Transference of Dance Knowledge through Interface Design

Natalie Ebenreuter
Submitted in fulfilment of Doctor of Philosophy
Swinburne University of Technology 2008
Abstract

This thesis is concerned with the careful arrangement and organization of technical content. I argue that subject matter in the context of observation or ideation acts in concert with the abilities of the designer and available materials to shape the form of a product with its functional purpose and relevance. To assist the inquiry into the treatment of form and matter, a poetic strategy has been adopted which includes elements of dialectic, rhetoric, and grammar to better understand the requirements of design and to formulate a solution. Within this framework, a prototype application, “LabanAssist,” has been designed to provide dancers, choreographers, artistic directors, choreologists, students, and educators with a tool designed to enhance dance literacy through greater provision and accessibility of the dance notation system “Labanotation.”

The ephemeral nature of dance and the absence of a widely acknowledged system to provide an objective record of dance movement have contributed to the scarce historical references to dance material (Calvert, Coyle, and Maranan, 2002). An increasing awareness of the drivers surrounding the preservation of movement highlights the necessity to effectively preserve dance works that risk being contaminated or lost (Wang, 2004).

The integration of technology into the arts motivated the development of complex computer applications that supply artists with a greater means of creative expression (Assey, 2005). Movement can be effectively documented by the use of dance notation. Languages such as Labanotation provide a precise system of recording movement; analogous to the techniques musicians employ to notate music (Calvert et al., 2002). Current literature emphasises that existing dance notation applications are not equipped to detect or prevent errors made during the composition of Labanotation scores. These dance notation applications require an expert knowledge of Labanotation to operate effectively (T. Calvert, I. Fox, R. Ryman, and L. Wilke, 2005), fuelling the risk of further contamination as dance knowledge is transferred to a digital environment.

This research proceeds on the basis that the integration of an operational structure for the documentation of movement within the prototype application LabanAssist can ensure that the correct syntax of dance notation is established. Coupled with the visual
interpretation of notated movement in an immediate environment, LabanAssist functions as a diagnostic tool in which novice users of Labanotation may evaluate their notation and more easily interpret errors in their notation. LabanAssist has been tested in the dance community to assess levels of user response, understanding, accessibility, and capability.
Acknowledgements

I am deeply thankful to Dr. Deirdre Barron, my principal research supervisor at Swinburne University of Technology (SUT), for her untiring support, encouragement, and contact throughout the various locations in which this thesis was developed. By acknowledging my abilities and passion for my area of research, Dr. Barron has given me the freedom to explore the full potential of this research. This in turn allowed me to move far beyond my own expectations, and to achieve my research aspirations; many that I would not have thought possible. I also would like to thank Dr. Margaret Zeegers and Ms. Anita Kocsis for supporting this research.

Fundamental to the design of the LabanAssist prototype has been the participation of Labanotation experts and students at Ohio State University’s (OSU) Dance Department. In particular, I would like to thank Associate Professor Sheila Marion (my research supervisor while at OSU), Professor Emerita Lucy Venable, Professor Emerita Odette Blum, Professor John Giffin, and Mr. David Ralley (programmer of “LabanWriter”) for their invaluable support, expertise, and contribution to the development of this research, which was made possible by a 2006 Fulbright Postgraduate Award in Visual Performing Arts, sponsored by Anthony Joseph Pratt; and I would like to express my thanks to the Australian American Fulbright Commission.

The knowledge and exposure to design literature, philosophy, and the work of noble laureates that have come to influence my thinking about design draws on Professor Richard Buchanan’s lectures at Carnegie Mellon University’s (CMU) School of Design. For the final year in writing this thesis, I had the pleasure of accepting an invitation from Professor Dan Boyarski, head of CMU’s School of Design, to participate in design lectures at the school as a visiting research scholar under a Fulbright Academic Training Agreement. The impact of this year has played a significant part in shaping the experience, which has led to the completion of this thesis.

Furthermore, I would like to thank both Dr. Paul Pangaro and Dr. Ranulph Glanville for their invaluable comments and expert advice in reference to my work and subsequent publication regarding cybernetics and design.
Finally, it is with my greatest admiration that I thank Ms. Dianne Summons (aka “the moots”), who has been an inspiration throughout the thesis writing and prototype development phases; particularly for her ongoing support in everything I do; for the constant revisions of my work; and for being such a wonderful motivator from start to finish.

Many thanks also to OSU, CMU, Swinburne University of Technology Research, the CHI 2006 Doctoral Student Consortium, the Creativity and Cognition 2007 Graduate Student Symposium, Claire and Steven Schwartz, the Australian American Fulbright Commission, and the Australian Government for financial and academic support during my candidature.
Declarations

I certify that the thesis entitled “Transference of Dance Knowledge through Interface Design,” submitted for the degree of Doctor of Philosophy, is the result of my own research, except where otherwise acknowledged; and that this thesis in whole or in part has not been accepted for an award, including a higher degree, by any other university or institution. Furthermore, I acknowledge that this thesis has been professionally edited. This has been done on the provision that only the style and/or grammar of the examinable outcome, and not its substantive content, have been addressed to maintain the consistency of the work.

