I declare that, to the best of my knowledge, this thesis is my own original work and does not contain any material previously published or written by another person except where otherwise indicated.

Lynette Frances Johns-Boast

20 January 2016
Dedicated to the memory of my father

Colin William Francis Johns

who taught me to love learning,
  to believe in myself,
  to give things a go,
not to give up just because something is hard,
  but to know when to quit,
and always to be the best I can.
Brick walls are there for a reason.
They’re not there to keep us out.
They give us a chance to show how badly we want something.¹

ACKNOWLEDGEMENTS

I would like to start by thanking and acknowledging Professor Gerard Corrigan, my primary supervisor: your willingness to take me on as a student when you had little real knowledge of my abilities, and your friendship, guidance, and unstinting support have made this thesis possible. You have taught me an enormous amount about academic writing and the conduct of research. The feedback you have provided throughout has been invaluable. Without you, this thesis would not exist.

I am also extremely grateful to the other members of my supervisory panel: Drs Margaret Kiley and Linda Hort, and Associate Professor Chris Johnson. The direction and feedback you have provided has guided and facilitated my development as an academic researcher. Your readiness to meet with me and to discuss my project was invaluable. Chris, without your willingness, enthusiasm and ability to act as a bridge between the worlds of engineering and technology on one hand and education and social science on the other, I would have dropped out long before I reached the end.

I would also like to thank Dr Shayne Flint who first encouraged me to undertake research leading to a PhD. Without your early encouragement, I would never have begun, and without your continuing encouragement I may not have finished. I should also like to thank friends and colleagues who provided friendship, encouragement and support along the way, especially Professors Shirley Gregor and Susan Howitt, Ms Denise Higgins, Drs Kim Blackmore, Pam Roberts and John Fricker. Without you the process would have been less pleasant, enjoyable and productive, and I may not have completed my journey.

No acknowledgement would be complete without acknowledging the tremendous support and patience shown me by my family during this challenging and arduous period of my life. Claire and Brigette, I look forward once again to having time to spend for mother-daughter activities; Douglas, thank you: initially for creating the environment in which I determined to do something for myself and later on for providing the support necessary to enable me to complete the thesis. I love you all.
ABSTRACT

The curriculum is one of the most important artefacts produced by higher education institutions, yet it is one of the least studied. Additionally, little is known about the decision-making of academics when designing and developing their curricula, nor how they make use of them.

This research investigates how 22 Australian higher education engineering, software engineering, computer science, and information systems academics conceive of curriculum, what approaches they take when designing, and developing course and program curricula, and what use they make of the curriculum. It also considers the implications of these conceptions and behaviour upon their curricula. Data were collected through a series of one-to-one, in-depth, qualitative interviews as well as small focus group sessions and were analysed following Charmaz' (2006) approach to grounded theory.

In this thesis, I argue that the development of curricula for new higher degree programs and courses and / or the updating and innovating of an existing curriculum is a design problem. I also argue that curriculum is a complex adaptive system. Surrounding the design and development of a curriculum is a process of design that leads to the creation of a designed object – the official-curriculum. The official-curriculum provides the guiding principles for its implementation, which involves the design and development of the curriculum-in-use, its delivery, and evaluation.

Data show that while the participants conceive of curriculum as a problem of design involving a design process leading to the development of the official-curriculum, surprisingly, their behaviour does not match their conceptions. Over a very short period, their behaviour leads to a process I have called curriculum drift where the official-curriculum and the curriculum-in-use drift away from each other causing the curriculum to lose its integrity. Curricular integrity is characterised through the attributes of
alignment, coherence, and cohesiveness. Without integrity, a curriculum is unlikely to be able to deliver all its required outcomes.

Utilising the concepts of system dynamics and systems thinking I propose that not only is the curriculum a complex adaptive system, it is a multi-dimensional object. Adopting this notion facilitates possible interventions that may be used to monitor the curriculum and to moderate the effects of curriculum drift.

I argue that using the articulated purpose of the curriculum to determine the desired outcomes of that curriculum will enhance curricular alignment, leading to improved student learning and outcomes. Furthermore, perceiving the curriculum as a multi-dimensional object reinforces the proposition that aligning the purpose and desired outcomes of each course with those of the program will achieve improved desired outcomes from the program as a whole.

The original contributions to knowledge arising from this research are curriculum drift, an enhanced approach to the curricular alignment, and a multi-dimensional view of curriculum.

