiment Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control</strong></td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>Pre</td>
</tr>
<tr>
<td>Post</td>
</tr>
</tbody>
</table>
The independent sample test showed that the change was not statistically significant (Table 42) and returned a wide confidence interval with a negative lower result and positive upper result. This shows that the spread was very wide and that some participants may have felt less confident at the conclusion of the teaching intervention. The comparison of musician and non-musician groups did not yield meaningful results.

<table>
<thead>
<tr>
<th>Table 42: Levene's Test for Equality of Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Groups</td>
</tr>
<tr>
<td>Confidence to teach music</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>0.56</td>
</tr>
</tbody>
</table>

**6.6.8 Summary of the Confidence in Teaching Results**

Participating in a unit of study that is designed specifically to improve a student’s ability to teach a given subject area should anticipate an improvement at the conclusion of the unit. Both groups reached a similar level of confidence in teaching music and they ranking their skills in teaching music between fourth and fifth within a list of 15 subjects. It could be presumed that subject areas that are compulsory to Year 10 or 12, such as English, Maths or Science, might be in the top four rankings.

The result of greater interest comes from the pre-test and shows the level of confidence each group began with and how far they moved. The experiment group returned a lower ranking than the control group. This may mean that the teaching intervention encouraged participants to gain considerable confidence in teaching music and that the experiment group entered the teaching intervention with a notably lower level of confidence that the control group.

**6.7 Confidence in Teaching the Arts**

In this section of the survey, participants were asked to rank their confidence levels in teaching the four arts subjects in the primary school curriculum (Figure 34).
After completing a paired sample test on the participant group of 52, it was found that the confidence levels in teaching music in comparison to the other arts subjects went up and showed a statistically significant positive change, returning a \( p \) value of 0.000 (Table 43). The 95% confidence interval was the narrowest of all the tests performed on the Value of Music Education, Confidence in Teaching and Confidence in teaching the arts sections, at just 0.58. The mean of the paired difference was just over one full ranking (1.06). During the unit of learning, students also undertake a similar course in Dance. For the purposes of Study B results on participants’ confidence in Dance was not analysed but would be of interest in the future. Due to their degree design, participants had not undertaken courses in Drama or Visual Art prior to this study.

### Table 43: Pre- and Post-Test Means, Standard Deviation and \( p \) and \( t \) Values

<table>
<thead>
<tr>
<th>Confidence to teach music within the arts</th>
<th>Mean difference</th>
<th>SD</th>
<th>( t )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Groups</td>
<td>1.06</td>
<td>1.02</td>
<td>7.36</td>
<td>0.000</td>
</tr>
</tbody>
</table>

A further paired sample test was conducted on the control and experiment group mean. This test highlighted a small difference between these two groups with the experiment again returning a higher result. The control group mean was under one ranking place (0.84), whereas the experiment group’s mean was comfortably above one (1.28) ranking place (Table 44).

### Table 44: Comparison of Control And Experiment Group Pre- and Post-Test Results

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th></th>
<th>Experiment</th>
<th></th>
<th>All Groups</th>
<th></th>
<th>( t )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>2.78</td>
<td>1.12</td>
<td>2.80</td>
<td>1.00</td>
<td>2.80</td>
<td>1.03</td>
<td>7.36</td>
<td>.000</td>
</tr>
<tr>
<td>Post</td>
<td>1.96</td>
<td>1.06</td>
<td>1.52</td>
<td>0.65</td>
<td>1.74</td>
<td>0.90</td>
<td>.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

The independent sample F test returned an assumed equal variance of 0.00 and although the \( p \) value was the second lowest (1.28) it did not indicate that the change was statistically significant (Table 45). The confidence interval was also in both the
negative and positive range, indicating that some participants may have been less confident at the conclusion of the teaching intervention. The comparison of musician and non-musician groups did not yield meaningful results.

<table>
<thead>
<tr>
<th>Table 45: Levene's Test for Equality of Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All Groups</strong></td>
</tr>
<tr>
<td>Confidence to teach music</td>
</tr>
</tbody>
</table>

6.7.1 Summary of Confidence in Teaching the Arts Results

In a similar manner to the Confidence in Teaching results, this question revealed that the teaching intervention assisted the participants to improve their levels of confidence in teaching music. The two groups ranked music education close to third out of four arts areas at the start of the intervention. As anticipated, both groups confidence had improved after the teaching intervention, but in a similar trend to other areas of the survey, the experiment group’s improvement in confidence was greater. The teaching intervention improved confidence levels but the additional of the neuromusical research findings may have amplified that improvement.

6.8 Open Response Questions

The survey contained three open response questions, Question 41, 77 and 78 (Table 46).

<table>
<thead>
<tr>
<th>Table 46: Division of Open Response Question by Pre- and Post-Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number</strong></td>
</tr>
<tr>
<td>Q41</td>
</tr>
<tr>
<td>Q77</td>
</tr>
<tr>
<td>Q78</td>
</tr>
</tbody>
</table>

The results from these three open response question were analysed using different methods that were appropriate to the content and purpose of each question. A
comparative analysis was performed on the results of Question 41 using the five themed statement groups in the Value of Music Education section. Each participant’s comment were examined for themes and then compared with the 53 statements from the Value of Music Education section. Participant responses with multiple themes were dissected so that each theme could be allocated to a statement. Participant responses were matched as closely as possible to the most appropriate individual statement and any slight differences that occurred were noted against the individual statement. This analysis was divided into control and experiment groups and pre- and post-tests. After the comparison was completed, trends in the data were identified and similarities and differences between the groups and tests were highlighted.

A thematic analysis was performed on the results of Question 77. The responses were compiled into one document without identifiers for the control or experiment group as these responses were only part of the pre-test and had no bearing on the teaching intervention. The responses were read and initial thoughts were annotated next to the responses. Upon successive readings, these thoughts were defined into themes and supporting quotes were highlighted. This question was included in the survey to allow for the collection of additional qualitative data on the participants experience of learning a musical instrument.

A text-analytics and content analysis was performed on the results of Question 77. Initially, a thematic analysis was designated as the appropriate methodology for this question. However, the nature of the responses called for a different approach to the data as detailed in Section 6.10. The text-analytics software Leximancer was used to assist in this analysis.

6.8.1 The Value of Learning a Musical Instrument

All responses, or partial responses, were assigned to one of the statements within the Value of Music Education themed statement groups. These responses were expected to engage the participants in a different manner to the majority of the survey that required ratings and rankings. These qualitative responses were expected to reveal the values at the forefront of the participants’ minds.
In the initial analysis, each response was paired with a statement within the 53 statements that were the basis of Value of Music Education section of the survey. In the first step of the analysis the statements were counted, while the second step looked for similarities and difference between the tests and groups. In the pre-test, 23 participants ($n=27$) from the control group and 23 participants ($n=25$) from the experiment group included some type of a response to this question. In the post-test, 25 participants ($n=27$) from the control group and all 25 participants from the experiment group included some type of a response to this question. The initial numerical analysis indicated a number of interesting and expected trends in the focus of the responses (Table 47).

The control group revealed a strong level of value at the pre-test in three out of the five statement groups: Quality of Life, Social-Emotional and Non-Factored benefits. At the post-test, all three of these groups decreased within the responses, in place of higher levels of value in the Aesthetic and Neuroscience Benefits. The experiment group showed a very strong value at the pre-test in the Social-Emotional benefits and a similar level of value as the control group in the Non-factored benefits. At the post-test, the number of responses focusing on the Neuroscience benefits increased dramatically, while responses in the four other statement groups decreased. As the only variable within the teaching intervention was the introduction of the neuromusical research to the participants, this result was expected. However, the size of the increase showed the notable impact that the neuromusical research had on the experiment group in this particular test. The following section highlights the notable similarities and difference across both the pre- and post-tests and the control and experiment groups. The groups and number of comments are indicated by a C for control group and an E for experiment group, followed by the identification number of the participant who commented on the item.
6.8.1.1 Quality of Life Benefits

There were a number of similar comments across the groups and tests concerning the Quality of Life benefits. In the pre-test, there were six participants (C=3, E=3) who focused on the improvement in the quality of life (Item 73) benefits. The language that was used included ‘a sense of accomplishment’, ‘development of a passion or hobby’ and ‘sense of happiness’. Only one participant in the control group focused on this value in the post-test. In the post-test, nine participants (C=5, E=4) believed that learning a musical instrument developed a student’s personality (Item 75). No participants focused on this value in the pre-test. The language that was used included ‘the development of persistence, determination, focus, responsibility and ownership of a task’. This could also be included within good citizenship habits (Item 56) and wholesome ideas of conduct (Item 20).

There were several notable differences between the comments made by each group and within each test concerning the Quality of Life benefits. In the pre-test, three participants from the control group indicated that learning a musical instrument is
valuable as preparation for a career in music (Item 13). No participants highlighted this in the post-test, and no participants from the experiment group highlighted this value (Item 13) in either pre- or post-test. In both the pre- and post-tests, three responses from the control group focused on the improved physical well-being (Item 63) that learning a musical instrument can bring. In the pre-test, no participants in the experiment group indicated a value in this area. In the post-test, only one participant indicated a focus on the improved physical well-being (Item 63) that learning a musical instrument can bring.

These results show that before the teaching intervention, both groups highlighted the improvements to the quality of life and development of a student’s personality as the more important benefits of learning a musical instrument within the Quality of Life statement group. Before the intervention, a small number of participants in the control group indicated that learning a musical instrument prepared you for a career in music and improved physical well-being, while no participants in the experiment group highlighted this belief. After the teaching intervention, both groups indicated an increased level of value in the development of a student’s personality through learning a musical instrument. The control group continued to highlight the improvement in physical well-being, while the experiment group did not.

6.8.1.2 Social-Emotional Benefits

There were a number of similar comments across the groups and tests concerning the Social-Emotional benefits. Nine participants (C=3, E=6) focused on the development of self-confidence (Item 32) that learning a musical instrument can provide. Seven participants (C=5, E=2) highlighted that learning a musical instrument provided relief from more structured classes (Item 27) although they used language such as ‘less or not academic’, ‘different talents and gifts’ and ‘experience in new areas’. At the post-test, three participants in the control group and only one in the experiment group highlighted this value and used the language ‘different to what they know’ and ‘different goals to normal classes’. Five participants (C=3, E=2) singled out that learning a musical instrument helped students participate in social events (Item 72). It should be noted that responses around social events and social skills were divided....
between Item 72 (QL) and Item 40 (NS), but all related to the social aspects of learning a musical instrument.

There were several notable differences between the comments made by each group and within each test concerning the Social-Emotional benefits. In the pre-test, four participants from the experiment group indicated that learning a musical instrument improved self-esteem (Item 17). Only one participant highlighted this in the post-test. No participants from the control group highlighted this value (Item 17) in either pre- or post-test. In the pre-test, one participant in the experiment group indicated a value that learning a musical instrument improved motor-coordination (Item 26), which increased to three participants in the post-test. Only one participant from the control group highlighted this value (Q26) in the post-test.

These results show that before the teaching intervention, both groups highlighted the development of self-esteem, relief from more structured classes and participation in social events as the more significant benefits of learning a musical instrument within the Social-Emotional statement group. Before the intervention, a small number of participants in the experiment group indicated that learning a musical instrument improved self-esteem, while no participants in the control group highlighted this belief. After the teaching intervention, three less participants from both groups highlighted the development of self-confidence value but the overall six of the group \((n=6)\) was 12\% of the entire participant group. The experiment group showed an increased belief in the improvement of motor-coordination after the teaching intervention.

### 6.8.1.3 Aesthetic Benefits

The number of responses was very small in this statement group, and there were no similarities at the pre- or post-test between the control and experiment group. However, there were some notable differences. In the pre-test, four participants from the experiment group indicated that learning a musical instrument encouraged creativity (Q70) in students. No participants from the experiment group highlighted this in the post-test, and no participants from the control group highlighted it in either test. In the post-test, four participants from the control group indicated that learning a
musical instrument developed musical potential and talents (Item 39). No participants from the control group highlighted this in the pre-test. In the pre-test, two participants in the experiment group highlighted this value (Item 39), and this decreased to one participant in the post-test.

These results show that before the teaching intervention, both groups did not share identifiable commonalities within the Aesthetic statement group. Before the intervention, four participants in the experiment group indicated that learning a musical instrument encouraged creativity, while no participants in the control group highlighted this belief. After the teaching intervention, none of the participants highlighted creativity as a benefit of learning a musical instrument but in the control group four participants believed it assisted in the development of musical potential and talents. At the end of the teaching intervention, six more participants in the control group highlighted values from this group, while five fewer participants from the experiment group focused on these values.

6.8.1.4 Neuroscience Benefits

The Neuroscience statement group returned the largest increase in responses from both the control and experiment groups. In the control group, responses increased by ten, while in the experiment group responses increased by 20. In the pre-test, the number of responses was very small in this statement group and there were no similarities at the pre-test between the control and experiment groups. However, at the post-test, seven participants (C=2, E=5) believed that learning a musical instrument improved student’s memory (Item 38). Three participants (C=1, E=2) believed that learning a musical instrument improved social skills (Item 40). Only one participant in the experiment group focused on this value in the pre-test.

The differences in the responses were noted. In the post-test, five participants from the experiment group indicated that learning a musical instrument helped students think more flexibly (Item 15). No experiment group participants highlighted this in the pre-test and only one participant from the control group highlighted this value in the post-test. In the post-test, five participants from the experiment group indicated that learning a musical instrument helped students improve brain functions (Item 29).
No experiment group participants highlighted this in the pre-test and only one participant from the control group highlighted this value in the post-test. In the post-test, two participants from the experiment group indicated that learning a musical instrument helped students excel academically (Item 31). No experiment group participants highlighted this in the pre-test and no control group participants highlighted it in either test.

These results show that before the teaching intervention, both groups did not share identifiable commonalities or believe that learning a musical instrument did not affect cognitive development. After the teaching intervention, the number of responses from the experiment group was noticeably higher than the control group and focused on the improvement of memory, social skills, brain plasticity (flexible thinking), brain function and academic achievement. It is interesting to note that although the control group were not exposed to any of the neuromusical research findings, they highlighted many of the findings in their responses.

6.8.1.5 Non-factored Benefits

The Non-Factored benefits statement group attracted the largest number of single responses to a single statement. Across the pre- and post-tests, a total of 30 responses were recorded against the statement offers opportunities for self-expression (Q19). Out of a possible 96 responses, 31% of the responses were related in some way to the value that learning a musical instrument gives students the opportunity to express themselves. In the pre-test 17 participants (C=10, E=7) believed that learning a musical instrument offers students an opportunity for self-expression (Item 19). The number of responses decreased at the post-test in both groups (C=8, E=5) but still remained high in comparison to the other responses. In the post-test, three participants (C=1, E=2) believed that learning a musical instrument cultivated use of a unique symbol system (Item 35). Only two participants in the experiment group focused on this value in the pre-test. A notable difference in this statement group was that two participants in the pre-test from the experiment group indicated that learning a musical instrument broadened student horizons (Q14). No participants highlighted this in the post-test and only one participant from the control group highlighted this value.
These results show that before the teaching intervention, both groups held a very strong belief in the opportunity for self-expression through learning a musical instrument. After the teaching intervention, this belief was highlighted comparatively less but still remained a very strong value. No other differences could be identified in the response results.