Full Name: Natalie Erika Ebenreuter

Signed ________________________________ Date 11th December 2008
## Table of Contents

Abstract ........................................................................................................................................... ii
Acknowledgements ......................................................................................................................... iv
Declarations ................................................................................................................................... vi
Table of Contents ............................................................................................................................ vii
List of Illustrations & Tables ........................................................................................................... x

### INTRODUCTION

AN INTERACTIVE DANCE OF COMMUNICATION ........................................................................ XIII
Summary of Thesis .......................................................................................................................... xxiii

### PART I: DESIGN PURPOSE

1. A VEHICLE FOR CULTURAL EXPRESSION ............................................................................. 1
   PROBLEM STATEMENT ................................................................................................................ 1
   NECESSITY OF RESEARCH PROPOSAL .............................................................................. 7
   DESIGN PURPOSE .................................................................................................................... 11
   A Final Note .............................................................................................................................. 14

2. A BASIS FOR DESIGN ............................................................................................................. 15
   INTRODUCTION ....................................................................................................................... 15
   SYMBOLIC COMMUNICATION ............................................................................................... 16
   THESIS PREMISE ...................................................................................................................... 24
   RESEARCH FOR DESIGN .......................................................................................................... 27
   RESEARCH ABOUT DESIGN ..................................................................................................... 28
   RESEARCH THROUGH DESIGN ............................................................................................... 30

### PART II: RESEARCH FOR DESIGN

3. DOCUMENTING MOVEMENT .............................................................................................. 35
   INTRODUCTION ....................................................................................................................... 35
   THE NATURE OF MOVEMENT ............................................................................................... 36
   Perceiving and Interpreting Movement .................................................................................... 37
   Describing Movement ............................................................................................................. 39
   Authenticity of Movement ....................................................................................................... 42
   Understanding Movement ....................................................................................................... 44
   MOVEMENT NOTATION SYSTEMS ....................................................................................... 45
   A Comprehensive System ....................................................................................................... 47
   Visual Representation .............................................................................................................. 51
   Evaluative Method of Notation Systems ............................................................................... 53
   Benesh Movement Notation .................................................................................................... 55
   Labanotation ............................................................................................................................ 57
   Eshkol-Wachman Movement Notation .................................................................................. 60
   Research Findings .................................................................................................................. 61
   SUMMARY ................................................................................................................................. 64

4. THE APPLICATION OF TECHNOLOGY TO MOVEMENT .................................................. 66
   INTRODUCTION ....................................................................................................................... 66
   THE APPLICATION OF TECHNOLOGY TO THE DOCUMENTATION OF MOVEMENT ......... 68
   Evaluative Method of Technology That Preserves Movement .............................................. 70
   Labanotation ............................................................................................................................ 72
   Motion Capture ......................................................................................................................... 73
# Digital Video

Key-frame Animation 77

Research Findings 79

**THE APPLICATION OF TECHNOLOGY TO VIRTUAL MOVEMENT** 81

Evaluative Method of Technology That Visualises Movement 83

Labanotation 84

Digital Video 86

Key-frame Animation 87

Notation-based Animation 89

Motion Capture-based Animation 90

Research Findings 92

**SUMMARY** 94

## PART III: RESEARCH ABOUT DESIGN 96

### 5 DESIGN METHODS

- **INTRODUCTION** 97
- **CHARACTERISTICS OF DESIGN** 98
- **THE ACT OF DESIGNING** 100
- **THE NATURE OF DESIGN** 102
- **DESIGN METHODS** 104
- **INTERPRETATION AND ANALYSIS** 105
- **DESIGN POTENTIALITIES** 107
- **THE DEVELOPMENT OF DESIGN METHODS** 109
- **DESIGN RESEARCH AND STUDIES** 112
- **SUMMARY** 115

### 6 DESIGN STRATEGIES

- **INTRODUCTION** 117
- **A STRATEGY FOR DESIGN** 118
- **SYSTEMATIC INQUIRY** 119
- **A UNIFYING CONCEPT OF DESIGN** 120
- **A UNIFYING IDEA FOR DESIGN** 122
- **THEORY AND PRACTISE** 124
- **STRATEGIC DESIGN THINKING** 127
- **A CONCEPTUAL FRAMEWORK** 129
- **A POETIC STRATEGY FOR MAKING** 132
- **A PLACE FOR CREATIVITY** 134
- **SUMMARY** 139

## PART IV: RESEARCH THROUGH DESIGN 140

### 7 THE POETICS OF INITIAL DESIGN REQUIREMENTS

- **INTRODUCTION** 141
- **ENVISION** 143
- **Notation Applications** 144
- **An Appropriate Use of Materials** 145
- **The Impact of Functionality on Form** 147
- **Evaluative Method of Functional Requirements for LabanAssist** 148
- **The Useful Functions of a System** 151
- **The Usability of a System** 155
- **The Visibility of a System’s Form** 156
- **Initial Design Requirements** 158
- **FRAME** 163