Perhaps the most important implication of this research, is insight into how we might incorporate curriculum drift into curriculum review models. Successful incorporation has the potential to deliver increased quality of educational outcomes by enabling innovation whilst maintaining the integrity of the curriculum.
# CONTENTS

<table>
<thead>
<tr>
<th>Acknowledgements</th>
<th>i</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>ii</td>
</tr>
<tr>
<td>Contents</td>
<td>iv</td>
</tr>
<tr>
<td>List of Tables</td>
<td>viii</td>
</tr>
<tr>
<td>List of Figures</td>
<td>ix</td>
</tr>
<tr>
<td>Pull-out Figures</td>
<td>xi</td>
</tr>
<tr>
<td>Publications arising from this research</td>
<td>xii</td>
</tr>
<tr>
<td>Glossary of Terms</td>
<td>xiii</td>
</tr>
<tr>
<td><strong>Part I.</strong></td>
<td><strong>Research Context</strong></td>
</tr>
<tr>
<td><strong>Chapter 1</strong></td>
<td><strong>Overview</strong></td>
</tr>
<tr>
<td>1.1</td>
<td>Introduction</td>
</tr>
<tr>
<td>1.2</td>
<td>Motivation and research problem</td>
</tr>
<tr>
<td>1.2.1</td>
<td>Research aim</td>
</tr>
<tr>
<td>1.2.2</td>
<td>Research questions</td>
</tr>
<tr>
<td>1.2.3</td>
<td>Definition of curriculum used in this study</td>
</tr>
<tr>
<td>1.2.4</td>
<td>Limitations of the research</td>
</tr>
<tr>
<td>1.3</td>
<td>Thesis scope</td>
</tr>
<tr>
<td>1.4</td>
<td>Thesis structure</td>
</tr>
<tr>
<td>1.4.1</td>
<td>Part I – Research Context</td>
</tr>
<tr>
<td>1.4.2</td>
<td>Part II – Research Project</td>
</tr>
<tr>
<td>1.4.3</td>
<td>Part III – Conclusions and Further Research</td>
</tr>
<tr>
<td>1.5</td>
<td>Summary of contribution</td>
</tr>
<tr>
<td><strong>Part II.</strong></td>
<td><strong>Curriculum and Higher Education</strong></td>
</tr>
<tr>
<td>2.1</td>
<td>Curriculum – what is it?</td>
</tr>
<tr>
<td>2.1.1</td>
<td>A contested term</td>
</tr>
<tr>
<td>2.1.2</td>
<td>Types of curriculum</td>
</tr>
<tr>
<td>2.1.3</td>
<td>Constructivism and the multiple understandings of curriculum</td>
</tr>
<tr>
<td>2.1.4</td>
<td>Concepts of curriculum</td>
</tr>
<tr>
<td>2.1.5</td>
<td>The importance of a common understanding</td>
</tr>
<tr>
<td>2.1.6</td>
<td>Definitions of curriculum used in this thesis</td>
</tr>
<tr>
<td>2.2</td>
<td>Curriculum design, excellence and implementation</td>
</tr>
<tr>
<td>2.2.1</td>
<td>Curriculum design</td>
</tr>
<tr>
<td>2.2.2</td>
<td>Curricular excellence</td>
</tr>
<tr>
<td>2.2.3</td>
<td>Curriculum implementation – Moving from the abstract to the concrete</td>
</tr>
<tr>
<td>2.3</td>
<td>The dynamic nature of curriculum</td>
</tr>
</tbody>
</table>
# Engineering the Curriculum: Towards an Adaptive Curriculum

**Lynette Johns-Boast** – January 2016

## Contents

**Chapter 3** Systems and Design 47
3.1 Design 48
3.1.1 Engineering design process 49
3.1.2 Software design and development 53
3.2 General Systems Concepts 56
3.2.1 Understanding the whole rather than the parts 60
3.2.2 Complex adaptive systems 63
3.3 System dynamics 67
3.3.1 Tolerance 69
3.4 Modelling 69
3.4.1 Visual language 71
3.5 Systems thinking 78

**Part II.** Research Project 81

**Chapter 4** Research Design 82
4.1 Research Context 83
4.1.1 Ethics approval 84
4.2 Methodological approach 84
4.3 Research design 87
4.3.1 Research sites and participant selection 91
4.3.2 Data collection 93
4.3.3 Data analysis 108

**Chapter 5** Findings 118
5.1 Curriculum – In the words of participants 119
5.2 Curriculum – concepts 122
5.2.1 Confusion of understanding and terminology 123
5.2.2 Both a process and an object 124
5.2.3 Elements of curriculum 124
5.2.4 Curriculum applies to both programs and courses 129
5.2.5 Curriculum as a Design Problem 131
5.2.6 The curriculum development process 132
5.2.7 Layers of curriculum 142
5.2.8 Curriculum review 142
5.3 Curriculum – development and use 144
5.3.1 Focus attention on courses 144
5.3.2 Using the curriculum to implement a course 145
5.3.3 Curriculum design and development 149
5.3.4 Curriculum drift 149