6.8.2 Summary of Value of Learning a Musical Instrument Results

In the pre-test, the participants shared some similar beliefs about the value of learning a musical instrument. These were improvements to the quality of life, self-esteem and confidence. Primarily, the participants highlighted beliefs about a musical instrument providing opportunities for self-expression. In the post-test, the focus of the responses was markedly different. The control group continued to highlight the above-mentioned areas but also added a small number of other themes, such as improvement to fine motor skills, broadening horizons and deriving satisfaction from music. Viewed as a group of comments, they were wide-ranging and often personally significant to the participant. The experiment group’s responses were very different from their pre-test with some shifting away from the Quality of Life and Social-Emotional responses and shifting more towards the Neuroscience statements. This shift is interesting as the neuromusical research findings took up no more than a total of five minutes in each tutorial (sometimes less) and the printed information sheets were not reviewed in class but handed out as participants left the room at the conclusion of the tutorial. With so little direct emphasis, it is surprising that their responses are clearly focused on these benefits of music education.

6.9 Experiences of Learning a Musical Instrument

A thematic analysis was carried out on the responses to Question 77 (What are the positive and/or negative experiences from learning a musical instrument?). Five themes emerged as positive experiences (teachers, accomplishment, social, music as an art, well-being), and two themes (teachers, practise) emerged as negative experiences. The only crossover theme was that of teachers, which is discussed first,
followed by the remaining positive themes and negative themes. Participants will be identified by a two-part code: their group (C=control group, E=experiment group) and their participant number (i.e. 42), as identified in the pre-test data entry process. As this question was only asked in the pre-test, all responses were viewed as equal and examined as a participant group ($N=48$).

6.9.1 Teachers

The participant group identified both positive and negative experiences with their teachers when responding to this question. The positive responses centred on the encouraging nature of their teachers and the stability that the consistency of their teachers brought to their music learning. Participants commented that:

My teacher was very encouraging. (E13)
[A positive was] keeping the same teacher. (E15)

The negative responses centred on a perceived lack of appropriate guidance, enthusiasm, repertoire, teacher personality and struggles with repertoire that was too difficult or did not engage the participant. Participants commented that:

I found my music teachers to be very pushy particularly considering my young age. (C44)
I started learning the clarinet at the age of 8, my teacher was not that helpful and did not teach properly. (E54)
[I was] struggling with difficult pieces [and] lack of guidance. (C53)
I was given bad feedback at a young age, so I have never wanted to pursue music again. (E43)
Some teachers changed my mind about music . . . due to lack of enthusiasm and fun. (C19)

The complexities of learning a musical instrument came through in a number of responses where positive and negative aspects were interrelated:

I didn't always like my teacher or particular songs we might have played, but I loved the feeling when I was able to play a piece I had been struggling with. (E3)
6.9.2 Accomplishment and Social Themes

Numerous participants identified the sense of accomplishment and confidence that came from learning a musical instrument as a positive:

[I] felt a strong sense of accomplishment when you were able to notice your improvement. (E13)
I got frustrated when I got something wrong in playing music [but a] great feeling of satisfaction and confidence when I got it right. (C24)
[I liked] attempting something I thought I couldn't do and succeeding at it. (E25)

This sense of accomplishment tended to be linked with social outcomes of friendship, the ability to impress peers and family and join ensembles:

[I] became friends with students I wouldn't have normally have spoke to. (C4)
[It] enabled me to participate in social events. (E49)
[I] impressed peers (relatives, fun!). (C53)
[It] enabled me to participate in bands/ groups [which was] socially satisfying. (C16)

6.9.3 Music As an Art and Themes of Well-Being

Participants identified a number of positive experiences when learning a musical instrument. These included the nature of musical learning, learning a new language that was different to other disciplines or subjects:

Music was a fun experience to learn, had many hours of fun, and it helped me to expand my general basis of knowledge. (E33)
I loved understanding a language some others didn't know. (E26)
[I enjoyed] a different way of learning. (C4)

Participants also highlighted the sense of positive well-being that learning a musical instrument provided for them:

I started learning piano six months ago and find it to be a good form of stress relief [and] enjoyable. (E38)
[It gave me a] massive confidence boost. (C37)
A chance to escape from day-to-day life. (C46)

6.9.4 Practice

The only other negative theme, along with teachers, was the demands and requirement for practising a musical instrument. Some participants highlighted how practice removed the enjoyment from learning a musical instrument:

I liked learning it to begin with, but I grew to dislike it because we had set guidelines for homework and were made to practise too often; it lost its fun. (E32)

I enjoyed learning the piano when I was younger but practising everyday when I was eight didn't seem like a great thing to do. I regret giving it up now. (C51)

Other participants highlighted the commitment and results of practice:

I didn't enjoy practising or exams, but I loved achieving new pieces. (E5)

It was very rewarding although as a child I found it had to commit to practising. (E1)

One participant focused on the difficult balance between practice and improvement:

Without consistently practising the guitar or keyboard, it was hard to make progress. (C48)

6.9.5 Summary of Experiences of Learning a Musical Instrument

This open response question was included to allow for any additional qualitative data to inform the quantitative results collected on music experience and history in Section C of the survey. There were no notable new findings from those anticipated prior to the survey. However, the results did support the tailored pedagogical approach that was employed in Study B. Participants highlighted how learning a musical instrument made them feel and how the relationships they established through music learning were pivotal to their enjoyment levels. The focus of these responses reinforces the pedagogical approach of the teaching intervention.
Participants need to feel emotional and intellectually safe, through the Rogerian approach and social constructivist model, in order to reconnect with positive experiences of music learning or confront and change their negative connections to music learning. Participants need to then build the intellectual and technical skills, as outlined in the Jeanneret (1995) model, in order to find confidence through expertise in the field of music education.

6.10 Valuable Learning During the Teaching Intervention

Within the project design framework, a thematic analysis was identified as the most appropriate method to use in the analysis of Question 78: What are the most valuable things you have learnt in the ten weeks about music education? This analysis was begun with the control group responses and resulted in four themes: musical concepts and skills, purpose of music education, general teaching skills and personal skills and capacity to teach music. The responses fell neatly and without question under these themes. The same themes were then applied to the experiment group responses. It was clear from the beginning of the analysis that the nature and style of their responses was so markedly different to those of the control group that a standard thematic analysis was not the appropriate method to analyse them. It was concluded that a combination of text analytics and content analysis would be a more appropriate methodology to use.

The purpose of text analytics is the study of text for elements such as word frequency, sentence length and structure and patterns of common concepts. The text-analytics software Leximancer was used to assist in this stage of the analysis. The survey responses to these questions were analysed using the standard settings of the software for three outcomes: themes that were present in the text, concepts that emerged commonly in the text and a map of the frequency of responses within the given themes. In addition, an analysis was conducted on the average length of response and length of sentence provided by the control and experiment groups.

The analysis of themes highlighted in a marked difference in the responses from the control and experiment groups. The control group highlighted what they had learnt
about music and music education but also about their own development and confidence to teach more generally. The main theme of the responses was ‘I can read music, use music and have the confidence to teach music’. There were six subthemes and subthemes 1, 2 and 3 were present in more than 23% of the responses, the highest being in 42% of the responses. They show an understanding of the capacity to teach music (Sub 1), that music is for everyone and not just those who show ‘talent’ (Sub 2) and the teaching intervention taught the participants about basic techniques and principles of teaching (Table 34). This result was also evident in the visual map of the themes, with many subtheme circles radiating out from the central theme.

<table>
<thead>
<tr>
<th>Subtheme</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subtheme 1: Everyone can teach music</td>
<td>42%</td>
</tr>
<tr>
<td>Subtheme 2: Music is for everyone</td>
<td>25%</td>
</tr>
<tr>
<td>Subtheme 3: I learned a lot about teaching</td>
<td>23%</td>
</tr>
<tr>
<td>Subtheme 4: Musical concepts</td>
<td>12%</td>
</tr>
<tr>
<td>Subtheme 5: Student participation in music</td>
<td>4%</td>
</tr>
<tr>
<td>Subtheme 6: Music in other subjects</td>
<td>2%</td>
</tr>
</tbody>
</table>

**Figure 35: Text Analytics of Themes for the Control Group (Question 78)**

The experiment group concentrated their responses on the impact of music education on child development, and far less on their own development as teachers. The main theme of the responses was ‘music develops the brain and social and emotional skills and has a positive impact on students’. In contrast to the control group’s main theme, this shows a focus not on their personal experience of music education but of the broader impact and importance of music education for children. As outlined in Table 35, the majority of responses focused on the main theme, with only a very small percentage adding in additional themes. This result was echoed in the visual map of the themes. In comparison to the control group map, the central theme was larger and had fewer subthemes radiating from it.
An analysis of the concepts in the text yielded a similar result to the analysis of themes (Figure 37). The control group responses focused on the teaching techniques and principles they had experienced during the intervention, with 47% of responses highlighting teaching in some way. The question included the word ‘valuable’, and it is interesting to note that this concept was included in one third of the responses. The concept of ‘self’ was also highlighted in 27% of the responses.
An analysis of the experiment group responses yielded a very different list of concepts (Figure 38). Where the control group focused on teaching, the experiment group focused on concepts of brain, education, students and development before focusing on learning. In a similar fashion to the theme analysis results, the experiment group focused on the impact of music education rather than the techniques and principles of teaching. It is interesting to note that ‘self’ was not included in the list of concepts for the experiment group.

To complete this stage of the analysis, the basic structure of the text was examined for response and sentence length. The control group appeared to have shorter
responses, but when the average number of words in the responses was compared the results were similar. The average length of responses was 23 words for the control group and 27 words for the experiment group. It was when the length of the sentences was compared that the differences became more pronounced, with the average length of sentences being nine words for the control group and 16 words for the experiment group, close to double the number of words. This final result indicated that a content analysis method could shed greater light on the differences in the responses.

Content analysis is the method of systematically examining the content of a given communication. Holsti (1969) defined the method as ‘any technique for making inferences by objectively and systematically identifying specified characteristics of messages’ (p. 14). Holsti (1969) suggested a three-step approach to content analysis: 1) make inferences about the antecedents of a communication, 2) describe and make inferences about characteristics of a communication and 3) make inferences about the effects of a communication.

In this case, the antecedent or forerunner to the communication was the teaching invention. In this teaching intervention, participants were physically, emotionally and cognitively active in musical games, activities, performances and teaching. All participants were treated as a member of an early childhood or primary class for the first five weeks of the intervention, where they developed their musical literacy and understanding of music teaching methods. In the second five weeks of the intervention, the participant and tutor switched roles, and the individual participant led the class in short and focused music learning activities with verbal and written feedback on the day of the teaching exercise. The only difference in the participants’ experiences was the distribution of information sheets on the brain and music education and verbal discussions and questions about the effects of music education on brain development. It could be deduced that with such a small difference between the groups, the themes and concepts they focused on in this communication should be similar. In terms of the amount of time dedicated to neuromusical research, the experiment group would have only discussed this aspect of music education for less than five minutes in a 90-minute tutorial, and may or may not have read the information sheets in their own time. No class time was dedicated to understanding
the information sheets. Yet it could be concluded from the marked differences in the top themes and concepts, disregarding the focus on music, that this additional information made a marked impact on the beliefs of the participants.

The characteristics of the communications were the most prominent feature of the responses. The control group responses were quite short, many participants chose to use dot points, the content was very direct, and the language did not connect ideas together. The responses focused on the functionality, the how and what, of music education. For example, typical responses from the control groups were:

- Everyone has a singing voice. Music allows for all students to participate.
- All in class activities can incorporate music. (C2)
- How to teach students through simple activities & how to extend on a basic activity (C6)

In contrast, the experiment group responses were far longer and connected concepts together. The responses focused on the philosophical underpinnings of music education, often within the broader context of a child’s education. For example:

- I have learnt about the academic reasoning behind including arts education in the curriculum and that music helps improve students’ well-being, memory and attitude towards learning in general. (E9)
- Music is more than just learning an instrument. It is a fundamental part of a well-rounded education and has increasing benefits to brain growth and self-confidence that may not be gained if not for music education. Participation in music education can benefit all other areas of social and educational life. (E34)

These responses focused on the broader educational principles that participants in the experiment group believed that music education provided. The responses focused less on their personal beliefs and feelings and more on the educational underpinnings on the discipline. It should be highlighted that these participants were also in the first semester of the first year of the four-year Bachelor degree in education. In their course experience, they had only received a preliminary overview of educational theory and none of the participants had experienced a practical teaching placement yet. The participants in the experiment group were displaying a deep and reasoned
understanding of the educational values of music education. It could be concluded that the neuromusical research findings had a significant impact on their understanding and value of educational theory, far more than the participants in the control group who displayed simplistic and mechanical understandings of the same educational theory.

The effects of this communication depend on the audience. Comparing the two groups of responses, I, as the researcher, was immediately struck by the difference in focus and depth. The experiment group displayed an understanding of the relevance of educational theory to the practice of teaching. This type of understanding is what we in teacher education expect to see as the students approach the end of the four-year degree, not at the very beginning of it. This outcome opens new opportunities for extending the critical and analytical thinking capacities of the students and graduating students to a far higher standard than with the current model of development. In my observations as a researcher, the control group responses were of a standard and quality that was expected after one semester of teacher education training.

The effect of this communication on the students was also of interest. Although the teaching intervention had no intended impact on the students’ assessment for the unit, it was observed that students in the experiment group achieved significantly higher results for the music assessment items than the control group. For these assessment items, the experiment group achieved marks within the high Credit and Distinction (70–85) range, while the control group achieved marks in the Pass and low Credit (50–69) range. All assessment items were marked and moderated by a team of markers so these marks were reflective of the standard across the student cohort of 290. Music was only 50% of the unit learning experiences and assessment, and it was observed that the experiment group participants also achieved in the same range for their Dance assessment items. The control group participants’ assessment marks remained consistent with the music assessment marks. On the whole, the experiment group participants performed at a higher academic level than the control group participants. This could have been due to participants having higher academic skills, different motivations towards achievement or more effective social interactions within the group. However, it could be concluded that the response to this single
question on the survey shows evidence of the broader effects of the intervention on the experiment group’s overall academic performance.

6.10.1 Summary of Valuable Learning During the Teaching Intervention

Until this point in the results analysis, there were only indications of the degree of change that had occurred in the control and experiment groups. Due to the nature of the quantitative survey, the quality of that change was unable to be determined. The question itself was intended to reveal any small details that the quantitative survey had been unable to obtain. Its purpose was to put ‘flesh on the bones’ of the quantitative data. However, upon reading the responses, it was clear that this question had served as a culmination of all of the learning that the participants had experienced. The preceding quantitative data had shown time and time again that a positive value change had occurred and that it had occurred more appreciably in the experiment group than in the control group. Yet the final responses were evidence that this positive change in value had also altered the experiment group’s focus. They were highlighting the broader implications of music education and the philosophical underpinnings of the discipline. Their responses were well-structured, highly analytical and showed evidence of critical thinking. In contrast, the control group’s responses were subjective, simplistic and focused on the functionality and mechanics of music education. As the two groups received the same content, learning activities, pedagogical approach and assessment items, it seemed possible that the neuromusical research findings had been a catalyst to not only significant changes in value towards music education, but marked intellectual development of the participants themselves.
This chapter will discuss the main findings of Study A, 1.1 and Study B and how these findings relate to previous studies in the field. The impact of the pedagogy and the neuromusical research findings will be analysed and explored. It is important to note at this point that statistical significance is not necessarily an indicator of educational significance (Eisner, 1998). While a number of statistically significant results were identified in Chapter 6, these results need to be considered in light of contextual factors also.