---

viii
## List of Illustrations & Tables

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1.</td>
<td>Laban Primer</td>
<td>xvii</td>
</tr>
<tr>
<td>Figure 2.</td>
<td>Dance Notation Educators and Institutions</td>
<td>9</td>
</tr>
<tr>
<td>Figure 3.</td>
<td>The Components of Form</td>
<td>20</td>
</tr>
<tr>
<td>Figure 4.</td>
<td>Notation Systems in Fields of Application</td>
<td>48</td>
</tr>
<tr>
<td>Figure 5.</td>
<td>Benesh Movement Notation Score</td>
<td>55</td>
</tr>
<tr>
<td>Figure 6.</td>
<td>Labanotation Score</td>
<td>57</td>
</tr>
<tr>
<td>Figure 7.</td>
<td>Notation Applications</td>
<td>59</td>
</tr>
<tr>
<td>Figure 8.</td>
<td>Eshkol-Wachman Movement Notation Score</td>
<td>60</td>
</tr>
<tr>
<td>Figure 9.</td>
<td>Technologies in Application</td>
<td>69</td>
</tr>
<tr>
<td>Figure 10.</td>
<td>Design Thinking</td>
<td>126</td>
</tr>
<tr>
<td>Figure 11.</td>
<td>Design Process Model</td>
<td>135</td>
</tr>
<tr>
<td>Figure 12.</td>
<td>Design Techniques</td>
<td>136</td>
</tr>
<tr>
<td>Figure 13.</td>
<td>LabanAssist Preliminary Interface and Menu Design</td>
<td>164</td>
</tr>
<tr>
<td>Figure 14.</td>
<td>LabanAssist Preliminary Interface and Panel Design</td>
<td>165</td>
</tr>
<tr>
<td>Figure 15.</td>
<td>LabanAssist Preliminary Interface, Document and Library Design</td>
<td>166</td>
</tr>
<tr>
<td>Figure 16.</td>
<td>LabanAssist Preliminary Movement Editor Design</td>
<td>167</td>
</tr>
<tr>
<td>Figure 17.</td>
<td>Mapping Movement and Interactivity for the Interface</td>
<td>172</td>
</tr>
<tr>
<td>Figure 18.</td>
<td>Task Analysis Schematic</td>
<td>177</td>
</tr>
<tr>
<td>Figure 19.</td>
<td>Persona Questionnaire</td>
<td>189</td>
</tr>
<tr>
<td>Figure 20.</td>
<td>Expert Persona</td>
<td>190</td>
</tr>
<tr>
<td>Figure 21.</td>
<td>Student Persona 01</td>
<td>191</td>
</tr>
<tr>
<td>Figure 22.</td>
<td>Student Persona 02</td>
<td>192</td>
</tr>
<tr>
<td>Figure 23.</td>
<td>Interface Recognition Questionnaire</td>
<td>196</td>
</tr>
<tr>
<td>Figure 24.</td>
<td>LabanAssist Notation Task</td>
<td>199</td>
</tr>
<tr>
<td>Figure 25.</td>
<td>User Scenario</td>
<td>200</td>
</tr>
<tr>
<td>Figure 26.</td>
<td>Horizontal and Vertical Patterns for the Description of Movement</td>
<td>201</td>
</tr>
<tr>
<td>Figure 27.</td>
<td>Interface Cards</td>
<td>203</td>
</tr>
<tr>
<td>Figure 28.</td>
<td>Interface Design Questionnaire</td>
<td>205</td>
</tr>
<tr>
<td>Figure 29.</td>
<td>Working Task Analysis Model</td>
<td>206</td>
</tr>
<tr>
<td>Figure 30.</td>
<td>Group One Task Analysis</td>
<td>208</td>
</tr>
<tr>
<td>Figure 31.</td>
<td>Group Two Task Analysis</td>
<td>209</td>
</tr>
<tr>
<td>Figure 32.</td>
<td>Design Rationale</td>
<td>210</td>
</tr>
<tr>
<td>Figure 33.</td>
<td>Supports and Gestures Columns</td>
<td>211</td>
</tr>
<tr>
<td>Figure 34.</td>
<td>Symbol Definition</td>
<td>214</td>
</tr>
<tr>
<td>Figure 35.</td>
<td>Symbol Recognition</td>
<td>215</td>
</tr>
<tr>
<td>Figure 36.</td>
<td>Error Detection</td>
<td>216</td>
</tr>
<tr>
<td>Figure 37.</td>
<td>Grammar Rules</td>
<td>217</td>
</tr>
<tr>
<td>Figure 38.</td>
<td>Score Guides</td>
<td>218</td>
</tr>
<tr>
<td>Figure 39.</td>
<td>System Feedback</td>
<td>219</td>
</tr>
<tr>
<td>Figure 40.</td>
<td>Score Structure</td>
<td>220</td>
</tr>
<tr>
<td>Figure 41.</td>
<td>Rotating Movement</td>
<td>221</td>
</tr>
<tr>
<td>Figure 42.</td>
<td>Aerial Movement</td>
<td>222</td>
</tr>
<tr>
<td>Figure 43.</td>
<td>Interaction Design Application Mode and Template Selection</td>
<td>225</td>
</tr>
<tr>
<td>Figure 44.</td>
<td>Interaction Design New Score Setup</td>
<td>226</td>
</tr>
<tr>
<td>Figure 45.</td>
<td>Interaction Design Movement Editor</td>
<td>227</td>
</tr>
<tr>
<td>Figure 46.</td>
<td>Interaction Design Score Editor and Motion Viewer</td>
<td>228</td>
</tr>
<tr>
<td>Figure 47.</td>
<td>Interaction Design Symbol Inspector</td>
<td>229</td>
</tr>
<tr>
<td>Figure 48.</td>
<td>Interface Design Startup</td>
<td>230</td>
</tr>
<tr>
<td>Figure 49.</td>
<td>Interface Design Score Setup</td>
<td>231</td>
</tr>
<tr>
<td>Figure 50.</td>
<td>Interface Design LabanAssist Basic</td>
<td>232</td>
</tr>
<tr>
<td>Figure 51.</td>
<td>Interface Design LabanAssist Intermediate</td>
<td>233</td>
</tr>
<tr>
<td>Figure 52.</td>
<td>Interface Design Artifacts</td>
<td>234</td>
</tr>
<tr>
<td>Figure 53.</td>
<td>Interface Design Tool Bar</td>
<td>235</td>
</tr>
<tr>
<td>Figure 54.</td>
<td>Interface Design Menu Items</td>
<td>236</td>
</tr>
<tr>
<td>Figure 55.</td>
<td>LabanWriter Score</td>
<td>237</td>
</tr>
<tr>
<td>Figure 56.</td>
<td>Movement Attributes</td>
<td>240</td>
</tr>
<tr>
<td>Figure 57.</td>
<td>The Interface for LabanAssist</td>
<td>242</td>
</tr>
<tr>
<td>Figure 58.</td>
<td>The Movement Editor</td>
<td>244</td>
</tr>
<tr>
<td>Figure 59.</td>
<td>The Score Editor, Labanotation staff</td>
<td>247</td>
</tr>
</tbody>
</table>
Figure 60. The Score Editor, dancers counts ................................................................. 248
Figure 61. The Motion Viewer, playback .................................................................. 249
Figure 62. The Motion Viewer, drag bar .................................................................... 249
Figure 63. The Symbol Inspector, symbol recognition ............................................. 252
Figure 64. The Labanotation Reference Library ....................................................... 252
Figure 65. The Symbol Inspector, measure contextual recognition ......................... 253