**Chapter 6** Discussion 153
6.1 Curriculum as a design problem 155
6.1.1 Curriculum is both an object and a process 157
6.2 Curriculum as process 162
Engineering the Curriculum: Towards an Adaptive Curriculum  
Lynette Johns-Boast – January 2016

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.2.1</td>
<td>Designing and developing the official curriculum</td>
<td>170</td>
</tr>
<tr>
<td>6.2.2</td>
<td>Operationalising the official curriculum</td>
<td>174</td>
</tr>
<tr>
<td>6.3</td>
<td>Difference between concept and reality</td>
<td>183</td>
</tr>
<tr>
<td>6.3.1</td>
<td>No formal pedagogical approach to design</td>
<td>184</td>
</tr>
<tr>
<td>6.3.2</td>
<td>Ignore the official curriculum</td>
<td>184</td>
</tr>
<tr>
<td>6.3.3</td>
<td>Lose sight of the big picture</td>
<td>190</td>
</tr>
<tr>
<td>6.4</td>
<td>Impact of the lack of a common understanding</td>
<td>196</td>
</tr>
<tr>
<td>Part III</td>
<td>Conclusions and Further Research</td>
<td>200</td>
</tr>
<tr>
<td>Chapter 7</td>
<td>Conclusions and Implications</td>
<td>201</td>
</tr>
<tr>
<td>7.1</td>
<td>Conclusions drawn for research questions 1 – 3</td>
<td>202</td>
</tr>
<tr>
<td>7.1.1</td>
<td>Concepts of curriculum – curriculum-in-the-abstract</td>
<td>203</td>
</tr>
<tr>
<td>7.1.2</td>
<td>Curriculum-as-process – processes surrounding curriculum design and development</td>
<td>211</td>
</tr>
<tr>
<td>7.1.3</td>
<td>Curriculum-as-artefact – the output of the curriculum process</td>
<td>217</td>
</tr>
<tr>
<td>7.2</td>
<td>Implications</td>
<td>219</td>
</tr>
<tr>
<td>7.2.1</td>
<td>Curriculum drift</td>
<td>221</td>
</tr>
<tr>
<td>7.2.2</td>
<td>A multi-dimensional model of curriculum</td>
<td>227</td>
</tr>
<tr>
<td>Chapter 8</td>
<td>Limitations and Further Research</td>
<td>237</td>
</tr>
<tr>
<td>8.1</td>
<td>Limitations of this research</td>
<td>237</td>
</tr>
<tr>
<td>8.1.1</td>
<td>Credibility and trustworthiness</td>
<td>238</td>
</tr>
<tr>
<td>8.1.2</td>
<td>Ability to generalise the results</td>
<td>241</td>
</tr>
<tr>
<td>8.1.3</td>
<td>Existence, nature and importance of relationships in the proposed curricular layers and hierarchy</td>
<td>242</td>
</tr>
<tr>
<td>8.2</td>
<td>Further research</td>
<td>242</td>
</tr>
<tr>
<td>8.2.1</td>
<td>Disciplinary differences</td>
<td>242</td>
</tr>
<tr>
<td>8.2.2</td>
<td>Curriculum Drift</td>
<td>243</td>
</tr>
<tr>
<td>8.2.3</td>
<td>A multi-dimensional view of curriculum</td>
<td>244</td>
</tr>
<tr>
<td>Part IV.</td>
<td>References &amp; Appendices</td>
<td>247</td>
</tr>
<tr>
<td>References</td>
<td></td>
<td>248</td>
</tr>
<tr>
<td>Appendices</td>
<td></td>
<td>262</td>
</tr>
<tr>
<td>Appendix A</td>
<td>Ethics Approval</td>
<td>263</td>
</tr>
<tr>
<td>Appendix B</td>
<td>Informed consent</td>
<td>264</td>
</tr>
<tr>
<td>Appendix C</td>
<td>Information Statement – Phase 1</td>
<td>265</td>
</tr>
<tr>
<td>Appendix D</td>
<td>Information Statement – Phase 2</td>
<td>267</td>
</tr>
<tr>
<td>Appendix E</td>
<td>Demographic and personal data Pro-forma questionnaire</td>
<td>269</td>
</tr>
<tr>
<td>Appendix F</td>
<td>Participant personal and demographic data summary</td>
<td>270</td>
</tr>
<tr>
<td>Appendix G</td>
<td>Phase One – Interview Protocol</td>
<td>271</td>
</tr>
<tr>
<td>Appendix H</td>
<td>Pre-prepared &amp; Participant Created Tags</td>
<td>273</td>
</tr>
<tr>
<td>Appendix I</td>
<td>Sample email invitation to participants</td>
<td>274</td>
</tr>
<tr>
<td>Appendix J</td>
<td>Sample email to Dean seeking permission to invite staff</td>
<td>275</td>
</tr>
<tr>
<td>Appendix K</td>
<td>Phase Two – Questioning Route</td>
<td>277</td>
</tr>
</tbody>
</table>
Appendix L. Composite mind map – curriculum concepts 282
Appendix M. Interview D – Curriculum concepts Mind map 283
Appendix N. Interview C – Example Analysis Summary 284
Appendix O. Focus Group – Post session notes 288
Appendix P. Example Memos 291
Appendix Q. Photo of Focus Group Model 292
Appendix R. Elaborated Focus Group Model 293