7.1 Main Findings

As a result of this they-week unit of learning, it was expected that the pre-service teachers would increase the value they held towards music education for children in primary school. This change was expected due to the use of a research-based pedagogy that was specifically tailored to the needs and context of the pre-service generalist primary teacher. The confidence in this predicted change was high, as it had been witnessed in previous cohorts of teachers, but never measure as extensively as in this study. These anticipated changes did occur and were observed as statistically significant positive change in the value that the participants held towards music education in a child’s development and education (Table 48).

In addition to this change in value, it was anticipated that exposure to neuromusical research findings would generate a larger positive change in the value held by the pre-service generalist primary teachers in the experiment group towards music education. This change was predicted due to preliminary interest shown by practising teachers in the neuromusical research findings. The confidence in this predicted change was far lower, as the neuromusical research had never been methodically introduced to this cohort of pre-service generalist teachers before. Furthermore, the introduction of scientific justifications for the value of music education was a significant departure from the generally accepted aesthetic justifications for music education used in pre-service teacher education. However, the positive changes in
value did occur in the experiment group. In the majority of measures within the research instrument, the experiment group displayed a higher change in values than the control group towards music education. An unanticipated outcome was the quality of the positive change. The experiment group focused on the broad philosophical benefits of music education to a child’s development. Conversely, the control group focused on the functional and mechanical benefits of music education that related more to their own development than that of a child’s education (Table 48).

**Table 48: Key Study Findings**

<table>
<thead>
<tr>
<th>Finding</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finding 1</td>
<td>Use of the specifically tailored teaching intervention made a positive impact on the value that the pre-service primary generalist teachers held towards music education.</td>
</tr>
<tr>
<td>Finding 2</td>
<td>The addition of the neuromusical research findings to the pedagogical approach heightened the values that the pre-service primary generalist teachers held towards music education. It also encouraged a higher level of critical thinking and philosophical justifications for music education in a child’s education.</td>
</tr>
</tbody>
</table>

**7.2 Research Questions**

The research questions that this thesis was based upon were split across two studies. This was due to the interdisciplinary nature of the field of neuroscience and music education. Study A distilled the findings from the extensive neuromusical field into those that would be of interest to music educators and had a potential impact on music pedagogy. Study B experimented with these findings to see if presenting them in an easy to understand and distil manner would have an impact on the value that pre-service generalist primary teachers assigned to music education. In all five secondary research questions, this study has revealed understandings about pre-service teacher education and the impact and place of neuromusical research in the development of these teachers. These findings have led to a positive answer to the primary research question and a large body of data that can support and explain the nature of the impact of neuromusical research on the values of pre-service generalist teachers (Table 49).
Table 49: Research Questions and Results

<table>
<thead>
<tr>
<th>Research Questions (Study A)</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Are there identifiable categories within neuromusical research focused on music?</td>
<td>Yes (Section 3.1), and they are grouped as Cognitive Abilities, Biological and Physiological Findings and Neural Development.</td>
</tr>
<tr>
<td>3. What categories and findings in recent neuromusical research have relevance for music education?</td>
<td>Yes (Section 2.7.2), and they are grouped into categories such as Memory, Language, Executive Function and Music Processing.</td>
</tr>
<tr>
<td>4. What potential impact might these findings have on music pedagogy?</td>
<td>Provisional yes (Section 3.6), but further research and collaboration needs to occur for such impact to be authentic and measureable.*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Research Questions (Study B)</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. What potential impact might these findings have on perceptions of the value of music in education?</td>
<td>The impact has been found to raise the participant’s value of music education above the pre-existing levels observed in pre-service generalist teacher (Section 6.4). In addition, participants have been observed to use higher levels of critical thinking and philosophical justifications when explaining the benefits of music education for children (Section 6.10).</td>
</tr>
<tr>
<td>6. Does a positive impact on perception of the worth of music education lead to greater inclusion of music in the primary curriculum?</td>
<td>Yes, through indicating higher levels of confidence (Section 6.7), importance (Section 6.5) and compulsory inclusion (Section 6.6) of music education in the curriculum.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Primary Question</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Do recent findings in neuromusical research have an impact on the perceptions of music education held by pre-service teachers?</td>
<td>Yes, through higher levels of agreement with value statements about music education, confidence to teach music, the relative importance of music education within the broader school curriculum, levels of responsibility to deliver music education and critical thinking and philosophical justifications for music education in a child’s education.</td>
</tr>
</tbody>
</table>

*Since completing Study A there have been further developments in the field, and I have taken small steps through scholarly publications and conferences to propose connections between neuroscience and music pedagogy.

7.3 Study A: Discussion

Study A revealed that the field of neuromusical research is well on the way to revealing aspects of music processing, creativity and musical talent that have never been understood in a scientific way before. The ability to track, in real time, the structures and functions of the brain that contribute to musical understanding is revolutionary. It should be the catalyst to a new period in the field of music education, but not without a healthy degree of caution. This field is incredibly new in research terms, and many neuroscience researchers in the field warn against the literal interpretation, over reliance or inflation of the findings. This is a prudent
warning at this time for music educators and we should step carefully into the domain, but we must step into it to guarantee the continued development and relevance of our discipline and pedagogy.

Many points of discussion were raised in Study A, some pertaining to music pedagogy and some to music education advocacy. Study A set out to discover if neuromusical research could inform, develop and challenge current theories of music pedagogy. The result was provisionally yes. The reason it was provisional was because a number of steps needed to be taken before actual teaching projects could be undertaken. The neuromusical research findings needed to be translated into the music education field from the neuroscience field. This would take expertise from individuals or teams of specialists who could straddle the two fields authentically and appropriately. At the time of writing, this is still some years from realisation but interdisciplinary institutes have been established with this end point in mind.

However, Study A did reveal a number of important areas where music educators can begin to engage concerning pedagogy. The first is the mapping of the music processing system in our brains. The music processing models by Koelsch and Siebel (2005) and Peretz et al. (2009) go a long way towards tracking the actual process that occurs in the brain. This type of understanding must influence the sequence, types of activities, types of music and teaching strategies that are currently used in music education. By influence, I do not mean to change. It may well be that these modes of music processing support and reinforce successful methodologies that have been in use for decades or centuries. However, we will not realise the full potential of these models unless music educators engage with the research field and the models. This requires effective and appropriate translation of the models into a format and language that music educators can interact with.

Another finding from the neuroscience field that may inform or influence pedagogy are the findings on musicians who utilise performance by memory regularly. There are established traditions within the instrumental pedagogy concerning the types of instrumental players who regularly perform from memory and those who do not. Typically, high-level pianists and violinists perform entire works from memory, whereas trombonists and clarinettists are rarely seen in performance without a music
stand in front of them. The neuromusical research findings point to the more
effective use of brain structures and functions of those musicians who regular
perform from memory. These findings could lead to a revisiting of these traditions in
memorisation in order to facilitate greater brain development in all musicians. There
is an obvious question as to why improvements in brain structures and functions
should matter. As a music educator, I would propose that there is great benefit in the
holistic development of the musician, not just their musical abilities, to allow them to
become both better musicians and more effective human beings.

Research findings in genetic markers for musicality should also be of great interest to
music educators in terms of their pedagogy. The ground breaking research by Pulli et
al. (2008) into the musical gene shows that every human being has the capacity or
potential to be musical and it is the experiences they have in life that activates or
suppresses that innate potential. This finding needs a great deal more investigation
and replication, but for music educators this finding should signal discussion and a
keen interest in future findings. If all humans have an innate capacity for musicality
then it is the experiences we provide through music education that activate, or
suppress, that innate potential. Therefore, adherence to a singular set vehicle for
music education, such as singing or instrumental students, or music listening, may
not activate every child’s innate musicality. Similarly adherence to a singular set
context for music learning, such as weekly instrumental lessons or a whole school
singing event, may not activate every child’s innate musicality. This research may
point to the need for variety in each child’s music education experiences, and
appropriate time in the curriculum and resources must be allocated for this variety to
be effective. In the current climate of the crowded curriculum and economic
rationalism, this seems unlikely. However, when taken with the extensive benefits of
formal music education to cognitive, emotional and physical development outlined in
Study A, this requirement may be viewed very differently.

There is a very good reason why neuroscientists became so excited about the
possibilities of using music as a stimuli and examining the brain structures and
functions of musicians over two decades ago. They could observe brain patterns they
had never seen before and observe groups that had measurable, and sometimes
significantly different, ways of processing. For a scientist designing a study, it was a
dream combination. For the most part, these studies have focused on the questions that interest neuroscientists and serve to further the field of neuroscience. Even though it is the field of music and music education that they are investigating, we have yet to pose the questions we would like to see answered. However, the research findings that do exist can serve music educators very well as points of advocacy for our discipline.

Formal music training has been found to improve skills in memory formation and retrieval, learning pathways, language acquisition and syntax, attention, moderation of emotional and cognitive selves (executive function) and specific mathematic skills. Formal music training has been found to increase brain plasticity that allows for lifelong learning and effective brain pruning that allows for more effective development and maintenance of the brain. These developments in the brain lead to better immunity levels in the body and ability to cope with physically and emotionally with conflict and discomfort. This research shows that formal music education, and possibly other forms of music education, serve to develop a well-rounded, cognitively advanced, emotionally secure and physically healthy human being. How could these research findings not be used to advocate for the value of music education and possibly challenge the current place of music education in a child’s educational development?

In this, the knowledge era, school, state and national curriculums are looking to develop global citizens who are innovative and flexible. These characteristics begin within the brain and the better equipped the student’s of tomorrow are neurologically then better they can cope and contribute with the world of tomorrow. Even to pull back slightly from this worldview, the current wave of educational accountability, often measured by standardised testing in such areas as numeracy and literacy, can only be strengthened by learning experiences that neurologically develop their students. Formal music education has been found to do just that, and while it is important to constantly qualify each statement with a warning of the preliminary nature of the researching findings, there may well be enough validated and replicated research to begin to examine if such as case for music education is reasonable.
The opportunity for advocacy based on neuromusical research findings should not supersede the current aesthetic justifications for music education but should complement and strengthen them. Within curriculum designs, music and arts education has been seen as vital in the development of concepts of respect for diversity, equity and cultural tolerance. Within the current framework of advocacy, this has been based on developing a respect for all cultures of the world through an appreciation of their music and art forms. The neuromusical research findings would not change these concepts but add to them. Neuroscientific studies have shown that participants who have developed their music processing pathways are more capable of recognising discomfort, the reasons for discomfort and how to positively process discomfort. If a student is effectively and consistently exposed to new music they develop these skills and they transfer into a larger skill set contained with executive function. Music education does encourage tolerance, diversity and equity across cultures but we now have evidence of how and why it does it on a neurological level. Such attributes will be vital in the development our global citizens and music education has been shown through experience and now science that it has the capacity to do just that.

7.3.1 Neuromusical Research in Study B

The presentation format of the neuromusical research findings in Study B, including the format, use of language, focus and integration into the curriculum, was appropriate and successful. The information sheets were distributed at the conclusion of the tutorials for participants to take away and review, and after three weeks of exposure the participants in the experiment began to make verbal connections across the categories and identified that each music activity reinforced multiple types of learning. The participants undertook independent research suggested in the information sheets in their assessment items. This became evident in the participants’ assessment items that cited studies and researchers that had been mentioned in the information sheets.

The balance of language, metaphors and pictorial prompts also appeared to be successful. The participants showed that they understood the material in both their verbal and written responses, and also began to use the carefully selected
neuroscientific nomenclature correctly in their speech and assessment items. The participants in the experiment group express that the use of metaphor and imagery was very effective.

During the teaching intervention two activities were added to the original teaching program. This was in line with the pedagogical model of teaching artistry (Rubin, 1985) that promotes taking opportunities to reinforce or clarify ideas and using digressions to enrich lessons. In Week 5, I as the facilitator had a ‘hunch’ that the participants in the experiment group did not have the neuromusical researching findings at the front of their minds. They had been bombarded by so much information, both musical and pedagogical, that the neuromusical research had taken a back seat to the more immediate needs. Week 5 was the final week of the facilitator-led part of the unit, when the participants were acutely aware that the roles would shift in the following week, and they would become the teacher/facilitator. It was at this point that I took the opportunity to digress from the planned activities in favour of reinforcing some of the research.

This digression took the form of a question–and-answer session. Participants were asked to write down one aspect of music education and the brain they found interesting, and one question they had around the same topic. I then collected the responses, typed up the questions so to remove any identifying factors, and the placed them in a small bag. In the following tutorial, we sat in a circle and passed the bag around and participants asked a random question. As facilitator, my first response to a question was not always to provide an answer but to ask the group if they could provide full or partial answers. This displayed which information sheets the participants had both read and remembered. The most commonly quoted information sheet was titled Music and Memory. This information seemed to resonate more effectively than the other topics in both experiment groups. This may have been because the effective use of memory had become a theme as the participants worked through the content heavy curriculum of the first five weeks. This question and answer session appeared to bring the focus back onto the neuromusical researching findings. A complementary exercise was completed in Week 11, where students were asked to complete the statement ‘Children should learn a musical instrument because. . . .’.
7.3.2 Value of Mapping Exercise

The mapping exercise of the neuromusical research served many purposes, including enhancing my understanding of the relevant findings in the field. Similarly, this review has afforded me the opportunity to distribute the research findings in publications and seminars using the appropriate format and language that music educators can easily understand and relate to. The neuromusical information sheets have been proven to resonate with pre-service generalist teachers and can be used in other tertiary institutions if appropriately distributed. These resources are not strictly limited to the Australian educational context as the scientific content is of interest internationally. Distribution of these research findings could allow music educators to form a basis of understanding in the field and thus, when new findings are released they have a body of research upon which to assess the meaning and significance of the findings.

7.3.3 Study A2: Definition of a Musician

It was anticipated that those participants with previous musical training would hold a higher value towards music education than those who did not. This previous training was defined by Study A1 and was based on a meta-analysis of the criteria used in 14 neuroscientific studies to define participants as musicians or non-musicians. It was hoped that by identifying these participants, a possible variable within the data might be minimised.

Two unexpected results occurred in this section of the results. First, only a very small percentage of the participants were identified as musicians. Only ten participants met the inclusionary criteria for the musician group; however, 75% of participants had learnt a musical instrument and 55% had learnt a musical instrument but did not meet the criteria for musician in this survey. This result meant that reliable statistical analysis was not possible within the data. Second, a larger than anticipated number of participants were excluded due to past professional careers as musicians or music educators. Through collecting data on the previous musical training of the participant group some interesting insights were revealed. A very large proportion of the
participants had experienced some form of musical training on an instrument, but failed to meet all of the survey criteria for a musician.

The criterion met by the highest number within the participant group was learning an instrument between the ages of four and 17 years. As a very large proportion of the participant group were in the 18–25 years age bracket, this finding is not inconsistent. The criteria that the lowest number of the participant group met were learning an instrument for more than two years. This finding reveals some interesting data regarding the Australian (only three participants within the group had been educated outside Australia) music education system. From this small sample group, it appears that instrumental music training is common but not continued for a long period of time. This was one of the fundamental factors in the neuroscientific studies to indicate changes in brain function and structure. Musical training needed to be continued beyond two years for both structural and functional brain development to be observed.