Figure 66. Heuristic Evaluation Questionnaire 1 ...................................................... 259
Figure 67. Heuristic Evaluation Questionnaire 2 ...................................................... 260
Figure 68. Heuristic Evaluation Questionnaire 3 ...................................................... 261
Figure 69. Heuristic Evaluation Questionnaire 4 ...................................................... 262
Figure 70. Heuristic Evaluation Questionnaire 5 ...................................................... 263
Figure 71. Heuristic Evaluation Questionnaire 6 ...................................................... 264
Figure 72. Heuristic Evaluation Questionnaire 7 ...................................................... 265
Figure 73. Heuristic Evaluation Questionnaire 8 ...................................................... 266
Figure 74. Heuristic Evaluation Questionnaire 9 ...................................................... 267
Figure 75. Heuristic Evaluation Questionnaire 10 .................................................... 268
Figure 76. Heuristic Evaluation Questionnaire 11 .................................................... 269
Figure 77. Heuristic Evaluation Questionnaire 12 .................................................... 270
Figure 78. Heuristic Evaluation Questionnaire 13 .................................................... 271
Figure 79. Heuristic Evaluation Storyboard 1 ......................................................... 272
Figure 80. Heuristic Evaluation Storyboard 2 ......................................................... 273
Figure 81. Heuristic Evaluation Storyboard 3 ......................................................... 274
Figure 82. Heuristic Evaluation Storyboard 4 ......................................................... 275
Figure 83. Heuristic Evaluation Storyboard 5 ......................................................... 276
Figure 84. Heuristic Evaluation Storyboard 6 ......................................................... 277
Figure 85. Heuristic Evaluation Storyboard 7 ......................................................... 278
Figure 86. Heuristic Evaluation Storyboard 8 ......................................................... 279
Figure 87. Heuristic Evaluation Storyboard 9 ......................................................... 280
Figure 88. Heuristic Evaluation Storyboard 10 ....................................................... 281
Figure 89. Heuristic Evaluation Storyboard 11 ....................................................... 282
Figure 90. Heuristic Evaluation Storyboard 12 ....................................................... 283
Figure 91. Heuristic Evaluation Storyboard 13 ....................................................... 284
Figure 92. Heuristic Evaluation Storyboard 14 ....................................................... 285
Figure 93. Heuristic Evaluation Storyboard 15 ....................................................... 286
Figure 94. Heuristic Evaluation Storyboard 16 ....................................................... 287
Figure 95. Heuristic Evaluation Storyboard 17 ....................................................... 288
Figure 96. Heuristic Evaluation Storyboard 18 ....................................................... 289
Figure 97. Heuristic Evaluation Storyboard 19 ....................................................... 290
Figure 98. Heuristic Evaluation Storyboard 20 ....................................................... 291
Figure 99. Heuristic Evaluation Storyboard 21 ....................................................... 292
Figure 100. Heuristic Evaluation Storyboard 22 ..................................................... 293
Figure 101. Heuristic Evaluation Storyboard 23 ..................................................... 294
Figure 102. Heuristic Evaluation Storyboard 24 ..................................................... 295
Figure 103. Heuristic Evaluation Storyboard 25 ..................................................... 296
Figure 104. Design Heuristic Evaluation Findings 1.............................................. 299
Figure 105. Design Heuristic Evaluation Findings 2.............................................. 300
Figure 106. Dance Heuristic Evaluation Workshop Discussion 1.......................... 301
Figure 107. Dance Heuristic Evaluation Workshop Discussion 2.......................... 302
Figure 108. Dance Heuristic Evaluation Workshop Discussion 3.......................... 303
Figure 109. Dance Heuristic Evaluation Workshop Discussion 4.......................... 304
Figure 110. Dance Heuristic Evaluation Workshop Discussion 5.......................... 305
Figure 111. Dance Heuristic Evaluation Workshop Discussion 6.......................... 306
Figure 112. Dance Heuristic Evaluation Workshop Discussion 7.......................... 307
Figure 113. Dance Heuristic Evaluation Workshop Discussion 8.......................... 308
Figure 114. Dance Heuristic Evaluation Workshop Discussion 9.......................... 309
Figure 115. Dance Heuristic Evaluation Workshop Discussion 10......................... 310
Figure 116. Dance Heuristic Evaluation Results ..................................................... 311
Figure 117. Preliminary Product Evaluation Task 1 ............................................... 313
Figure 118. Preliminary Product Evaluation Task 2 ............................................... 314
Figure 119. Preliminary Product Evaluation Task 3 ............................................... 315
Introduction