Pull out Figures 294
<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Holistic coding – Categories and codes</td>
<td>114</td>
</tr>
<tr>
<td>4.2</td>
<td>Sample codes generated during open coding</td>
<td>114</td>
</tr>
<tr>
<td>4.3</td>
<td>Focused coding – Curriculum Concepts theme – Categories and codes</td>
<td>115</td>
</tr>
<tr>
<td>4.4</td>
<td>Focused coding – Participant Behaviour theme – Categories and codes</td>
<td>116</td>
</tr>
<tr>
<td>4.5</td>
<td>Focused coding – Curriculum Drift theme – Categories and codes</td>
<td>117</td>
</tr>
<tr>
<td>9.1</td>
<td>Demographic &amp; personal attributes of study participants</td>
<td>270</td>
</tr>
<tr>
<td>9.2</td>
<td>List of pre-prepared &amp; participant created tags</td>
<td>273</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure 1.1 – Thesis Structure 6
Figure 2.1 – Curricular Continuum, based on Fig. 1-1 in Zais (1976), p. 12 32
Figure 3.1 – Engineering Design Process (French, 1998, as cited in Dubberly, 2004, p. 31) 50
Figure 3.2 – Concepts of complicated versus complex systems 59
Figure 3.3 – Systems level, or holistic view of the Mona Lisa 61
Figure 3.4 – Sub-systems level view of the Mona Lisa 61
Figure 3.5 – Reductionist view of the Mona Lisa 62
Figure 3.6 – The multiple dimensions of curriculum 67
Figure 3.7 – Simplified $\frac{3}{4}$UML model of a library 73
Figure 3.8 – $\frac{3}{4}$UML model of Curriculum as Intention (Print, 1993, p. 6) 74
Figure 3.9 – $\frac{3}{4}$UML model of Lattuca & Stark’s (2009, p. 5) Academic Plan 75
Figure 3.10 – CLD representing the provision of formative feedback to students 77
Figure 3.11 – CLD of System Dynamics in Lattuca & Stark’s Academic Plan 78
Figure 4.1 – Diagrammatic representation of the conceptual framework adopted 88
Figure 4.2 – Visual synopsis of the research design 90
Figure 5.1 – Number of different terms used describe program outcomes 127
Figure 5.2 – Terms used to describe program outcomes 128
Figure 5.3 – Number of different terms used to describe course outcomes 128
Figure 5.4 – Terms used to describe course outcomes 129
Figure 5.5 – Hierarchy of curricula 130
Figure 5.6 – Constraints identified by participants 135
Figure 5.7 – Hierarchy of curricular outcomes 138
Figure 5.8 - Top 25 words based on frequency of usage 144
Figure 6.1 – Meta-level model of the official-curriculum and its operationalisation 158
Figure 6.2 – Model of the curriculum process as described by participants 163
Figure 6.3 – Designing & developing the official -curriculum 165
Figure 6.4 – Design, develop and implement the curriculum-in-use 166
Figure 6.5 – Implementing and evaluating the curriculum-in-use 167
Figure 6.6 – Review of implemented curriculum-in-use 168
Figure 6.7 – Curricular Continuum, based on Zais (1976, p. 12) 175
Figure 6.8 – The layers of curriculum
Figure 7.1 – Curriculum-in-the-abstract
Figure 7.2 – The curriculum-as-process onion
Figure 7.3 – Decomposition of a program curriculum showing the relationships between the different levels of the curricular hierarchy
Figure 7.4 – Curricular continuum, based on Zais (1976, p. 12)
Figure 7.5 – Curriculum Drift
Figure 7.6 – Reductionist view of the Mona Lisa
Figure 7.7 – Reductionist view of the Mona Lisa with 5 minor changes as marked
Figure 7.8 – Systems level, or holistic view of the Mona Lisa with many minor changes
Figure 7.9 – Graphical representation of Curriculum Drift for a program
Figure 7.10 – A visual representation of uncontrolled Curriculum Drift for a program
Figure 7.11 – A visual representation of uncontrolled Curriculum Drift for a course
Figure 7.12 – Causal Loop Diagram for curriculum drift
Figure 7.13 – Reinforcing loop behaviour
Figure 7.14 – Intervention – What needs to happen
Figure 7.15 – Balancing loop behaviour
Figure 8.1 – Spider/radar chart
(http://peltiertech.com/Excel/Charts/VBAdrawradar.html)
Figure 8.2 – Node-Link Diagram
(http://lgimages.s3.amazonaws.com/data/imagemanager/62927/force-protovis.png)
Figure 8.3 – Heat map
(https://lcolumbus.files.wordpress.com/2012/08/big-data-heat-map-by-industry2.jpg)
LIST OF PULL-OUT FIGURES