As already established by Abril and Gault (2005) and Berke and Colwell (2004), it is likely the participant group established their values around music education based on their own musical experiences. Yet through their responses in this survey, these experiences may not have included the benefits of musical training to their own brain development. This may be further reinforced by their responses to the question on positive and negative experiences of learning a musical instrument (Q77). Participants identified both inter-personal and intra-personal themes. As these students did not continue their musical training past two years, this result may indicate that the music education community could focus more on these two aspects of music learning in order to lead children to maintain their music training beyond two years, thus gaining the benefit of brain development that the neuroscience research has shown. This thesis was not focused on this aspect of music education and far more targeted research would need to be conducted to understand such a trend.
7.3.4 Future Uses for This Criteria

It became quite clear during the literature review, and then in Study A2, that the criteria that the neuromusical studies were using for a musician vary significantly. A tension with all studies is the ability to access appropriate participants in both numbers and characteristics. Similarly the studies were initiated by neuroscientists, with a view to understanding more about the brain, not by music educators who have an interest in the effects of different types of pedagogy within their discipline. This lack of standardisation around the definition of a musician made authentic comparison of the research findings difficult. It also poses problems with the use of the findings to advocate effectively and authentically for music education.

The criteria developed in Study A2 was a result of a synthesis of multiple studies and could potential be used into the future by neuromusical researchers to create a consistency across studies to further our ability to effectively compare studies from a single vantage point. Furthermore, alteration of one criterion while maintaining the others, such as learning a musical instrument for more than one year or formal music training through daily Kodaly lessons, could shed more light for both music educators and neuroscientists on the effects of different types and periods of music education.

7.4 Study B: Discussion

The teaching intervention, using a specifically tailored pedagogy, raised the values participants expressed towards music education. Regardless of any exposure to neuromusical research findings, the pedagogical approach used in Study B had a positive effect on the participants’ values towards music education. Holding a positive value towards music education as pre-service generalist teachers is a first and vital step towards ensuring that future students receive the effective and enriching music education.

While a discussion of the teaching intervention is important, and will follow this introductory section on Study B, the focus of this thesis was the impact the
neuromusical research findings would have on the perceived value of music education in pre-service generalist teachers. The impact was positive, but it was the quality of that positive impact that was surprising and could mark a step forward in the education of pre-service generalist teachers in music education.

Participants in the experiment groups experienced the same content, learning experiences and teaching strategies as the participants in the control group. The only difference was the use of neuromusical research findings to reinforce class discussions and one-page information sheets (Study A1) highlighting the very broad findings. Considering the relatively small exposure to the neuromusical research findings, the resulting effects as measured by the survey instrument were significant. Exposure to the neuromusical research findings affected the overall value they attributed to music education. Across multiple measures, the experiment group indicated a higher level of value towards music education than the control group. As the neuromusical research findings were the only variable within the experiment, it can be concluded that the scientific research had a profound effect on the value that participants ascribed to music education.

Participants in the experiment group indicated this change through a number of distinct statements. Exposure to neuromusical research findings heightened the participants’ value of music education in the development of general intelligence and enhancement of aesthetic awareness and sensitivity. The neuromusical research findings appeared to focus the experiment group participants on the cognitive capabilities that music education could develop. Furthermore, they related these directly to specific subject areas such as maths and science. Overwhelming numbers of participants highlighted the benefit of learning musical instrument as an opportunity for self-expression, but the experiment group tended to list a great number and variety of benefits than the control group. For the experiment group participants, the neuromusical research findings expanded the scope for the benefits of music education beyond the music classroom.

The teaching intervention broadened the participants’ view of the benefits of music education to learning beyond the discipline of music itself and into the holistic development of a child. This was evident in the control group’s results but far more
significant in the results from the experiment group. The control group appeared to maintain the focus they entered the teaching intervention with, which was the inter- and intra-personal benefits of music education. In contrast, exposure to the neuromusical research findings appear to have shifted the experiment group’s initial focus far more towards the broader benefits of music education within and beyond the arts classroom. The combination of the quality of life and neuroscience benefits generates stronger values towards the benefits of music education to a child’s development. The findings encouraged the participants to look at the holistic development of the student and not as a separate or discreet discipline area. This shift in focus had follow-on effects to other areas of the participants’ learning.

The teaching intervention was designed to improve the confidence levels of the participants in their ability to deliver music education activities. This was done through developing their competencies through participation and a targeted curriculum. Confidence levels across the majority of participants rose between the pre- and post-tests, but again exposure to the neuromusical research findings further improved the confidence of the experiment group participants from a notably lower starting point than the control group participants. This could be because recognition of the importance of music education led to a greater level of engagement and effort from the participants, leading to more successful and fulfilling experiences during the teaching intervention, which finally contributed to higher levels of confidence. Whatever the reason, the neuromusical research findings provided the catalyst for the participants to engage and invest themselves in their learning. With issues of engagement and limited time available to pre-service generalist teacher education in music education, the use of the neuromusical research findings in an appropriate context could heighten the effectiveness of those programs.

The neuromusical research findings appear to have influenced the experiment group participants towards the idea that more compulsory music education should be afforded to children. While both groups began the unit of learning indicating a high level of responsibility towards the delivery of music education, the neuromusical research findings tended to push the responsibility levels slightly higher in the experiment group. This was also shown in the higher level of disagreement with the concept that external specialists should come in to deliver music education. The
present model for the delivery of music education by generalist primary teachers in Australian schools is unlikely to change in the near future, but the current low amount of time allocated to the training of these teachers in teacher education degrees should be re-examined. With the cognitive, emotional and physical benefits of formal music training that Study A highlighted, the place of music education and its role in the well-rounded development of every child should be reassessed. If the benefits of music education were recognised more readily, this may change the requirements for teacher training. At present, the graduate students leave their initial teaching degree with a bare minimum of musical skills, both personally and professionally. Due to the low entry standards of these students in terms of personal music training, a new approach would be needed to raise the proficiency levels of these teachers before they entered the profession. Similarly, practising teachers would need to understand the reason and research behind the need to improve their skills in music education. Without a focus on the underlying reason for the professional development in music education, its effectiveness would be minimal.

Finally, the nature of the positive impact of the neuromusical research findings on the experiment group participants was the most surprising and pleasing results of Study B. The results from the final question in the survey lifted the results to a new level. Exposure to the neuromusical research findings appears to have triggered an entirely new and unexpected view of music education. The experiment group participants focused not on the functionality of how to teach music, but on the broader implications of music education and the philosophical underpinnings of the discipline. Their responses were well structured, highly analytical and showed evidence of critical thinking. In contrast, the control groups responses were subjective, simplistic and focused on the functionality and mechanics of music education. As the two groups received the same content, learning activities, pedagogical approach and assessment items, it seemed possible that the neuromusical research findings had been a catalyst to not only significant changes in value towards music education, but marked intellectual development of the participants themselves. This has important implications for the quality of teacher education degrees and the graduates they produce. If a first-year unit of learning of a four-year degree can provoke this level of academic thinking and philosophical
thought, then the subsequently units of learning can set higher expectations and produce graduates of a higher quality.

7.4.1 Study B: Discussion of the Teaching Intervention

It is clear from Finding 1 that the specifically tailored pedagogy that was implemented during the teaching intervention has had a positive impact on the participants. While this thesis set out to determine the direct effects that the presentation of scientific findings would have on the value that participants placed on music education, it is very clear that regardless of this presentation the pedagogy I used had an overall positive effect. Many of the measures of the data were based on means and therefore it should be acknowledged that the pedagogical approach will not have been effective for all participants. However, the statistically significant rises in the majority of mean measurements within the data indicate that a notable positive change occurred for most participants.

The pedagogical approach was a combination of different theories and philosophies, and therefore it is important to discuss why the approach had a positive impact on the participants. It is useful to frame this discussion around the trajectory of the participants’ intellectual, emotional and physical development across the ten-week unit of learning. This will outline where the various theories and philosophies intersected (Figure 39) to support the participants to become architects of their own experience and learning (Eisner, 2002a).
7.4.5 Relevance of Findings

Such a significant change is encouraging, as past research has found that pre-service teacher’s attitudes towards music education are highly resistant to change (Anderson & Piazza, 1996; Kagan, 1992b) and after a similar 12-week course in the US, were found to value and appreciate music less than when they started (Gifford, 1993). These attitudes are established through their own music education experiences (Abril & Gault, 2005; Berke & Colwell, 2004) and the attitudes expressed by their former teachers (Abril & Gault, 2005). This was mirrored in the participants in this study who cited both these influences in the initial session. In particular, the significant change in the level of importance the participants placed on music education shows an important improvement from past research. In this study, participants had a mean ranking of 58% for music education amongst 15 curricular subjects, whereas in a study by Krehbiel (1990) practising elementary teachers in Illinois ranked arts education at the very bottom of a list of eight curricular subjects (12%).

In the Australian educational context, generalist primary teachers are expected to be capable of taking responsibility for the planning and delivery of music education to their students. However, numerous studies have shown that these teachers often feel uncomfortable and accept less responsibility for teaching music (Byo, 1999; Giles & Frego, 2004; Koops, 2008; Wiggins & Wiggins, 2008). This situation can lead to poor educational outcomes for their students in music education. It was anticipated
that a combination of a tailored pedagogy and the neuromusical research findings would increase the participants’ comfort levels and sense of responsibility for the delivery of the music education curriculum.

The level of agreement did increase after the teaching intervention and the percentage levels of agreement were far higher than those found in similar, previous studies. In the study for this thesis, 90% of participants believed they should be capable of teaching music, which was an increase of ten per cent from the pre-test. In Hash’s (2010) study, only 32% of pre-service generalist elementary teachers indicated agreement with this statement in a single survey, rather than pre- and post-test format. The significant difference in these findings could be explained by the difference in educational contexts. The Hash survey was conducted in the US where generalist elementary teachers are not expected to deliver music education in their professional roles. The study in this thesis was based in Australia where, although music specialists exist, it is widely expected that generalist primary teachers are capable of delivering music education to their students. This may also point to a high level of motivation to learn present in this studies participants, as they have a direct expectation that they will use the skills and knowledge learnt during the teaching intervention.

The delivery of music education by a specially trained teacher was found to be similar to comparable studies, which found that 77% (Berke & Colwell, 2004) or 79% (Colwell, 2008) of pre-service generalists primary/elementary teachers accepted responsibility for delivery of the music curriculum in the absence of a music specialist. In the study in this thesis, 75% of participants indicated a similar belief. Again this was across two different educational contexts.

The level of importance of music amongst the other arts disciplines was not measured as part of this survey, only the level of confidence the participants had before and after the teaching intervention. This omission makes complete comparisons with previous studies difficult, but this study found that the level of confidence increased by at least one ranking across the participant group. However, confidence in teaching music was still ranked between second and third place across the four arts disciplines (Table 44). This is a comparable result with the findings in
Krehbiel’s (1990) study where the participants felt more comfortable teaching visual art and drama compared to music and dance. The current data from Study B did not determine which arts disciplines were ranked above music but this could serve as an interesting comparison for future development.

As far back as the late 1980s, the topic of effective pre-service generalist education in music has been examined in a number of studies (Austin, 2000; Price & Burnsed, 1989; Walker, 2000). This focus was due to consistently low student satisfaction ratings evident in a number of US music fundamentals and music methods courses. These courses served the same purpose as the unit of learning that this thesis is based upon, to prepare pre-service primary generalist teachers to deliver the music education component of the curriculum. These low ratings were attributed to a mismatch between the content and skills the pre-service teachers learnt in the tertiary course and the activities they were expected to lead or contribute to when they entered the classroom environment (Price & Burnsed, 1989; Saunders & Baker, 1991). Tertiary lecturers were concentrating on music theory and developing skills on a musical instrument while pre-service teachers wanted experiences in singing, listening, movement and integration (Bryson, 1983; Stroud, 1981). This mismatch was seen to be leading to not only low student satisfaction results but to teachers who were ill-prepared to deliver quality music education to their students. They possessed neither the necessary musical skills nor the confidence to deliver effective music education. This mismatch was evident when I first began teaching at my current tertiary institution where the previous lecturer had allocated all of the class time to learning beginner guitar and keyboard.

The curriculum and teaching intervention implemented, as part of this thesis, followed some findings outlined in the research literature in this period. Austin (2000) suggested that lecturers:

- must make a more concerted effort to either debunk students’ erroneous perceptions about their abilities or create legitimate success experiences (via quality instruction and the selection of appropriately difficult tasks) that will lead to enhanced ability beliefs. (p. 8)
I would alter Austin’s (2000) recommendation slightly and replace the word *either* with *both*. Any approach that includes only one of these aspects will inevitably fail in light of Gardner’s (2004) *Changing Minds* model. It is only with the emotional *and* the logical brains, the self-perceptions and the physical experience of success, that students will permanently alter their values towards music education.

In the same paper, Austin (2000) recommended that the message conveyed by the teacher to the students needed to shift:

Realistic teacher feedback that conveys to students ‘You have a lot of skill in this area, but need to improve your skills in these other areas’ promotes stronger motivation than matter-of-fact expressions or more subtle cues that imply ‘You either got it or you don’t’. (p. 8)

The curriculum and pedagogy employed in this thesis focused squarely on developing a therapeutic relationship between facilitator and students that included honesty through realistic feedback. This approach in isolation had the potential to be positive and negative for the students. Therefore, this honesty was coupled with musical successful experiences in the first five weeks of the unit of learning. These experiences challenged any pre-existing ideas that people were innately musical. This was evidenced in the open response comments from participants in the control group who focused on the development of their own musical abilities, where they previously believed they had none (Section 6.10). Again, the emotional and logical brains were catered for equally to ensure persistent and significantly positive changing in the values they held towards music education.

Berke and Colwell (2004) make some notable points from the implications of their study that are applicable to the broader issues in the pre-service teacher education context. In both US and Australian tertiary education systems, the amount of time afforded to music education for pre-service generalists has been reduced substantially in recent years. This fact, coupled with a lower entry level of basic music skills, has caused tertiary educators to reassess what is possible and expected for these pre-service teachers to learn in the limited time available. Berke and Colwell (2004) make the point that a paradigm shift needs to occur. The limited time does not allow for the development of advanced music skills in the pre-service
teachers, rather than units of learning should be focusing on developing a sense of advocacy for music education in pre-service teachers. They suggest that this advocacy could lead to the pre-service teachers’ recognition of the need to develop their own musical skills further and to seek advice from specialist music teachers on the design and delivery of musical activities. In this thesis, the study revealed a heightened level of confidence in teaching music for the participant group but the heightened level of value, confidence and importance expressed by the experiment group may mean that exposure to neuromusical research findings could add to this paradigm shift towards advocacy in pre-service primary generalist education.

The curriculum and pedagogy implemented in this thesis was similar in some ways to the 15-week course evaluated by Siebenaler (2006), which included basic music literacy, vocal pedagogy for children, song-leading techniques, selection of age-appropriate songs, movement lessons, incorporation of classroom instruments, singing games, listening lessons, and cross-curriculum connections. This study found that pre-service teachers’ confidence and music skills rose due to the tailored teaching instruction and that they felt far more confident in delivering music lessons. Unfortunately the exact division of the curriculum into facilitator led activities and student-led teaching experiences was not reported. However, it is interesting to note that this type of approach was effective in positive altering values and confidence towards music education. This course was implemented over 37.5 hours of class contact whereas the study in this thesis had only 15 hours class contact, and still made a significant positive change to the participants’ values, confidence and skills in music education. This type of model, combining musical literacy and musical skills with teaching experiences, has been shown to be effective in the way it changes the values and confidence that pre-service teachers hold towards music education. The development and refinement of this type of model in this thesis has shown that similar results can be achieved in a significantly less number of class contact hours. If the pre-service generalist teachers can reach a higher level of confidence and musical skill in a short period of time, then the remain class contact hours can be dedicated to achieving far higher levels of musicality and music education training than previously considered possible.
7.4.6 Study B: Discussion of the Impact of the Neuromusical Research

As mentioned in the main findings section of this chapter (Section 7.1), the type and degree of impact that the neuromusical research findings might have on the values that the pre-service generalist teachers held towards music education was unknown. This was for a number of reasons: the neuromusical research findings were still predominantly reported in scientific peer-reviewed journals, the findings had not been summarised in categories that non-scientists would be able to engage with and the findings were reported in highly scientific language that was unfamiliar to educators and pre-service educators. Before the impact of the neuromusical research findings could be measured on a group of pre-service generalist teachers, a great deal of research had to be done to distil and fashion the research findings into a language and format that pre-service generalists teachers could engage with.