An Interactive Dance of Communication

From an early age, I have been actively involved in visual and performing arts. My first career as a classical ballet dancer enabled me to dance internationally with companies in Australia, New Zealand, and Germany. Upon my return to Australia, a career change turned my focus to design. My research developed out of a combination of my experience as a dancer and a desire, through my newfound knowledge, to develop a tool that would offer the dance community the potential to preserve and foster its cultural heritage.

It was during the final year of my undergraduate degree in design that I was fortunate enough to stumble across an old series of interviews on computers in the arts. One interview in particular featured the work of Eddie Dombrower (KCSM-TV, 1989) in which he gave a working demonstration of a computer application capable of representing movement by an animated human figure. This required a programmer to specify each individual frame of movement in order to create a sequence of movements. In this interview, Dombrower refers to the method of recording the language of dance on paper as being too cumbersome to view. Therefore, he designed a system to visually replicate the information of dance movement on a screen. This method of representing movement is analogous to the way movement is visually communicated and then learned through imitation during dance rehearsals. Such an exchange of dance information can be from a choreographer, a notator, or from one dancer to another. The computer system Dombrower designed back in the late 1980s offered choreographers a powerful tool with which to create movement, and was considered an animation tool. On reflection, it was apparent to me that this manner of representation was without reference to its written form. Such limitation meant that it did not offer a means to develop the language of dance, its literacy, or scholarship. I wanted to find a way to integrate the missing elements that Dombrower referred to as being too cumbersome.

For those with an understanding of established notation systems, the documentation of dance enables the critical analysis of movement concepts to be communicated. It also allows for the interpretation of movement to be verbalised, and enables intellectual
discussion to develop in the discipline of dance (as I will discuss further in Chapter Two). From my past experience as a student at the Australian Ballet School, I am well aware of the attitude and general resistance towards learning to read, write, and interpret dance notation systems. For the most part, this was because of the necessary complexity of a notation system to capture a detailed account of movement, which adds to the time-consuming tasks of using such systems. Yet, at the same time, I also had experienced the pleasure of learning to decode a notation score; to embody, experience, and perform great classical works such as *Giselle* and *Cinderella* from my interpretation of the score. There is a sense of elegance and simplicity about a language that captures an infinite variety of cultural works; especially one in which such diversity can be expressed through the visual representation of movement. This is achieved in a manner that facilitates the ephemeral transformation and expression of creative thought and movement as tangible records, and by this means exemplifies a rich source of cultural heritage. I use the word “rich” in the sense that participating in its reading, understanding, interpretation, and performance contributes to the use and enjoyment of its art in a wider social and cultural context.

When I compared the experience of interpreting movement from a score against the experience of learning choreography by imitating another performer’s interpretation of the same movement, I came to appreciate the necessity and value of enhancing dance literacy. At its core, the process of creating and interpreting dance notation scores enables a choreographer’s intent of movement to be expressed (Hutchinson Guest, 1984). This is separate from a record of movement that captures the physical and stylistic capability of another dancer’s performance; most commonly found in video and motion-capture data. For this reason, the symbolic notation of movement, as it is expressed in dance notation scores, provides its reader or interpreter, and ultimately its performer, with a greater sense of artistic interpretation in the recreation and performance of movement. Yet surprisingly enough, most dancers are unable to make use of the information contained within dance notation scores without the assistance of a professional notator or the use of computer support tools that facilitate its translation (R. J. Neagle, Ng, and Ruddle, 2004).

It has long been understood that literacy contributes to the development of modern society and civilisation. As such, members of the dance community have the resources
to develop dance scholarship and to create, share, and communicate dance knowledge through the use of dance notation scores. Hutchinson Guest (1984), a leading world expert on dance notation looks to the role of music notation in the cultural development of Western music as a promising indication of the potential for the development of dance literacy. Selma Jeanne Cohen, an instrumental figure in the development of dance criticism and scholarship, looks at the practical application of dance literacy in the wider community:

Scholarship, however, is not just for the library shelf, but for use—by the scholar, by the critic, and by the young person just developing an interest in dance (G D, 1995, p. 150).