This thesis has a number of complex diagrams placed within the text and to which the text refers. At times, text relating to the diagram goes over more than one page, or is not on the same page as the diagram itself. To facilitate understanding, these diagrams are also placed at the end of this thesis in a format that enables them to extend past the text so they sit alongside as the text is being read. The diagrams included are:

Chapter 1 – Overview
- Figure 1.1 – Thesis Structure

Chapter 2 – Curriculum and Higher Education
- Figure 2.1 – Curricular Continuum, based on Fig. 1-1 in Zais (1976), p. 12

Chapter 3 – Systems and Design
- Figure 3.1 – Engineering Design Process (French, 1998, as cited in Dubberly, 2004, p. 31)

Chapter 4 – Research Design
- Figure 4.1 – Diagrammatic representation of the conceptual framework adopted
- Figure 4.2 – Visual synopsis of the research design

Chapter 6 – Discussion
- Figure 6.1 – Meta-level model of the official-curriculum and its operationalisation
- Figure 6.2 – Model of the curriculum process as described by participants
- Figure 6.8 – The layers of curriculum

Chapter 7 – Conclusions and Implications
- Figure 7.1 – Curriculum-in-the-abstract
- Figure 7.2 – The curriculum-as-process onion
- Figure 7.3 – Decomposition of a program curriculum showing the relationships between the different levels of the curricular hierarchy
- Figure 7.9 – Graphical representation of Curriculum Drift for a program
- Figure 7.10 – A visual representation of uncontrolled Curriculum Drift for a program
- Figure 7.11 – A visual representation of uncontrolled Curriculum Drift for a course
- Figure 7.12 – Causal Loop Diagram for curriculum drift
- Figure 7.14 – Intervention – What needs to happen
PUBLICATIONS ARISING FROM THIS RESEARCH

Refereed Conference Papers


A number of common terms mean different things in different countries and different domains. I have attempted to gather these here and provide the definition for each used throughout this thesis.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACM</td>
<td>The Association for Computing Machinery (ACM) is, “the world's largest educational and scientific computing society, delivers resources that advance computing as a science and a profession. The ACM provides the computing field's premier Digital Library and serves its members and the computing profession with leading-edge publications, conferences, and career resources”².</td>
</tr>
<tr>
<td>A curriculum</td>
<td>The abstract notion of curriculum, and so relates to any curriculum. See <em>curriculum definition</em> and <em>curriculum-in-the-abstract</em> for more detail.</td>
</tr>
<tr>
<td>Academic</td>
<td>A member of staff of a higher educational institution engaged in teaching; sometimes also referred to as lecturer or professor; synonymous with faculty. An academic may be a permanent, on-going member of staff or one employed on a fixed term or sessional contract.</td>
</tr>
<tr>
<td>Alignment or Aligned Curriculum</td>
<td>Refers to a curriculum in which learning and teaching activities and assessment activities are aligned with the desired outcomes, which in turn are aligned with the stated purpose or strategic goal of that curriculum.</td>
</tr>
</tbody>
</table>