This was the role of Study A, to identify, understand, categorise, distil and format the neuromusical findings into a medium that undergraduate, non-scientific educators could connect with. Although this work was aimed at a specific group of research participants the resource now exists for both practising and pre-service educators, whether they are generalist or specialist educators, educational leaders or policy makers, to engage with in a multitude of ways. Not only is this resource a written resource yet Study A has enabled me to develop as a source of information and understanding for the broader education profession. In their written form, these findings are very simplistic and only provide an introduction to the findings. In order to appropriately understand and then use these findings, there must be clarification, discussion and education in the field of neuroscience. There is an ever-present danger that these findings could be used in isolation and repeat the damage that was done to the purpose and value of music education by ideas such as the Mozart Effect. In saying this, the concept of music education enhancing general cognitive, emotional and physical abilities could be built upon using a more informed and targeted approach. This approach needs to come not from a small number of educationalists and researchers but from all music and general educators, who need to be brought up to speed on the new findings in this field.
In terms of the parameters of Study B, the impact of the neuromusical research findings on the pre-service generalist teachers was unexpectedly positive. During the teaching intervention the neuromusical information sheets appeared to be pitched correctly at the interests, established knowledge and learning capacity of the pre-service teachers. The categories used for the neuromusical research findings, both through the information sheets and verbal discussions, seemed to connected effectively with the learning experiences contained in the curriculum. The frequency and volume of the information also appeared to engage the pre-service teachers without overloading them. The neuromusical research findings appeared to accelerate and enrich the trajectory of learning for the experiment group who took greater intellectual and personal risks in their teaching activities. In the assessment items for the unit of learning, which were not attached in any way to the outcomes of Study B, the neuromusical research findings provided the students with a larger pool of research upon which to base their advocacy statements. However, one of the most interesting and unexpected results was the generally higher level of academic achievement that students in the experiment group achieved multiple assessment items in both Music and Dance (the second arts discipline taught within the unit of learning). Another notable unexpected result was the tendency for the experiment group participants to focus on the broader philosophical concepts around music and arts education, which showed a marked difference from the control group whose focus was far more personal and functional or practice-based.

The results from Study B showed that the specifically tailored pedagogy had a positive effect on the values that the pre-service generalists teachers held towards music education, and that the neuromusical research findings appeared to enhance those values in the experiment group participants. This did not occur in all measures but in a majority of measures this was the result. It is interesting to examine the specific results where this did occur and to look more globally at the positive change in the participants’ values towards music education.

The difference in experience between the control and experiment group was actually minimal. The classes experienced the same learning sequence, learning activities, assessment items and content. The only difference was the inclusion of the neuromusical research findings in two ways: printed research literature in the form of
information sheets and verbal reference and short discussions around those researching findings during the tutorials. No more than five minutes in each 90-minute tutorial was allocated to the neuromusical research. That equated to just over 5% of their contact class time. However, the inclusion of the research within the pedagogical approach and curriculum structure created greater resonance for the students around the value of music education (Figure 40).

![Figure 40: Impact of Neuromusical Research Findings on Gardner's (2004) Changing Minds Model](image)

### 7.4.6.1 Connecting Importance With Confidence

The resultant amplified or heightened resonance may have occurred for a number of reasons. The first is the connection between the perceived importance of music education and the level of effort invested by the pre-service generalists teachers into developing their skills and knowledge in music education. Put simply, developing your skills in music education will benefit all of your teaching skills, therefore investing time and energy into this unit of learning will directly benefit you in the future.
Two ‘selling points’ were used at the beginning of the teaching intervention to connect the neuromusical research findings with the importance of mastering music education as a generalist teacher. The first was based on the premise that:

Effective, structured and consistent music education has the capacity to improve your student’s cognitive, physical and emotional capacities and that this improvement can help make your student’s development quicker and easier. This is turn makes your role as a teacher easier. You have happy and engaged students, they are willing to try new thing and have a thrust for knowledge.

This approach raises the level of investment the students are willing to make in the unit of learning as one of their chief concerns entering into an education degree is: ‘Will I be able to control my class?’ This approach gives meaning to their learning, taps into their altruistic concepts on education and is all backed up by science. This final point is important, as the belief in scientific findings and methods has been an important pillar in our development of knowledge over centuries. However, to maintain the integrity of the neuromusical research the information sheets included directions to specific and well respected research in the field, and students are encouraged to follow those directions and investigate further for themselves.

Once the personal importance of music education, or at the very least a heightened engagement in the unit of learning, is established students are more willing to invest energy and time into the activities and homework related to the unit of learning. This heightened investment leads to the willingness to take further intellectual and emotional risk in class activities. This then leads to deeper levels of learning and finally to greater levels of confidence in their own abilities, both musically and as a general teacher.

The results from the survey mirror this process. The experiment group ranked music education lower in importance than the control group at the pre-test; however, at the post-test the experiment groups ranked music education close to three ranks higher, while the control groups rankings on when up by close to one (Table 38). The raised level of importance led to a similarly raised level of confidence with the experiment group lifting in confidence by comfortable over five rankings while the control group
only achieved just over four rankings (Table 41). This focus on importance impacted on the focus of the experiment group participants on the broader philosophical values of music education that could be seen in their concluding comments in the survey (Section 6.10).

7.4.6.2 Connecting Confidence with Skills

As the students in the experiment group invested more of their energy and time into the unit of learning they came to view the development of musical skills differently. The neuromusical research findings directly connected the skills in reading, writing and creating music with development across the brain. Suddenly music reading is not a series of shapes, dots and lines but a language. Developing proficiency in the musical language in turn develops other language skills. Students gain more confidence in their musical competencies (Jeanneret, 1997) and this heightens the resonance they experience in the unit of learning. Again, an additional resonance is created when the development of musical skills is connected with the nationwide numeracy and literacy testing (known as NAPLAN in Australia). The pre-service generalists teachers know that they will be required to prepare their students for NAPLAN testing. The test results directly connect with whole school evaluations and scoring (via the website myschool.edu.au in Australia) which is made public. Therefore, NAPLAN testing is of significant concern to the pre-service teachers. Highlighting the capability of sequenced, continuous and high quality music education to improve brain functions and structures that assist with numeracy and literacy understanding can add to the importance they assign to their learning in the unit (Table 29 and Table 30).

7.4.6.3 Connecting Skills With Purpose

Even though only five per cent of the tutorial time was spent on the neuromusical researching findings, they obviously were at the forefront of the participants mind when they completed the post-test. This can be seen in the significant difference in the responses when asked about the value of learning a musical instrument. The majority of the experiment group responses carried themes found in the Neuroscience statement group. The number of responses highlighting these themes
was up by 766% from the pre-test. The control group’s responses were only up by
333% (Section 6.8.1). While these are very large numbers, this result shows that the
教学 intervention highlighted the broader learning benefits of music education to
the entire participant group. However, the written material and the verbal discussions,
although not lengthy, caused an increase in the resonance for the experiment group.
Skills in music and teaching music create a dual purpose for students; they can gain
both the aesthetic and neuroscientific benefits of music education. This may also be
connected to the increased level of compulsory music education that the experiment
group indicated in the post-test.

7.4.6.4 Development Through Music Education

An unexpected result from Study B was the raised level of value that the control
group placed on statements in the Neuroscience group. It was anticipated that since
the control group were not exposed to the neuromusical research findings, and
therefore their values in this area would not change. Interesting, this group had a
positive gain on many of the Neuroscience statements, but could be described as
modest in comparison to the significant gains made by the experiment group.
However, this points to some interesting outcomes for the study. Although the
scientific justification for these types of benefits was not shared with the control
group, the results showed that they applied the benefits of music education across
many of the Neuroscience statements. This may have been because due to my
knowledge or focus as the tutor on the broader benefits of music education or
through personal connection they made during the unit of learning. It is interesting to
note that these areas of develop, such as skills in science, maths and reading, had a
moderate effect on the control groups values towards music education, without the
connection to scientific brain studies.

7.4.6.5 Delivery of Music Education

Responsibility and capacity to deliver music education was not altered significantly
by the neuromusical researching findings. This may have been because the pre-test
results were already very high and had little room to move upwards. However, even
this result is interesting for the experiment group. There was a possibility that with

exposure to neuromusical research findings, the experiment group may see the incredible importance of music education and feel that their skills and knowledge were too low to teach music effectively. This may have led to a very different result at the post-test with participants indicating that they believed that specialist external teachers should deliver music education. While they did indicate that teachers specifically trained in the field should deliver music education they did not rule themselves out of that role (0). This could reflect that they believed they were capable at the end of the teaching intervention to teach music to their students, or that they were open to seeking additional support or training in order to do so.

7.4.7 A Model for Pre-Service Generalist Teacher Education in Music

The results of Study B point to two interlinked findings. The specifically tailored pedagogical approach that was employed in this study resulted in participants displaying a higher level of value, confidence and responsibility towards music education for their future students. In addition to this improvement, exposure to and understanding of the neuromusical research findings directly related to music education heightened or amplified these levels of value, confidence and responsibility. Furthermore, the addition of the neuromusical research findings into the curriculum resulted in a higher quality of critical thinking and philosophical justifications for music education by the participants. Importantly, in the current climate in the tertiary education sector of economic rationalism that had led to shrinking contact hours and increased pressure to favour blended or online learning models, these changes all occurred over a maximum of 15 hours of class contract.

The neuromusical researching findings altered the internal motivations of the participants towards engaging in the unit of learning. The recognition of the capacity of music education to improve the cognitive, emotional and physical abilities of their students, and consequently make their role as teachers easier and more enriching, changed how they approached the unit of learning. They could see the personal and professional benefits in learning as much as they could in the 10-week unit of learning. This insight made them more willing to invest more energy and time into the unit of learning than they otherwise would have. This helped raised their confidence levels, as they were willing to take more risks, set higher personal
expectations and utilise feedback immediately and effectively. The combination of these internal motivations and practical experiences caused a resonance within the participants, catering to their emotional and logical minds, and in turn making the positive change in their values, confidence and responsibility effortless. Instead of adhering to the 50/50 rule of effort and reward, this model created the 80/20 ratio that Gardner (2004) indicated was essential for changing a person’s mind. In Study B, the pedagogical model alone was effective to a point, but the neuromusical research findings amplified that effect.
Figure 41 - Model for Music Curriculum for Pre-Service Generalist Teachers (Post-Study B)
A combination of the neuroscience and aesthetic research into the benefits of music education catered to the research and reason aspects of Gardner’s (2004) *Changing Minds* model (Figure 41). This provided the participants with logical and trustworthy material upon which to base a re-examination of the views they held towards music education. The specifically tailored pedagogy and curriculum model that set the participants on a trajectory of learning from dependent to independent learner further enhanced this process. From this beginning this created resonance for the participants, making them both safe to examine their own belief skills and confidence in teaching music to their future students.

The use of reward, redescription and real world events strengthen this process and amplified the resonance the participants experienced. Once they began to move through the independent stages of learning, both their logical and emotional minds had been catered for and further resonance was created. As they completed the teaching intervention they had a sense of their own abilities in the area of music education. These included practical skills and confidence in their own abilities as well as recognition of their own developmental needs in this area of their profession. They begin their teacher education with the ability to think critically and philosophically about the place and purpose of music education in their student’s education.

The results of Study B mark a step forward in the education of pre-service teachers in the field of music education. Much of the research in this field has focused on the development of confidence as this was seen as the first stumbling block in the effective education of the pre-service generalist teachers. While this is still the first stumbling block when beginning to educate these students in music education, it may be timely to look more broadly at what these students need to become effective music educators. While the pedagogy used to educate these students is vital, this study has shown that a somewhat removed field of research, has been shown to have a positive effect on the values, confidence and responsibility that pre-service generalist teachers hold towards music education. Ultimately, this development has the capacity to change the quality and quantity of music education that is delivered by generalist teachers. The greater number of generalist teachers who recognise the importance of music education, to a degree that they maintain and develop their own
musical teaching skills, the greater number of student who receive quality music education as a consistent component of their education.

7.5 Limitations of the Study

Study B was undertaken within a specific educational context. While the training of pre-service generalists teachers in music education is a common component of tertiary undergraduate teaching degrees, the hours and resources allocated to the training, the expected levels of skill and musical knowledge exhibited by the students at the conclusion of the unit and the roles and responsibilities of practising teachers towards music education are all different. Additionally, the level of music education, both formal and informal, that the student’s enter the degree with can be different. This difference has a significant effect on the focus on the unit and how far the students can develop their musical skills in relation to their initial level of expertise. Therefore, some aspects of Study B are limited by the context within which it was carried out. However, some areas of the study are not affected by this context and could be applied in similar but not identical education contexts.

Any interpretation of the results obtained in this study must be undertaken with caution for a number of reasons. The first issue is the smaller than anticipated number of paired surveys. It was expected that over 80 paired surveys would be able to be included in the statistical analysis, but due to larger than anticipated shifts in student numbers and a greater number of excludes participants, the number of paired surveys was far lower than predicted. Statistically, when the data sets where divided into control and experiment group the lower number of paired surveys weakened the statistical analysis. However, the large amount of data was a rich source of descriptive information. The relatively even numbers across the control and experiment group allowed for strong comparisons in most areas and when the results from the participant group as a whole group were examined, the level of confidence in the statistical validity of the findings was high.

Within the survey instrument the section examining the Value of Music Education (Section D) contain two potential weaknesses. Three of the statement groups from
the Austin/Reinhart (1994; 1996) surveys contained nine statements, with one statement group containing only five statements. The statement group that was added to the survey, based on the neuromusical research findings, contained 19 statements. This imbalance between the groups may have cause greater emphasis to be placed on the Neuroscience statement group. However, it has been determined that this potential weakness had little effect on the overall findings of the study. The second potential weakness was in the slightly difference use of the statements from the Austin/Reinhart surveys. In their original form, the statements were divided in advocacy and validity statements within the larger themed statement groups. This was done to determine the different levels of advocacy and/or validity that participants held towards music education within different themed areas. This measure would not have benefited the focus questions of this thesis, and therefore the questions were not divided into advocacy or validity statements.

Although there was a richness of quantitative data as a result of Study B, some of the richest and most informative results came from the very small group of qualitative questions. The greater focus on quantitative results means that the findings could be misinterpreted without equal amounts of quantitative data to compare the findings.

Possibly the most significant impact that may have affected the results of this study was my desire to prove the hypothesis which may have affected my teaching. It should be acknowledged that as I was the sole tutor involved in this study, I could have invested greater levels of energy and expectation in the experiment groups in order to create a positive outcome. This possibility was identified during the design process and several procedures were implemented to minimise this issue. The first was the creation of detailed lesson plans that I aligned across both the control and experiment groups. This level of planning allowed for a minimal amount of variation. The inclusion of the neuromusical researching findings was scheduled into the existing lesson plans, rather than used to dictate entirely different learning experiences. Other tutors in the unit marked the participants’ assessment items in order to maintain consistency and minimise favouritism. Finally, participants’ feedback from the control group on my performance as a tutor was observed to monitor for impartiality.
Chapter 8: Conclusions and Implications

This chapter examines the implications of the findings of the thesis in its entirety. It also highlights the conclusions that arise from this thesis and the possible future directions for research in this field.