This suggests that greater accessibility to the practical use of dance notation scores is vital to the preservation and cultural heritage of dance. I have taken the position that this information should encompass both established and new dance works for widespread use by the general public. However, much work needs to be done to foster the development of dance literacy at a fundamental level.

With the advantages of a further sixteen years of development in computer technology in the arts that was unavailable to Dombrower in the late 1980s, I set out to research the design of a system to facilitate the documentation and interpretation of dance knowledge. I quickly discovered, however, that previous and existing attempts to do this via the translation of dance notation to animation brought with it a new set of technical difficulties that, to date, impede its technical development. As a response to these difficulties, I wrote an article suggesting that the combination of Labanotation and animation were proficient and accessible uses of technology to record, edit, and visualise a wide range of human movement (Ebenreuter, 2005). I suggested that the design of an interface could further support the visual representation and interpretation of this information (as outlined in Chapter Three). I argued that not only would this enhance the usability and usefulness of these systems from a cultural perspective and assist members of the dance community, but it also has the potential to provide a structure that could be leveraged to assist modern developments in the computational translation of Labanotation. Because of the broad use of Labanotation in the United States and the Dance Notation Bureau’s sixty-six-year history in maintaining and
disseminating Labanotation scores, I applied for a Fulbright Award in visual and performing arts to work with leading world experts in Labanotation at the Dance Notation Bureau Extension for Education and Research located at Ohio State University.

After nearly eight years outside the theatre and the dance world, I suddenly found myself in foreign, yet familiar territory. The shift from dancer to designer, and a return to the former, provided me with a unique opportunity to combine the knowledge of these disciplines in a new environment. In September 2006, I spent six months learning the practise of Labanotation in the studios of the Ohio State University’s Dance Department together with dancers, like myself, who were new to the language, and with the assistance of experts in the field.

Rudolph Laban, the creator of Labanotation in the early twentieth century, was a teacher and a shaper of attitudes towards dance and movement. He believed that through actively experiencing movement, a better understanding of theatre dance could develop among the wider community (Wilk, 2006). Laban (in Wilk, 2006) regarded dance as a social and communal activity, and was a pioneer in the early development of dance education. In 1928, he published his system of notating movement, called “Labanotation,” which was the result of his studies in architecture, the moving body, and space (Wilk, 2006).

Today, members of the dance community use Labanotation to describe a wide range of human movement (see Figure 1. Laban Primer). It provides a system of recording movement that is similar to the techniques musicians use to notate music. Labanotation is a symbolic language designed to record the nuances and intricacies of all forms of human movement. As you might imagine, the range of human movement is vast. With this in mind, Labanotation offers an extensive symbolic vocabulary to describe a wide variety of human movement.

In comparison to the English language alphabet, which consists of twenty-six letters, Labanotation is a complex language made up of more than seven hundred symbols. The process of describing or notating movement involves the careful composition of these symbols on a score. This is where an understanding of the staff and specific columns of
The Labanotation Staff is made up of three vertical lines, that is read from bottom to top. The center line of the staff represents the center of the body that is divided into the left and right sides. The diagram above indicates which column each body part is assigned to.

Direction Symbols
Direction symbols are made up of three basic shapes. The first indicates forward and backward directions, the second sideways direction and the third diagonal direction. A rectangle is used to indicate no direction when a movement is in place.

Level of Movement
The level of movement is indicated by the shading of the symbol. These levels can be upward, downward or horizontal movements in any direction.

Laban scores are crucial to its description. While Labanotation is effective in supplying the dance community with a powerful language to describe movement, the visual representation of its symbolic language is difficult to interpret. Labanotation poses a problem for novice users of the system, because the notation itself does not transparently represent the movement it describes.

Through the experience of learning Labanotation from an introductory to an intermediate level, I soon discovered through trial and error the difficulties students encounter in gaining an understanding of the language. At OSU, students learn to read, write, and interpret Labanotation in two, distinct ways. At first, they learn to read and interpret its symbolic language, in a dance studio, by physically embodying and performing the movement they read from Labanotation scores. Once a basis for this understanding has developed, students learn to notate scores of movement in a computer lab with the use of a dance notation editor called “LabanWriter” (Ohio State Department of Dance, 2008).

Dance notation editors are very similar to text editors such as “Microsoft Word.” They make the creation and preservation of digital artifacts possible. However, instead of using the letters of the alphabet to write words, sentences, and paragraphs; dance notation editors use symbols to construct beats, bars, and scores of movement. LabanWriter is a dance notation application, created as a result of the foresight of Lucy Venable (I. Fox, Marion, and Venable, 2004; Venable, 1999), who saw a need to enable Labanotation scores to be created, copied, edited, and saved on a computer. As the former head of the Dance Notation Bureau and both founder and Director of the Extension for Education and Research, Venable’s extraordinary commitment to dance literacy continues today in the ongoing development of LabanWriter with programmer David Ralley at OSU.