² [www.acm.org](http://www.acm.org)
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coherence or Coherent curriculum</td>
<td>Refers to a curriculum whose building blocks – from lessons, through courses, to aggregations of courses into majors or minors – all support each other to develop the goals and outcomes at each level of curriculum and together support the goals and outcomes at program level (Angere, 2008). Refers to a curriculum that is logical and consistent and which forms a united entity rather than one composed of a collection of unconnected or only loosely connected courses. Over time as students progress through the curriculum, content and outcomes develop from broad, surface knowledge and skills to deeper knowledge and more complex skills (Schmidt, Houang, &amp; Cogan, 2002).</td>
</tr>
<tr>
<td>Cohesion or Cohesive curriculum</td>
<td>A cohesive curriculum can be described as a curriculum where the pieces, i.e. the lessons, the courses, fit together without unnecessary overlap or gaps, just as with a jigsaw. A cohesive curriculum exhibits coherence, provides synthesising experiences, allows students ongoing practice of skills and provides systematically created opportunities to develop increasing sophistication and apply what is learned (Allen, 2004).</td>
</tr>
<tr>
<td>Constructive alignment</td>
<td>A constructively aligned curriculum integrates all aspects of teaching, including teaching method, and assessment activities and aligns those with the intended learning outcomes so that all aspects of the system work together to support appropriate learning (Biggs, 1996, 1999a, 2003).</td>
</tr>
<tr>
<td>Course</td>
<td>Course refers to a single unit of study, sometimes also called a unit, subject, or module. Students take a number of courses each semester and need to complete a set number of courses to meet the requirements to complete a program of study.</td>
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<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Curricular integrity</td>
<td>Is where a curriculum exhibits strong alignment, cohesion, and coherence. Curricular integrity is where all the elements of the curriculum as a whole work together to deliver the purpose or strategic goal.</td>
</tr>
<tr>
<td>Curricular purpose</td>
<td>The strategic goal, including the rationale for choosing that goal, which the curriculum is designed to meet.</td>
</tr>
<tr>
<td>Curriculum-as-artefact</td>
<td><strong>The</strong> curriculum – the published, planned curriculum, the official-curriculum, and is the instantiation, the making concrete of the abstract concept, of <em>a</em> curriculum. Using the curricular elements contained within curriculum-in-the-abstract, to create the official-curriculum that is developed by an organisation and is what should be taught by the teachers and learned by students in that institution. It includes the overall rationale; high-level descriptions of purpose, learning outcomes, and content; and is expressed in a form that can be translated readily into practice and can be communicated clearly to those associated with the institution.</td>
</tr>
<tr>
<td>Curriculum definition</td>
<td><strong>A</strong> curriculum will have a clearly articulated purpose or strategic goal including the rationale behind that purpose, which will determine one or more desired outcomes. A curriculum’s content is the product of the relationship between the articulated purpose and associated desired outcomes. Inclusion of appropriate content is determined by its relationship with one or more of the desired learning outcomes.</td>
</tr>
<tr>
<td>See also</td>
<td>Curriculum-in-the-abstract</td>
</tr>
</tbody>
</table>

_Glossary of Terms_
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Curriculum design</td>
<td>“The arrangement of the components or elements of the curriculum” (Zais, 1976, p. 16) leading to the creation of the curriculum.</td>
</tr>
<tr>
<td>Curriculum elements</td>
<td>The distinct but related components of a curriculum, which include curriculum purpose, content, and desired outcomes.</td>
</tr>
<tr>
<td>Curriculum goals</td>
<td>“Relatively specific, precisely worded statements of curriculum intent and are derived from aims” (Print, 1993, p. xix).</td>
</tr>
<tr>
<td>Curriculum-in-the-abstract</td>
<td>A curriculum – Incorporates the three curricular elements of (1) purpose, including the rationale for that purpose, (2) desired or intended learning outcomes, and (3) content, and is presented in a manner such that it is open to critical scrutiny and capable of effective translation into practice, and is also represented formally in writing</td>
</tr>
<tr>
<td>Curriculum intent</td>
<td>The set of aims, goals and objectives of a curriculum (Print, 1993, p. xvii)</td>
</tr>
<tr>
<td>Curriculum-in-use</td>
<td>The translated and implemented curriculum – ‘the official-curriculum’ that has been translated into ‘the curriculum-in-use’ and implemented by teachers of the organisation It includes detailed descriptions of intent, learning outcomes, learning activities, and associated content, as well as methods of delivery and assessment of learning. It is expressed in a manner that it can be readily critiqued and evaluated, and can be communicated to those associated with the institution. Syllabus is a sub-component of this aspect of curriculum and provides the structure, the sequencing of topics and activities identified within the implemented curriculum. A ‘translated’ curriculum will then be implemented: it will be delivered, taught.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>Curriculum life cycle</td>
<td>The process of curriculum related activities from inception to retirement, which includes planning, design, implementation, delivery or operation, evaluation, evolution and retirement.</td>
</tr>
<tr>
<td>Curriculum objectives</td>
<td>“Statements of learner intent designed to bring out change within the learner. This change results from student interaction with the curriculum as the objectives are achieved” (Print, 1993, p. xx).</td>
</tr>
<tr>
<td>Curriculum outcomes</td>
<td>“Are observable, measurable and assessable statements of intended learner behaviour usually expressed in terms of specified levels of achievement” (Print, 1993, p. xx) and include aspects of both behaviour and content (Tyler, 1949).</td>
</tr>
<tr>
<td>Design</td>
<td>“A plan or scheme conceived in the mind and intended for subsequent execution” (OED, 1995).</td>
</tr>
<tr>
<td>Engineering Design</td>
<td>“Engineering design is a systematic, intelligent process in which designers generate, evaluate, and specify concepts for devices, systems, or processes whose form and function achieve clients’ objectives or users’ needs while satisfying a specified set of constraints” (Dym, Agogino, Eris, Frey, &amp; Leifer, 2005).</td>
</tr>
<tr>
<td>Horizontal organisation</td>
<td>“Is concerned with the arrangement of curriculum components at any one point in time” (Print, 1993, p. 96).</td>
</tr>
<tr>
<td>IEEE</td>
<td>The Institute of Electrical and Electronics Engineers (IEEE) is “an association dedicated to advancing innovation and technological excellence for the benefit of humanity, is the world’s largest technical professional society. It is designed to serve professionals involved in all aspects of the electrical, electronic, and computing fields and related areas of science and technology that underlie modern civilization” ³</td>
</tr>
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</table>