8.1 Implications of Findings

Music education has been considered an essential part of any education curriculum that seeks to produce well-rounded, independent and intelligent human being for centuries. This view can be traced back to Confucius (551 B.C.)—‘to educate somebody you should start from poems, emphasis on ceremonies, and finish with music’ (Yue, 2008, p. 128)—and Pythagoras (6th century B.C.), who believed that ‘music contributed greatly to health, if it was used in an appropriate manner’ (Rkudhyar, 1982, p. 162). An enormous amount of research since Confucius and Pythagoras (Colwell, 1997; Gardner, 1983; Hallam, 2001; Reimer, 1989a) has validated their belief in the benefits of music education and its place as an essential part of the broader curriculum.

In Australia at this time, this view of music education still holds true. It is an essential part of the broader curriculum and still included explicitly in the most recent draft of the Shape of the Australian Curriculum: The Arts (July 2012). However, inclusion does not necessarily lead directly to quality. As the name of the curriculum document suggests, Music as an arts discipline is regarded as a member of the group of five arts subjects: Dance, Drama, Media, Music and Visual Arts. In the new Australian curriculum, these areas are grouped together because of similarities in the perceptions of their outcomes and purpose. This is not a new development as the arts has been a key learning area across Australian curriculums for decades. I have no problem with the concept that the types of aesthetic learning in these disciplines can be similar. However, this idea of similarity can be misinterpreted and evolve into the idea that the five arts disciplines are not worthy of attention in their own right. Put another way, music and visual art teach the same
concepts in aesthetic discernment; therefore, we can choose either discipline to achieve the same outcomes. The current resources within the school, and interested, confident and/or capable current staff members may also influence this choice.

I will agree that this is a somewhat extreme example, but there are many factors that could easily lead to this type of response. The first is the current state of music education in Australia. In the NRSME report commissioned by Australia’s Department of Education, Science and Training in 2005, it was found that although some excellent programs did exist, ‘many Australian students miss out on effective music education because of the lack of equity of access; lack of quality of provision; and, the poor status of music in many schools’ (Pascoe et al., 2005, p. v). In many Australian schools, music education is already under-resourced in both equipment and trained teachers, but the final point is the most significant one in relation to this thesis. Even if the balance could be redressed and the resources, both material and human, were provided to all schools across the country, the poor status of the discipline itself would still stop those resources being used effectively. This may be because ‘for years the arts were justified mainly from the aesthetic and utilitarian perspectives’ (Pascoe et al., 2005, p. 8), and in these times of economic restraint and the crowded curriculum, those justifications are not enough to maintain the value of music education against other subject areas and pressures.

This thesis has shown that neuromusical research findings, in conjunction with aesthetic justifications, can raise the status of music education in the minds of pre-service generalist teachers. These teachers will soon be practising generalist teachers and in a position to make decisions on the level and type of music education in their own classrooms and curriculums. They have also indicated a high level of personal responsibility for the delivery of music education. It is feasible that the neuromusical research findings used in this thesis could begin to remedy the current poor status of music education and give practising teachers a reason to reassess the value they prescribe to it. This may be especially pertinent with the research findings that indicate that formal music training improves skills in maths, language acquisition and reading. With national numeracy and literacy testing results rapidly becoming important measurements for educational quality within Australia, the purpose and place of music education could shift. Although the value of music education has been
anecdotally recognised for some time, expressing these scientific findings in an understandable manner to policy makers, teachers and teacher educators could radically alter the perception of music education in a broader curriculum setting. The neuromusical research findings could support the re-evaluation of the value of music education to the broader development of the learner and thus shift it from an equal member of the arts learning area to a stand-alone area. Current research into the capacity of arts disciplines other than music to affect brain development has shown they have fewer positive effects, but this may be simply because formal music training has been researched more thoroughly than other arts disciplines to this point.

This final point may debunk the concept of interchangeable arts disciplines, at least for music. Neuroscience research has found that formal music training has positive functional and structural effects on multiple areas of the brain. It is the nature of the activity itself that leads to this development. As defined by neuroscientific studies, formal music training in the form of learning a musical instrument develops the motor and auditory cortex simultaneously and activates and trains areas of the brain that store memories, regulate emotions and logical thinking and develop language. The discipline of learning a musical instrument enhances the ability to focus, discern and learn in a fast and flexible way. These are just a few of the specific benefits of that come from formal music training, not from any other singular arts discipline. Therefore, the neuroscience research findings tell us that music education is not interchangeable with another arts discipline, but are specific and unique. With this knowledge in mind, how then might a curriculum be structured, interpreted and delivered?

8.1.1 Implications for Policy Makers and Educational Leaders

There is enough research into the positive effects of formal music training to begin to question the current paradigms around music education. The research shows that music education in the form of learning a musical instrument can develop a child’s brain functions and structures more effectively than any other single activity that has been researched at this time. This brings into question whether music education should continue to be viewed as a discipline within the arts learning area with similar allocations of time and resources. With this type of paradigm shift would come the
need to rebalance the curriculum. Furthermore, the type of music education delivered to the students would need to be examined. Neuromusical research to date is largely based on formal music training in the form of instrumental music. Should such a paradigm shift be centred on the provision for instrumental music tuition alone, and what does this mean for the Kodaly/Orff-focused approach that is implemented in Australian primary schools at present? This research may lead to a cascade of paradigm shifts that bring into question the current methodologies and philosophies of music education that our educational systems are based upon. Conversely, this may be an indication that the neuromusical field has not provided policy makers with enough balanced research examining multiple music education methodologies, upon which to make such types of policy decisions.

A paradigm shift of this magnitude has implications in many areas of education. In the raising and shifting of the status of music education, practising teachers will need to participate in professional development around the neuromusical research findings as well as their own skills in music education. This seems a simple and straightforward implication, but changing minds takes time and needs a catalyst. While professional development is a requirement within the teaching profession, it has been my experience that when professional development in music education is offered in competition with professional development around literacy and numeracy, the majority of practising teachers will opt for the latter. I would propose that this is due to the external pressures of NAPLAN results as well as the individual teacher’s binary thought process that ‘if I have more professional development in the area I will be better at teaching it’. This means that professional development in music education needs to be a requirement, not an addition. This in itself is a paradigm shift, as music education needs to be seen as a necessity for all teachers and students, not an add-on for those who are interested or show ‘talent’ in the area.

8.1.2 Implications for Practising Teachers

Any new research area or a new approach to education poses a challenge. This study has revealed a number of research findings that should be disseminated to a myriad of sub-groups of practising teachers. There is also the added challenge of conveying research findings in a scientific area to participants in the educational field. Just as
with pre-service generalist teachers, there needs to be an incentive to engage with the material and the material needs to be presented in such a way that it is easy to engage with.

The far-transfer effects of formal music training would primarily engage generalist primary teachers and non-Music secondary teachers. The near-transfer effects would interest primary and secondary Music educators first, but the broader research findings could be support advocacy statements to school leaders, boards and parents. The tailored pedagogy and neuromusical research findings on the values of pre-service teachers would interest tertiary educators. All of the findings would interest instrumental music educators, as it pertains directly to their professional field. The challenge is to cater to different primary interests and knowledge bases effectively.

8.1.3 Implications for Pre-Service Generalist Teachers, Specialist Teachers and Teacher Educators

This thesis has brought together two different fields—neuroscience and music education—to create a positive change in pre-service generalist teachers’ values. The values that students hold towards different discipline areas in their pre-service training is often carried into their professional practice (Brand, 1982; Krueger, 1985; Pajares, 1992). Therefore, pre-service teacher training is an opportunity to effect considerable change on the status of music education in the school environment. Study B has shown that the integration of neuromusical research findings into a pre-service generalist unit of learning amplified the value that the students placed on music education. Of course it remains to be seen if that positive change will continue through the students’ pre-service and training and into their professional practice, but it is a move in the right direction for the status of music education.

Therefore, the neuromusical research findings into formal music training should be included with equal weight in music education courses for pre-service teachers, both generalists and specialist music teachers. This requires the findings to be available in a format that is accessible for pre-service teachers and included in readings lists and for students to engage with the research through class discussions and even assessment items.
This implication has ramifications for teacher educators in several ways. They need to engage with and understand the neuromusical research findings for themselves, but more importantly they need to give the research credence and accept it as an additional field that can inform their teaching. There are still many sceptics of this research field and the academic world is justifiably wary of the neuroscience field. After the particular brand of focus that the Mozart Effect brought to the field of music education, music education academics have every right to question the validity of the neuromusical findings examined in this thesis and tread cautiously when using scientific justifications. However, the neuroscience field may have advanced sufficiently over the past decade to inspire renewed confidence and interest in the findings for music academics and teacher educators. I believe this field should be followed with deliberate interest and cautious optimism by the tertiary sector, as it has the potential to affect the very basis upon which we understand and teach music.

8.2 Future Directions

8.2.1 Following the Neuromusical Research

The field of neuromusical research is expanding rapidly and new findings are being released daily. As these findings may reinforce or debunk the findings of Study A, maintaining currency is of vital importance. This will serve to strengthen the validity of neuromusical research findings within the field of music education. It may also reveal important insights about the way we understand music from a neurological point of view and consequently help to examine the current music pedagogies in use around the world. This currency must occur through informed and research-trained eyes to discern the true implications of the findings as well as the flaws or shortcomings of each study. Finally, the findings must be disseminated accurately, appropriately and widely through several formats and vehicles such as printed materials, websites and presentations.
8.2.2 Engaging with the Neuromusical Field

Neuroscientists around the world are investigating the inner workings of the arts discipline central to our profession. Music educators should be a part of those investigations. The growing number of interdisciplinary research institutes being established in recognition of this need will yield richer research findings due to their interdisciplinary approach. However, the greater the general levels of education in this area within pre-service and practising teachers, the greater engagement will occur. After this engagement occurs, research studies can be undertaken on questions posed by practising teachers to inform their understanding and pedagogy.

A pressing issue for practising teachers as a result of Study A may be a comparison in brain development between different types of music education. This could take the form of a comparison between instrumental music education and classroom music education (such as a Kodaly-based program) over the same period of contact with children of comparable ages and periods of music tuition. Similarly, comparisons could be made based on the length of music education and the age that it was undertaken. Such studies could inform music educators about establishing music education methodologies and how they affect brain development. It may also lead to greater understanding of how these sometimes competing methodologies may evolve into a new approach to music education.

8.2.3 Exploring New Models

The combination of a tailored pedagogy and neuromusical research findings in Study B leads to a positive gain in the values that pre-service generalist teachers held towards music education. This occurred in a standard tertiary teacher education degree structure. These findings alone have implications for other tertiary teacher educators and their own practices and contexts. However, further research may be warranted concerning the entire structure of teacher education degrees.

Within Australia, there are various governing and accreditation bodies that approve the content and structure of tertiary teacher education degrees. As Australia has moved towards more nationalised education expectations and standards with the
Australian Curriculum and NAPLAN testing, so teacher education degrees have become more prescriptive. With the new Australian curriculum, arts education in the tertiary context has had a heavy focus on equality across the five arts disciplines. Equal contact time and assessable items must be included. While I have no issues with the equitable treatment of the five arts disciplines, I am not convinced it is the most effective approach for the education of our pre-service generalist teachers.

Each pre-service teacher enters the course with pre-existing levels of skill and confidence in all five arts disciplines. They are expected to exit the course with equal levels of proficiency in all five arts areas. However, between the start and end of their course they are required to participate in units of learning in all five arts disciplines in equal measure, regardless of their pre-existing strengths and weaknesses. Many curriculum designers may say that such a situation is ideal for a differentiated curriculum and pedagogical approach. While I agree that differentiation is the answer in many cases, the sheer breadth of the pre-service teachers’ knowledge and skills is far wider than in other areas such as maths or science. A typical pre-service teacher can enter a teaching degree with the following equivalent levels of arts education: Dance (Year 4), Drama (Year 6), Media (Year 10), Music (Year 2) and Visual Art (Year 8). With such a broad range, an alternate structure to the equity of time model may be worth investigating. A model that involves individual testing in arts skills and knowledge prior to entry into the course and the use of a flexible structure that caters to the weakness and strengths of the pre-service teacher may be worth exploring.

**8.2.4 Justifications for Music Education**

The field of neuroscience is somewhat ‘in vogue’ at present. It is regularly used to bolster advocacy pieces in newspapers on the cuts to educational funding. Small snippets or scientific research are used to reinforce a predominantly aesthetic and utilitarian viewpoint or support a strong personal belief with the external justification of scientific research. At present, the neuromusical research findings are a very poor cousin to the tried and tested aesthetic justifications for music education.
Studies 1 and 2 have shown that neuromusical research has a place in the field of music education. It is true that it is newer and needs further time to become established, but further philosophical research is needed to explore how to express both the neuroscientific and aesthetic benefits of music education in a coherent way. We need to move from justifying music education primarily through the aesthetic lens and appropriately embrace the newer but no less important lens of neuroscience. Music has helped neuroscientists understand the structures and functions of the brain in numerous ways. While the scientific community is benefiting from understanding the art form we base our professional lives upon, music educators should also benefit from that enhanced understanding, and improve music education in as many different ways as we can.

8.2.5 Bigger, Better Brains

This journey began as an exploration into the ways that neuromusical research might inform, improve and evolve my practice as a music educator. It appeared so promising, an incredibly exciting new development that was unlike any other development in the field of music education. It had the potential to unlock the still somewhat mysterious process of how we, as human beings, develop musical understanding, and how I as a music educator enable, enhance and empower using that process.

I discovered a field of fascinating research that revealed incredibly engaging results and ‘scientific proof’ that music education enhanced cognitive function. This research bolstered my belief in the benefits of music education in the holistic development of each child, not just those who were interested, showed ‘talent’ or had the financial capacity to experience high quality and sustained music education. The study, however, it did not in many ways answer my initial questions that evolved from reading Hodges’ (2000) panel of experts. Neuroscientists area still unable to tell me how their studies could improve my teaching practices or understanding of music processing and development.

This was not because the neuroscientists did not know the answers; they are just focusing on different goals and have different motivations. Neuroscientists,
understandably, are interested in gaining a greater understanding of the brain’s structures and functions. Therefore, their experiments are designed to reach those goals. While these goals are also of interest to music educators, it is the initial conception of the experiments where the problems occur. At present, when a neuroscientific study is designed, the criteria for how participants are determined to be musicians is not standardised or detailed. A musician could be a participant who played a musical instrument for over ten years or just a few months or weeks. A musician could have started learning the violin via the Suzuki method at the age of three or the trombone in a class band environment at the age of 14. Information on the musical environment in which the participant has come from is not taken into account. As a music educator, such differences in the musical environments, musical learning activities and music methodologies are important and fundamentally influence how I interpret the results of each neuroscientific study. As a music educator, I need to view the results of the neuroscientific studies through the lens of the questions, ‘What do you define as a musician?’ and ‘What are your parameters for music education?’

Neuroscientific studies will continue to be undertaken and continue to provide the neuroscientific world with greater insights into the structural and functional aspects of the brain. I do not propose that a separate field of research be established, but I do believe it is possible for current neuroscientific studies to be of greater use to music educators. Greater demographic information needs to be gathered at the beginning of the studies so that a music educator can read the results with an understanding of clear and detailed criteria for the researchers’ definitions of their ‘musician and non-musician’ groups. Furthermore, music educators should be part of the conversation when studies are under development to include their perspectives on the findings that would be of relevance to the development of music education.