Eager to learn at a time when Labanotation was very new to me, I downloaded the freely available program LabanWriter from the Web, and began exploring the functionality of the system. In my explorations, I came to realise that the system was designed for expert use, and relied on a proficient knowledge of Labanotation to use it effectively. While I found the accessibility of the product to be encouraging, the system functioned more as drawing tool, which permitted the random placement of symbols on
a score. In order to describe and document movement, I was required to identify and select individual symbols from a wide range of unfamiliar libraries. Furthermore, the system’s interface provided me with little clue as to what course of action I could take or how I should proceed in a given context.

As a novice and interested learner of Labanotation, the application LabanWriter offered me little assistance in the correct composition of Labanotation scores or the identification of Laban symbols. From this perspective, the experience left me with a deep concern for the practise and ease of use of Labanotation. The experience also emphasised the significance of the implications surrounding the accurate preservation of dance records created in a digital environment, because even the foremost expert in Labanotation is subject to human error. In the eyes of a designer and novice user of Labanotation, this highlighted the potential for developing a notation application that facilitates the correct grammatical composition of Labanotation, and assists the identification of Laban symbols and scores for those with little knowledge of the language. To a certain extent, the development of the “LabanDancer” project (Tom Calvert, Ilene Fox, Rhonda Ryman, and Lars Wilke, 2005a), designed to translate Labanotation scores to computer-generated animation, assists the visual interpretation of Laban symbols and scores. This translation is clearly illustrated when a Labanotation score is placed in close proximity to the movement it represents for comparison. Yet, LabanDancer (Tom Calvert et al., 2005b) makes use of existing notation scores, and does not enable the creation, manipulation, and interpretation of scores within a single application.

As an alternative to existing dance notation applications, I set out to design a prototype application for novice users of Labanotation, called “LabanAssist” (see Appendix A1: LabanAssist). More important, this was in collaboration with Labanotation professors, who are experts in their field; and students learning Labanotation, who represent the potential users of this system. By involving members of the dance community in the development of this research, I have been able to create an application that has complemented and built upon the existing suite of Labanotation tools created at the OSU. LabanAssist makes use of broad terms of movement descriptions common to members of the dance community and those who deal with movement in general to facilitate the documentation of Labanotation scores. It supplies users with a visual
representation of the movement selections they make by associating a Laban symbol and a corresponding human figure illustration to the movement they specify. By integrating a structured process to the composition of Labanotation that provides user feedback and preventative measures during the selection of movement descriptions, the correct syntax of a score is maintained. This is achieved through a function of the system which positions Laban symbols on a score, once a basic description of movement has been specified. Coupled with the visual interpretation of notated movement in an immediate environment, LabanAssist proposes to function as a diagnostic tool in which novice users of Labanotation may evaluate their notation and more easily identify errors in their scores.

A fundamental aspect of design is the act of bringing differences together to create a product or service that enhances the human experience. This is achieved through the creation of a framework or plan for productive outcomes that facilitates a particular goal or need. In effect, design can be understood as a strategic instrument used to augment communication and the exchange of diverse ideas in a global society (Liedtka, 2004). As we communicate on a daily basis through various modes of interaction; be it verbal or nonverbal; we are creating, designing, choreographing, and reshaping elements of our public and personal lives (Glanville, 1988). To a certain extent, we are all designers (Simon, 1996). Whether it is in the conception and generation of ideas; the exploration of unknown possibilities; the consideration of potential alternatives; or negotiating differences to reach a desirable outcome; we have a basic understanding of the components that make up design (Petroski, 2003).

In a similar way that a choreographer forms an understanding of the physical capabilities of a dancer (or muse); and uses them to his or her advantage in consideration of its appeal to a prospective audience; a designer seeks to understand a user’s needs and requirements to create and design products or services that are useful, usable, and desirable (Buchanan, 2001b; Sanders, 1992, 2006). In recognition of such needs, designers create specific criteria to direct the focus of a design purpose or goal; while choreographers may be guided by the cultural sensitivity, emotion, or structure of music as a framework for the development of dance. The composition of movement differs from the process of choreographing movement in that, once a sequence of movement has been established conceptually, its documentation, if described using a
dance notation system, must follow specific rules and conventions to capture the intent of a choreographer’s work.

It is in the description of movement that specific and general aspects of style and motion are communicated. Once documented, the symbolic representation of movement can be read and interpreted in parts as distinct components of movement or in its entirety, as a broad description of movement. The combinations of compatible elements of movement as distinct parts and as a unified whole are continually examined for their ability to work in concert or conflict with one another. The iterative examination of the relationship between the parts of a design situation and a unifying whole echo the balancing act a designer performs in understanding, negotiating, and determining the requirements necessary to meet a distinct design objective. I see this process as an interactive dance of communication that, when successful, reflects the cultural foundation of a community and assists the development of an appropriate solution to a particular need.