³ [http://www.ieee.org/about/ieee_history.html](http://www.ieee.org/about/ieee_history.html)
<table>
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<tr>
<th>Term</th>
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<tbody>
<tr>
<td>Instructional alignment</td>
<td>Is the strength of the alignment between “intended outcomes, instructional processes, and instructional assessment” (S. A. Cohen, 1987, p. 16).</td>
</tr>
<tr>
<td>Major</td>
<td>A set number (as defined by the institution) of related courses that are intended for students to achieve a specified set of learning outcomes.</td>
</tr>
<tr>
<td>Official-curriculum</td>
<td>The published, planned, written curriculum developed by an institution; sometimes also called the formal curriculum. See <em>curriculum-as-artefact</em> for more detail.</td>
</tr>
<tr>
<td>Plan</td>
<td>(Noun) “A detailed proposal for doing or achieving something” (OED, 1995). (Verb) “To make detailed arrangements for something you want to do in the future” (OED, 1995).</td>
</tr>
<tr>
<td>Program</td>
<td>A complete, integrated course or program of study leading to the award of a degree qualification such as a Bachelor of Engineering, or a Master of Business Information Systems. A program is constructed from many courses.</td>
</tr>
<tr>
<td>Syllabus</td>
<td>A sub-component of the <em>curriculum-in-use</em>, which provides the structure, the sequencing of topics and activities identified within the implemented curriculum, including details of assessment. It may also include information relating to the teaching method.</td>
</tr>
<tr>
<td>System</td>
<td>A system is “a set of things – people, cells molecules or whatever – interconnected in such a way that they produce their own pattern of behavior over time” (Meadows, 2008, p. 2).</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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</tr>
<tr>
<td>System dynamics</td>
<td>Is an approach to policy analysis and design, often assisted by computer. “It applies to dynamic problems arising in complex social, managerial, economic, or ecological systems – literally any dynamic systems characterized by interdependence, mutual interaction, information feedback, and circular causality. The approach begins with defining problems dynamically, proceeds through mapping and modelling stages, to steps for building confidence in the model and its policy implications” (System Dynamics Society).</td>
</tr>
<tr>
<td>Systems thinking</td>
<td>&quot;Systems Thinking is the art and science of making reliable inferences about behavior by developing an increasingly deep understanding of underlying structure ... [and] is a paradigm and a learning method ... Systems thinkers see both the generic and the specific – not just the latter! Behaviorally they see both the pattern and the event – not just the latter!” (Richmond, 1994).</td>
</tr>
<tr>
<td>The curriculum</td>
<td>The published, planned, written curriculum; the official-curriculum for a specific program or course. See curriculum-as-artefact for more detail.</td>
</tr>
</tbody>
</table>
Part I. **Research Context**

*Our current levels of knowledge and understanding are inadequate for meeting current demands – we need more rigorous and systematic research investigating university pedagogy and curriculum. The insertion of new technologies introduces complexity and a raft of new questions relating to course delivery, program design and development, curriculum, pedagogy, and assessment.*

(Kirkpatrick, 2007)
Chapter 1  OVERVIEW

It is wonderful to see that engineering educators are reading the research literature in skill development, teaching, cognitive science, and collaborative learning in order to apply them to this field ... My hope is that the research in engineering will now migrate outside of its own neighborhood and begin to enrich the neighboring fields as well as the basic sciences of learning.