Despite the unconventional journey this thesis has taken me on, the lack of an answer to my initial question has not detracted from the outcomes. The impact that the neuromusical research findings had on the value that the pre-service teachers value of music education is an important finding that has many applications and implications. The value of music education in a child’s development has not necessarily diminished in the last century, but other priorities have taken centre stage.
We need to find new ways to renew the benefits of music education in the minds of policy makers, educational leaders, teachers, parents and children, and the neuromusical research findings may do just that. With this renewal could come greater emphasis on quality pre-service teacher education and professional development for practising teachers in the field of music education? What comes after the knowledge era is yet to be determined, but we can be sure that the development of bigger, better brains will play an important part.


Appendix 1: Ethics Approval

10 October 2011

Dr Neryl Jeanneret
Melbourne Graduate School of Education
The University of Melbourne

Dear Dr Jeanneret,

I am pleased to advise that the Melbourne Graduate School of Education Human Ethics Advisory Group (MGSE HEAG) has approved the following Minimal Risk application:

Project title: Bigger, Better Brains: A study into the perceived value of music education in light of recent neuromusical research findings.

Researchers: Neryl Jeanneret and Anita Collins

MGSE HEAG ID: 1136364

The project has been approved for the period: 10 October 2011 to 31 December 2011.

It is your responsibility to ensure that all people associated with the Project are made aware of what has actually been approved.

Research projects are normally approved to 31 December of the year of approval. Projects may be renewed yearly for up to a total of five years upon receipt of a satisfactory annual report. If a project is to continue beyond five years a new application will normally need to be submitted.

Please note that the following conditions apply to your approval. Failure to abide by these conditions may result in suspension or discontinuation of approval and/or disciplinary action:

(a) Limit of Approval: Approval is limited strictly to the research as submitted in your Project application.

(b) Amendments to Project: Any subsequent variations or modifications you wish to make to the Project must be notified formally to the Human Ethics Advisory Group for further consideration and approval before the revised Project can commence. If the Human Ethics Advisory Group considers that the proposed amendments are significant, you may be required to submit a new application for approval of the revised Project.

(c) Incidents or adverse affects: Researchers must report immediately to the Advisory Group and the relevant Sub-Committee anything which might affect the ethical acceptance of the protocol including adverse effects on participants or unforeseen events that might affect continued ethical acceptability of the Project. Failure to do so may result in suspension or cancellation of approval.

(d) Monitoring: All projects are subject to monitoring at any time by the Human Research Ethics Committee.

(e) Annual Report: Please be aware that the Human Research Ethics Committee requires that researchers submit an annual report on each of their projects at the end of the year, or at the conclusion of a project if it continues for less than this time. Failure to submit an annual report will mean that ethics approval will lapse.

(f) Auditing: All projects may be subject to audit by members of the Sub-Committee.

Please quote the ethics registration number and the name of the Project in any future correspondence.

On behalf of the Ethics Committee I wish you well in your research.

Yours sincerely,

Associate Professor Leo Goedegebuure
Chairperson, Melbourne Graduate School of Education Human Ethics Advisory Group
Phone: 83446619, Email: lgo@unimelb.edu.au

cc: Anita Collins and Human Research Ethics Committee, Melbourne Research Office.
Appendix 2: Consent Form

CONSENT FORM

PROJECT TITLE:
Bigger, Better Brains: A study into the perceived value of music education in light of recent neuromusical research findings

Name of participant:

Name of investigator(s): Dr Neryl Jeanneret & Ms Anita Collins

1. I consent to participate in the project named above, which includes two questionnaires to be completed in my first and last week of semester. A written copy of the information has been given to me to keep.

2. I authorise the researcher to use for this purpose the questionnaires referred to under (1) above.

3. I acknowledge that:
   (a) the possible effects of the questionnaires have been explained to me to my satisfaction;
   (b) I have been informed that I am free to withdraw from the project at any time without explanation or prejudice and to withdraw any unprocessed data previously supplied;
   (c) The project is for the purpose of research
   (d) I have been informed that the confidentiality of the information I provide will be safeguarded subject to any legal requirements.
   (e) (include other clauses as relevant, e.g., consent to interviews being audio-taped, acknowledgement that copies of transcripts will be returned to participant for verification, participants to be referred to by pseudonym or identified by name in any publications arising from the research, and in instances where a dependent relationship is involved confirmation that participation or non-participation in the research will have no affect on grades/assessment/employment)

Signature

Date

(Participant)

HREC: 1136364.1; Date: 15/11/11; Version: 1.1

Melbourne Graduate School of Education
The University of Melbourne Victoria 3010 Australia
T: +61 3 8344 8285 F: +61 3 8344 8529 W: www.education.unimelb.edu.au
Appendix 3: Confidentiality Form (Experiment Groups 3 & 4)

CONFIDENCIALITY FORM

PROJECT TITLE:
Bigger, Better Brains: A study into the perceived value of music education in light of recent neuromusical research findings

Name of participant: ____________________________

1. I agree to not share the printed materials I receive during the unit Arts Education 1 (Semester 1 2012) with other students outside of my tutorial group

2. I understand that all students in the unit will have access to the tutorial materials after the conclusion of teaching in the unit Arts Education 1 during Semester 1 2012

Signature (Participant) ____________________________ Date ____________________________
Appendix 4: Plain Language Statement

Title of research project: Bigger, Better Brains: A study into the perceived value of music education in light of recent neuromusical research findings.

You are invited to participate in the above research project, which is being conducted by Dr Neryl Jeanneret (supervisor) and Ms Anita Collins (PhD student) of the Graduate School of Education at The University of Melbourne. By selecting this tutorial time you have been selected to be involved in the research project. This project will form part of Ms Collins’ PhD thesis, and has been approved by the Human Research Ethics Committee.

The aim of this study is to investigate whether recent neuroscientific findings may change your perceived value of music education. The study will be carried out entirely during class time and will involve a questionnaire in the first and last tutorial of the semester. The questionnaire will take about 20 minutes to complete. The questionnaire will ask for two identifying pieces of information at the beginning and this information will be used to pair your first and second questionnaire. In no way will the researchers be able to identify you through these pieces of information and therefore the questionnaire will be anonymous. This research project has no bearing on your assessment or final grade for the unit.

We intend to protect your anonymity and the confidentiality of your responses to the fullest possible extent, within the limits of the law. While the questionnaires are anonymous they will contain responses to open ended questions that we will identify by a number only, such as Student 39. We will remove any references within the responses to personal information that might allow someone to guess your identity. To further protect your confidentiality and anonymity, we will store the questionnaires in a locked cabinet and all computer files will be accessible to the researchers only, and will be password protected. You should note that these measures are only able to guarantee confidentiality within the limits of the law.

Once the thesis arising from this research has been completed, a brief summary of the findings will be available to you via one of your Moodle websites in Semester 2, 2012. It is also possible that the results will be presented at academic conferences. The data will be kept securely in the University of Canberra Faculty of Education for five years from the date of publication, before being destroyed.

Please be advised that your participation in this study is completely voluntary. Although you have selected to attend this tutorial time you may elect not to participate in the study. You can do this by either choosing not to sign the consent form or by requesting to be reassigned to another tutorial group. Please note that if you are under 18 years of age you are ineligible to participate in the study.

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. You may do this at the end of the first tutorial that you attend.

Should you require any further information, or have any concerns, please do not hesitate to contact either of the researchers; Dr Jeanneret: +61 3 8344 8882, Ms Collins: +61 2 6201 2197. Should you have any concerns about the conduct of the project, you are welcome to contact the Executive Officer, Human Research Ethics, The University of Melbourne, on ph: 8344 2073, or fax: 9347 6739.

HREC: 1136364.1; Date: 3/08/11; Version: 1.1

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Appendix 5: Pre-Test Sample (Full Survey)

Music Education Survey 1

Identity code
This information will be used to pair your first and second survey together anonymously

1. The first street that you lived on

2. Your first pet’s name

Demographic information

1. **Age** - Please tick (✓) one the following
   - 17 yrs or younger
   - 18 - 25 yrs
   - 26 - 35 yrs
   - 36 - 45 yrs
   - 46 yrs or older

2. **Gender** - Please tick (✓) one the following
   - Female
   - Male

3. **Highest qualification attained** - Please tick (✓) one the following
   - Year 12 certificate
   - Bachelors degree
   - Masters degree & above

Musical background

Please answer the following questions

4. Have you ever learnt a musical instrument (excluding voice)?
   - Yes
   - No

5. Were you between 4 and 17 years of age when you learnt this musical instrument?
   - Yes
   - No

6. Did you have weekly lessons on this instrument?
   - Yes
   - No

7. Were your weekly lessons in a one-to-one format (one teacher and one student only)?
   - Yes
   - No

8. Did you have weekly lessons for more than two years?
   - Yes
   - No

9. Prior to commencing this degree, have you had a career as a musical performer, music composer or music educator?
   - Yes
   - No

10. Did you learn more than one musical instrument?
    - Yes
    - No

11. Did you learn a language other than English before you were 6 years of age?
    - Yes
    - No

12. What type of instrument(s) did you learn?
    - Strings
    - Wind
    - Brass
    - Percussion/Drums
    - Guitar
    - Voice
    - Piano
    - Other

Group 1
Music Education

Instructions
The following statements are commonly used to justify including music in the school curriculum.

Please read each statement carefully and make a tick (✓) in the appropriate box to indicate the extent to which you personally believe the statement is true or valid.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Definitely False</th>
<th>False</th>
<th>More False than True</th>
<th>More True than False</th>
<th>True</th>
<th>Definitely True</th>
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<tbody>
<tr>
<td>13. Prepares students for a career in music</td>
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<td>14. Broadens student horizons</td>
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<td>15. Helps students to think more flexibly</td>
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<td>16. Improves maths skills</td>
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<td>17. Provides opportunities to improve self-esteem</td>
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<td>18. Improves reading level</td>
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<td>19. Offers opportunities for self-expression</td>
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<td>20. Instills students with wholesome ideals of conduct</td>
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<td>21. Helps students learn faster</td>
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<td>22. Enables students to find meaning in the real world</td>
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<td>23. Helps students manage their emotions more effectively</td>
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<td>24. Enhances students’ aesthetic awareness and sensitivity</td>
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<td>25. Speeds up the acquisition of language at a young age</td>
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</tr>
<tr>
<td>26. Helps students improve their motor-coordination skills</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
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</tr>
<tr>
<td>27. Gives students relief from more structured classes</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
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<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
</tbody>
</table>

Importance of subjects

Instructions
28. Please rank the importance of each subject in the K-6 curriculum (1 being the highest level of importance, 15 being the lowest importance, no equal ranking please)

A. Dance ᵃ  B. History ᵃ  C. Physical Education ᵃ  
D. Drama ᵃ  E. Social Studies ᵃ  F. Science ᵃ  
G. English ᵃ  H. Maths ᵃ  I. Design & Tech ᵃ  
J. Geography ᵃ  K. Music ᵃ  L. ICT ᵃ  
M. Health ᵃ  N. Personal Development Education ᵃ  O. Visual Art ᵃ  

Group 1
Music Education (cont.)

Instructions
The following statements are commonly used to justify including music in the school curriculum.

Please read each statement carefully and make a tick (✓) in the appropriate box to indicate the extent to which you personally believe the statement is true or valid.

<table>
<thead>
<tr>
<th>Music education ...</th>
<th>Definitely False</th>
<th>False</th>
<th>More False than True</th>
<th>More True than False</th>
<th>True</th>
<th>Definitely True</th>
</tr>
</thead>
<tbody>
<tr>
<td>29. Improves students brain functions</td>
<td>☐ ☐ ☐ ☐ ☐</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>30. Teaches teamwork</td>
<td>☐ ☐ ☐ ☐ ☐</td>
<td></td>
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<tr>
<td>31. Helps students excel academically</td>
<td>☐ ☐ ☐ ☐ ☐</td>
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<tr>
<td>32. Helps to develop students' self-confidence</td>
<td>☐ ☐ ☐ ☐ ☐</td>
<td></td>
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<tr>
<td>33. Improves skills in science</td>
<td>☐ ☐ ☐ ☐ ☐</td>
<td></td>
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<td></td>
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<tr>
<td>34. Helps students resolve conflict</td>
<td>☐ ☐ ☐ ☐ ☐</td>
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<tr>
<td>35. Cultivates use of a unique symbol system</td>
<td>☐ ☐ ☐ ☐ ☐</td>
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<tr>
<td>36. Helps students learn the rules of language</td>
<td>☐ ☐ ☐ ☐ ☐</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>37. Is valuable in itself and needs no justification</td>
<td>☐ ☐ ☐ ☐ ☐</td>
<td></td>
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<tr>
<td>38. Improves students’ memory</td>
<td>☐ ☐ ☐ ☐ ☐</td>
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<td></td>
</tr>
<tr>
<td>39. Enables students to develop their music potential and talents</td>
<td>☐ ☐ ☐ ☐ ☐</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>40. Improves students social skills</td>
<td>☐ ☐ ☐ ☐ ☐</td>
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</tr>
</tbody>
</table>

Learning a musical instrument

41. What do you believe is the value of learning a musical instrument?
Delivery of Music Education

Instructions
Please indicate your level of agreement with the following statements

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>No Opinion</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

42. Music should be integrated into other subject areas
☐ ☐ ☐ ☐ ☐ ☐ ☐

43. A K-6 classroom teacher should be able to teaching music
☐ ☐ ☐ ☐ ☐ ☐ ☐

44. Music should be taught by a teacher qualified specifically in music education
☐ ☐ ☐ ☐ ☐ ☐ ☐

45. Music should be taught by a teacher who has an interest in music education
☐ ☐ ☐ ☐ ☐ ☐ ☐

46. Other subject areas should be integrated into music education
☐ ☐ ☐ ☐ ☐ ☐ ☐

47. A K-6 classroom teacher should be capable of supporting a specialist music teacher in teaching music
☐ ☐ ☐ ☐ ☐ ☐ ☐

48. Music education should be delivered to your students by external music specialists
☐ ☐ ☐ ☐ ☐ ☐ ☐

49. Music education should not be compulsory in the school curriculum
☐ ☐ ☐ ☐ ☐ ☐ ☐

50. Music education should be compulsory until the end of;
Yr 3 ☐ Yr 6 ☐ Yr 8 ☐ Yr 10 ☐ Yr 12 ☐

Confidence in teaching

Instructions
51. Please rank how confident you feel at present at teaching the following subjects to K-6 students (1 being the highest level of confidence, 15 being the lowest confidence, no equal ranking please)

A. Dance  _______ B. History  _______ C. Physical Education  _______
D. Drama  _______ E. Social Studies  _______ F. Science  _______
G. English  _______ H. Maths  _______ I. Design & Tech  _______
J. Geography  _______ K. Music  _______ L. ICT  _______
M. Health  _______ N. Personal Development Education  _______ O. Visual Art  _______

Group 1
Music Education (cont.)

Instructions
The following statements are commonly used to justify including music in the school curriculum.

Please read each statement carefully and make a tick (✓) in the appropriate box to indicate the extent to which you personally believe the statement is true or valid.