In the course of interaction, designers deal with various levels of bias and ambiguity in the exchange of ideas and information. Design is one such discipline that serves to enrich cultural life and its heritage. While perhaps this is not a generally accepted view, Margolin (1995, p. 354) argues: “Design in a deeper sense is a service. It generates the products that we require to live our lives.” In dealing with the complexities of society, Nelson (1957) sees the role of a designer as a provider of service that can be rendered at a variety of levels, and is crucial to the type and quality of products produced. Rittel (in Cross, 1984, p. 305) refers to the provision of a designer as: “That of a midwife or teacher rather than the role of one who plans for others.” This is achieved through the reexamination and negotiation of practise and purpose; by looking at how designers do things and developing a rationale for the grounds upon which new courses of action are taken. This requires collaboration, learning, and mutual understanding between various stakeholders in the design process. This is important because in the act of designing, there is a distinct possibility to induce cooperation between members of a community, and to facilitate change through effective modes of communication. In doing so, design becomes a powerful approach to shaping cultural practises that encourage and motivate people to take action. This thesis and the design of the prototype LabanAssist are examples of the application of design to a problematic situation.
LabanAssist is the culmination of nine months of working in close association with Shelia Marion, who graciously agreed to supervise this research. Sheila is an Associate Professor and Director of the Dance Notation Bureau Extension for Education and Research at OSU’s Department of Dance. Her involvement in this research has been instrumental in the pedagogical development of this prototype. She also is the creator of the online Labanotation tutorial site, “LabanLab” (Sheila Marion, 2001b), which is an educational resource within LabanAssist. By enabling novice users of Labanotation to progressively master the creation of Labanotation scores with the utility of LabanAssist, it is envisaged that LabanWriter may ultimately facilitate the expert use of the language. My aim in designing the interface for LabanAssist is to facilitate a creative approach to an otherwise technical procedure of notating movement. By emphasising the visual relationships between words, images, and symbols; it is envisaged that learners of Labanotation may interpret the movement it signifies. Moreover, as a means to reduce the ambiguity surrounding the meaning of specific Laban symbols, and enhancing the creative composition of scores, students may take a hands-on approach to notating movement and, in doing so, subtly learn the conventions of the language. The experience of actively engaging in the process of documenting movement through the utility of LabanAssist works to establish a basic understanding of Labanotation for dancers undertaking additional instruction in an introductory Labanotation course.

The effect of creating a prototype application that offers members of the dance community a valuable tool in relation to facilitating the art of composing Labanotation scores as grammatically precise and significant long-lasting cultural records and their interpretation was made clear to me during a presentation of LabanAssist. On its formal presentation to the staff and students at OSU, there was a sudden gasp of excitement from students in the auditorium as I demonstrated the facility of the tool. While such a reaction was unexpected, an element of surprise can be attributed to the emotional impact of a work that is simultaneously believable, necessary, and yet unanticipated. Aristotle (2005, p. 29) captures the notion of the art of design when he tells us:

"Tragedy is an imitation not only of a complete action, but of events inspiring fear or pity. Such an effect is best produced when the events come on us by surprise; and the effect is heightened when, at the same time, they follow as cause and effect. The tragic
wonder will then be greater than if they happened of themselves or by accident; for even coincidences are most striking when they have an air of design.

Summary of Thesis
This thesis is presented in five parts. The chapters in Part I focus on the purpose for design in the context of this research and establish a foundation for the creation of the prototype application LabanAssist. Part I is comprised of two chapters. Chapter One locates this research project in the field of design as a vehicle for cultural expression. Chapter Two establishes the basis for which the communication of symbolic information can be understood. I discuss the premise of this thesis, and provide an explanation of how the inquiry is organised. I propose a principle for design that is explored further in application to the research project LabanAssist.

The chapters in Part II focus on research for design. Part II consists of two chapters. In Chapter Three, I concentrate on the nature of movement and discuss how it can be perceived, interpreted, and described. I examine the strengths and weakness of three leading movement notation systems in order to determine how the description, documentation, and interpretation of movement are considered in this thesis. In Chapter Four, I address the types of technology used to record, edit, interpret, and visualise movement. I give focus to the strengths and limitations of modern technologies to capture an appropriate account of movement for its preservation and reconstruction.

The chapters in Part III focus on research about design. Part III is comprised of two chapters. In Chapter Five, I address the complexities and pluralism in design with regard to its practices and theoretical foundations. I provide an overview of design methods, with a specific focus on the treatment of analysis and synthesis in the design process. I do this in order illustrate how design processes can take shape and determine a method of approach for the development of the research project LabanAssist. In Chapter Six, I focus on a strategy for design that simultaneously captures knowledge from the arts and sciences in the realisation of design products. I offer a strategy for design that guides discovery, invention, and production that also leverages practical and theoretical knowledge.
The chapters in Part IV focus on research through design. They provide a working example of the application of design to the prototype application LabanAssist. Part IV consists of two chapters. Chapter Seven concentrates on the early conceptual development and functional requirements of the design situation for LabanAssist. It also concerns the communication and visual modelling of participatory design practices that seek to enhance mutual design decisions and capture diverse user interactions in task analysis schematics. Chapter Eight illustrates the problems of composing movement as Labanotation scores for novice users of the language. Drawing on my knowledge of these problems, I develop a rationale for the definition of system requirements that better address their needs. I also discuss how knowledge captured in the formative stages of design research can be incorporated in the design of a product and an interface that communicates its utility to a specific community of users.

The chapters in Part V focus on the outcomes of design research. Part V is comprised of two chapters. In Chapter Nine, I discuss the evaluative process for the prototype application LabanAssist. I illustrate the various methods employed to test and develop the prototype application, and discuss the subsequent results of the different evaluations. Finally, in Chapter Ten, I discuss the overall outcomes of this research. I return to the significance of the research premise and the principle employed in the development of the prototype application LabanAssist.