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<th>True</th>
<th>Definitely True</th>
</tr>
</thead>
<tbody>
<tr>
<td>52. Teaches students how to work together as a team</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>53. Improves students awareness of objects around them and their place in relation to those objects</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>54. Increases satisfaction students derive from music</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>55. Provides success experiences for students who struggle</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>56. Helps students to develop good citizenship habits</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>57. Allows students to have fun</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>58. Improves specific numeracy skills</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>59. Provides for a more well-rounded education</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>60. Improves the general intelligence of students</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>61. Improves fine motors skills</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>62. Encourages students to use their imagination</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
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<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>63. Enhances the physical well-being of students</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>64. Improves a students' ability to integrate new knowledge</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
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<td>☐ ☐ ☐ ☐ ☐ ☐</td>
</tr>
<tr>
<td>65. Enables students to understand more complex music</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
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</tr>
<tr>
<td>66. Exposes students to a different form of intelligence</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
<td>☐ ☐ ☐ ☐ ☐ ☐</td>
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</tbody>
</table>

Confidence in teaching the Arts

Instructions
67. Please rank how confident you feel at present at teaching the following Arts subjects to K-6 students (1 being the highest level of confidence, 4 being the lowest confidence, no equal ranking please)

A. Dance _____   B. Drama _____   C. Music _____   D. Visual Arts _____
Music Education (cont.)

Instructions
The following statements are commonly used to justify including music in the school curriculum.

Please read each statement carefully and make a tick (✓) in the appropriate box to indicate the extent to which you personally believe the statement is true or valid.

<table>
<thead>
<tr>
<th>Music education ...</th>
<th>Definitely False</th>
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<th>More True than False</th>
<th>True</th>
<th>Definitely True</th>
</tr>
</thead>
<tbody>
<tr>
<td>68. Helps students to develop good work habits</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>69. Increases students' awareness of mankind's cultural heritage</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>70. Encourages students to be creative</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>71. Help students think faster</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>72. Prepares students to participate in social events</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>73. Enables students to improve their quality of life</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>74. Improves students spatial awareness</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>75. Facilitates the development of a student's personality</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>76. Helps students to appreciate music as a historical force</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</tbody>
</table>

Learning a musical instrument (cont.)

77. What are your positive and/or negative experiences from learning a musical instrument?

Many thanks for your participation in this study
Music Education Survey 2

Identity code

This information will be used to pair your first and second survey together anonymously

1. The first street that you lived on
2. Your first pet’s name

Group 1
Music Education (cont.)

Instructions
The following statements are commonly used to justify including music in the school curriculum.

Please read each statement carefully and make a tick (✓) in the appropriate box to indicate the extent to which you personally believe the statement is true or valid.

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<tr>
<td>76. Helps students to appreciate music as a historical force</td>
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<td>☐</td>
<td>☐</td>
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<td>☐</td>
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</tbody>
</table>

Learning a musical instrument (cont.)

78. What are the most valuable things you have learnt in the 10 weeks about music education?

Many thanks for your participation in this study
Appendix 7: Title Page (Bigger, Better Brains Booklet)
Appendix 8: Snapshot of Research (Bigger, Better Brains Booklet)

Music Education & Brain Development

At the beginning of the 21st century, neuroscientists started using technology that enabled them to watch our brains working in real time. They started doing experiments and found that when the participants listened to music their brains worked in ways that hadn’t been seen before. Then they started comparing the brains of musicians and non-musicians. What they found was amazing.

These comparative studies, which began with adult musicians and then moved to children, found that the brains of participants who had been exposed to musical training at an early age (4 - 12yrs) by learning a musical instrument in weekly lessons with a specialist teacher were better at things like:

- Storing and retrieving information
- Learning and understanding language
- Regulating their logical and emotional responses
- Understanding and responding to sounds
- Working in teams
- Creating ideas and working creatively

Literally, musicians have been found to have bigger (brains with more grey matter), better (worked more efficiently) brains.

Near & Far Transfer

Near Transfer is the type of learning that is directly related to the task. For example, when you learn to play the cello you naturally develop your fine motor skills.

Far Transfer is the type of learning that is not directly related to the task. For example when you learn to play the cello you may also develop more advanced skills in reading, solving problems or interpreting emotions.

Some of the big names in music & brain science are Dana Foundation, BRAMS Lab, McMaster Institute, Isabelle Peretz, Robert Zatorre, Dan Levitan, Aniruddh Patel

What is Brain Plasticity and Pruning?

Brain Plasticity
The brain’s ability to change
We all have ‘plastic brains’. This term refers to the ability for our brains to change, grow and learn. It was thought that the brain stopped changing in adulthood, but this was incorrect. Musicians have been found to have high levels of brain plasticity, which means they can learn more effectively and faster.

Brain Pruning
The brain’s spring cleaning system
Without us knowing, our brain throws out things it thinks we don’t need in order to make room for new learning. Musicians have been found to have better storage systems in their brains, and can therefore store more while being more careful about what they throw out.

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Appendix 9: Music Education and Memory (Bigger, Better Brains Booklet)

Music Education & Memory

Memory is the power of the mind to remember something or 'the mental faculty of retaining and recalling past experience'. The new knowledge we learn today is built on what we remember we learnt yesterday.

Musicians have been found to have highly developed abilities in the field of memory. They can store and retrieve memories more effectively than non-musicians.

Think of it this way; learning a musical instrument helps us to have a really organized desk and filing cabinet in our brains; and when we want something quickly we know exactly where to get it from. We don’t waste any time or energy looking for it, which means we can move onto new learning quickly.

Memories are the very basis of effective learning, and this research means that children who learn a musical instrument can understand and integrate new information faster than children who don’t. Learning a musical instrument when you are young leads to a greater ability to learn and remember things throughout your life.

Brain research tells us

1. Musicians can make memories quickly, so they don’t need to have things repeated
2. Musicians can retrieve memories quickly, so they can quickly recall something they have learnt before when they need it
3. Musicians improve their memory by using the skills they learn through music rehearsal, so through practicing their instrument or rehearsing in a musical group improves their memory

How can I find out more?

Dana Foundation (www.dana.org) focuses on the Arts and brain research. Download these reports to find out more about music education and memory:

- Learning, Arts & the Brain Chapter 2 (John Jonides) and Chapter 7 (Kevin Dunbar)
- Neuroeducation: Learning Arts and the Brain

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Appendix 10: Music Education and Executive Function
(Bigger Better Brains Booklet)

Music Education & Executive Function

Executive Function is a broad term for many functions in the brain that regulate how we respond to a situation. By the time we are adults we have generally developed the ability to distinguish when we are responding emotionally or logically to a problem. It is also the very basis of problem solving.

Has anyone ever said to you “think before you speak”? Executive Function is the skill that helps us do that, to respond rather than react. It has been said that this is one of the skills that separates us from animals.

Musicians have been found to have higher abilities in the area of Executive Function than non-musicians. Musicians can approach a problem from different angles, they can weigh up the various logical or emotional factors, they can look at it depth in one specific area or broadly across many areas.

Researchers speculate that because music is so subjective (there is no hard and fast or correct answer) that learning music encourages flexibility to develop in the brain. And once it is there, it never goes away.

Brain research tells us

Learning a musical instrument helps to develop all of the different functions that make up the skill of Executive Function. Musicians are more able to:

- Listen and interpret instructions from the teacher
- Regulate their own responses to situations, causing less behavioral problems that require teacher intervention
- Maintain a higher level of attention for a longer period of time

But there is a lot of argument about these findings so keep a eye on the research.

I want to know more

Look up Michael Posner and his paper called “How Arts Training Influences Cognition” in the Dana Foundation (www.dana.org) report Learning, the Arts and the Brain

Music Education & Attention

An important part of Executive Function is the ability to pay attention. Now, this isn’t just looking like you are paying attention in class when really you are daydreaming. This is the ability to maintain your attention span for a long time on a single task.

Musicians have been found to be better able to maintain their attention. Researchers think this is because musicians have to be disciplined and practice their instrument every day. This is basic attention training for the brain from a very young age.

Imagine having a whole class of students who could maintain their attention?

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Appendix 11: Music Education and Language (Bigger, Better Brains Booklet)

Music Education & Language

There has been a lot of research done on the possible connections between music and language. The reason this happened is because researchers observed that the proposed music and language centres of the brain where in exactly the same position on opposite hemispheres of the brain. When they asked musicians to complete a language task, they seemed to be using both areas, not just one.

Researchers are fascinated by this and have been wondering if music training might change how children learn language. There have been several studies comparing children who have and have not learned a musical instrument. They have compared how quickly they learn words, understand how sentences work and inflection in speech.

Those students who had played a musical instrument from a young age displayed a significantly higher ability to acquire and understand language.

Imagine, how would your classroom look and function if all of your students could understand language and build on their language skills faster?

Brain research tells us

There is quite a lot of argument between researchers about the connections between music education and language, but what they do agree on is that they could be connected, but they are not sure how just yet.

1. Musicians can understand and remember new words faster than non-musicians
2. Musicians can grasp correct sentence structure quicker than non-musicians
3. Musical rhythm and musical pitch help children understand variations in verbal language. They can pick up inflections and emotional content of the spoken word more effectively

Want to know more?

The best researcher to follow on music & language is Aniruddh D. Patel.

The journal Nature is great for easy to understand articles on Music and the Brain. Go to www.nature.com, use ‘music’ as a search and narrow it to Jan – Dec 2008. Here you will find a special edition on Music and the Brain.
Appendix 12: Music Education and Music Processing  
(Bigger, Better Brains Booklet)

How do we understand music?  
This is not an easy question to answer. Why? Because researchers have watched the brain while it is processing musical information and in one researchers words, it light's up like a Christmas tree. There is so much going on at once that it is hard to know where to start.

Sounds strange, but as well as using many parts of the brain to process musical information, musicians use less of their brain than non-musicians to process the information. It is like they are more efficient at understanding something that is very complex.

So imagine that the brain can work like a series of light bulbs with different wattages, 30W for low light and 120W for strong light. A musician can run a 30W bulb throughout lots of brain areas at once to work out the different parts of the music. At the same time, the musician might want to concentrate on a one particular area, and switches on a 120W bulb for a short time to focus on a practical problem or something that is new. Non-musicians tend to switch on a 60W bulb all over their brain and ramp it up to 200W if they want to solve a problem. Put simply, non-musicians use more energy to solve the same problem.

Wikipedia in your Brain
Researchers at BRAMS in Canada have come up with a theory on how we understand music. They think we have a spot in our brain that is like a musical encyclopedia, and that we hear the sound, dissect it for pitch, rhythm and emotional content, compare it our existing encyclopedia, update the information and then translate the information into bodily movement. That’s when we start tapping our foot.

Most importantly this theory suggests we simultaneously process ideas about language from the music.

Search for Musical Lexicon on http://www.brams.org for more information

From Dangerous to Healthy!
At the Max Planck Institute researchers have proposed another version of how we understand music. Along with the steps below the brain is constantly checking for the Meaning and Emotion of the music.

1. We hear the music like computer language 01101110
2. The brain flips the music from a vertical block of sound to horizontal lines of information
3. Danger! Is when the brain decides if the music is dangerous? Danger means ‘is it too different to what I am used to’
4. The brain separates the music into pitch, rhythm, structure, tone colour
5. The brain understands the music, finding similarities and differences
6. The brain reconstructs the music from all of its parts
7. The brain matches new information with old
8. The brain sparks a physical reaction to music like toe tapping, chills or clapping
9. The brain tells the immune system to get stronger and healthier

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Appendix 13: Music Education and Our Bodies (Bigger, Better Brains Booklet)

Music Education & Our Bodies

The line in the Beach Boys song “I’m picking up good vibrations” is pretty close to the truth when it comes to the body’s reaction to music.

When the ear hears, and then the brain interprets, combinations of rhythm and pitch it is familiar with, it releases a complex set of positive signals to the body, like vibrations. These vibrations make us feel good and understandably we want more of them. So we keep seeking out music our brain finds familiar.

But when the ear and brain detect combinations they aren’t familiar with, the opposite happens, and vibrations that don’t feel good are released into our bodies. Soon after this internal reaction we might say, “that song is bad”.

Musicians, as they learn a musical instrument, inevitably listen to music that doesn’t always release good vibrations in their bodies. Through this experience musicians get used to feeling uncomfortable for a time. This can lead to a more open attitude to learning, examining points of view and wrestling with difficult ideas. Musicians are more willing to take intellectual risks and explore new experiences, rather than shy away from them.

Brain research tells us

1. Musicians are exposed to a wide range of music that produces both good and bad vibrations in their bodies. These challenges to their bodies lead to a more open approach to learning, a willingness to play with difficult ideas and endure a level of discomfort in order to learn more

2. Positive vibrations released in response to playing and listening to music are linked directly to our immune system, so listening and enjoying music makes us healthier

3. Music is a universal language. Studies have shown that people from different cultural backgrounds have the same bodily reactions to sad music, happy music etc.

Who is researching this?

Laurel Trainor researchers babies and gifted children and has some excellent resources on the McMaster Institute website.

Judy Willis is a great researcher who is both a teacher and a neuroscientist. She has a lot of resources online, just Google The Neuroscience of Joyful Education to start you off
Appendix 14: Music Education and Musical Talent (Bigger, Better Brains Booklet)

Musical Talent?
Are some people born with a talent for music? Are some people born with a talent for drawing? What is talent anyway?

These are big questions that researchers have been arguing about for a long time. Unfortunately, recent brain science discoveries haven’t given us a definitive answer yet, but they are working towards it.

What they have found so far is that it is possible that there is a musical chromosome. A chromosome is not one single gene, but a combination of acids and protein that carry genetic information. So, in layman’s terms, some people may have a genetic predisposition to be a musician.

BUT...

If that predisposition is not nurtured then it’s potential will never be realized, they won’t be the next John Lennon or Ella Fitzgerald. The same goes for someone who might not have the ‘musical chromosome’. Given the right encouragement and opportunities they could be the next Dame Nellie Melba or Yo-Yo Ma.

The key is to nurture every child and see how they respond to music education.

Being Creative?
What we know is that musicians have the capability to both UNDERSTAND creative ideas and MAKE creative ideas.

Researchers are still baffled by where creativity ‘lives’ in the brain. What they do know is when they measure creative problem solving or something called divergent thinking (thinking outside the square) musicians have higher skills and abilities than non-musicians. This has lead researcher to wonder if creativity is about how the brain is wired to work.

Musician’s brains actually look and work differently to non-musicians brains. Brain research calls this brain structure (where things are stored and which parts of the brain are bigger or smaller or look different) and brain function (how the brain works, how messages are sent and in what order, or simultaneous order and how the brain works to solve problems).

Follow these questions
On the musical gene, follow the work of Kati Pulli from the University of Helsinki and her research on 15 families of musicians.


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Appendix 15: Bigger, Better Brains Overview

Bigger Brains
Musical training, in the form of weekly individual lessons on a musical instrument for more than 2 years when you are young, fundamentally changes your brain structures

1. Musicians have been found to have a larger corpus callosum that is the bridge between the left and right hemispheres of the brain. This means messages can travel faster and more easily across the brain

2. Musicians have been found to have a larger motor cortex that involves planning and voluntary motor functions. This means musicians have more control over what they plan to do and how they body responds

3. Professional musicians have been found to 130% denser grey matter. That means they have more capacity to store and process information in their brains

Better Brains
Musical training, in the form of weekly individual lessons on a musical instrument for more than 2 years when you are young fundamentally, changes your brain functions

1. Musicians have been found to have faster and more synchronized neural firings. Think of it like a really great postal service. A non-musician’s brain will get the message their overnight, a musician’s brain will get it their the same day

2. Musicians have been found to have a higher level of plasticity, meaning they are more flexible, better at problem solving and can learn faster

3. Musicians have been found to have more effective brain pruning mechanisms that lead to more effective use of brain space and brain function

Music training fundamentally changes the structure and functions in the human brain. The brain becomes larger, denser, faster and more flexible.
Appendix 16: Literature Review Mind Map
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