(Shulman, 2005, p. 11)

1.1 Introduction

The research upon which this thesis is based centres on the design and development of higher education engineering, software engineering, computer science, and information systems accredited curricula. It explores the concepts of curriculum held by Australian academics teaching in those domains, and investigates how they use the curriculum. It also considers the effect these beliefs and behaviour have upon higher education curricula in those domains. It further considers how the understanding provided by this exploration might assist with the development of curricula that are flexible and can be readily adapted to the rapidly changing world in which they exist.

In this chapter, I provide a brief overview of the thesis. Section 1.2 describes the motivation leading to this study, includes the aims of the research and the questions that underpinned its design and conduct, provides the definition of curriculum (Section 1.2.3) used in this research and concludes with a brief summary of the limitations of this research. Section 1.3 provides a concise statement of the scope, while Section 1.4 provides information intended to help navigate this thesis.
1.2 Motivation and research problem

I was motivated initially to undertake this study by my interest in the intersection of technology and pedagogy and the potential impact that changes in technology will have upon higher education.

Change is constant, especially in the domain of science and technology where new discoveries and developments happen with increasing frequency. Quite apart from the need for our educational institutions, at whatever level, to become “learning organisations” (Senge et al., 2000) if, as a nation, we are to take advantage of and build upon these discoveries and developments, then our education system must also keep pace. To achieve this, engineering and computer science education in particular, must make full use of information and communication technology to improve teaching and learning (Brisk, 1997).

This thesis argues that to enable our higher education curricula to remain relevant in the rapidly changing world of the 21st century, their design and development must change. Instead of being based on long held tradition, intuition and personal experience, both as students and teachers, and academic convenience, (Daniel, 2009; Jamieson & Lohmann, 2012), higher education curricula must be designed to meet the needs of students, industry, employers, and society at large. Furthermore, engineering and computer science programs especially, must be flexible and adaptive if they are to keep pace with the rate of growth of knowledge in scientific and technological fields (Baldwin & Baumann, 2005).

To achieve the required transition, innovations need to be grounded in sound pedagogical practice and confirmed learning theories (Jamieson & Lohmann, 2012) and the academics involved must be “encourage[d] and support[ed as they] ... shift from being successful practitioners and gifted amateurs to professionals in learning and teaching” (Kirkpatrick, 2007).

1.2.1 Research aim

This research seeks to understand the factors that influence how engineering, software engineering, computer science, and information systems academics conceive the curriculum (as defined in Section 1.2.3 below); how those academics use it on a day-to-day
basis when working with their courses and programs, and the implications, if any, of their conceptions and behaviour.

1.2.2 Research questions

The following questions directed the research design for this project:

- How do engineering, software engineering, computer science, and information systems academics conceive of curriculum?
- What processes do they engage with when designing, developing and implementing both course and program curricula? That is, how do they use the curriculum?
- What is the output of the design and development process and how is it shaped?
- What are the implications of these conceptions and practices?

1.2.3 Definition of curriculum used in this study

As there are many definitions for curriculum (see Section 2.1 below), I provide a definition for the term curriculum, on which this research is based.

The term curriculum refers to the published, planned, official curriculum; in other words, “what organisations develop for the learners in their educational systems and what should be taught by teachers in that system” (Print, 1993, p. 4) and is expressed “in a form that can be communicated to those associated with the learning institution ... [is] open to critique, and ... able to be readily transformed into practice” (Prideaux, 2003).

A detailed review of the literature on curriculum caused this definition to be extended to include definitions of the abstract notion of a curriculum, as well as the implemented curriculum itself (see Sub-Section 2.1.6 below).

Definitions of other common terms used throughout this document can be found in the Glossary of Terms (pages xiii-xix above).
1.2.4 Limitations of the research

The aims of this research limited it to the domains of engineering, software engineering, computer science and information systems within the realm of Australian higher education. This limitation may affect the generalizability of the findings to other national higher education systems as well as to other domains within the realm of higher education both in Australia and abroad. The research limitations and the future research that might be used to mitigate these limitations are discussed in detail in Chapter 8.

1.3 Thesis scope

This thesis is concerned with the theoretical concepts of curriculum. It does not consider decision-making related to determining appropriate goals, content, and learning outcomes. Nor does it consider aspects related to the operationalisation of a curriculum, that is its design, development, delivery, and evaluation. Neither does it consider the pedagogy associated with implementing a curriculum including teaching and learning, and assessment activities. Other aspects often considered in conjunction with curriculum, such as the hidden curriculum, are also not considered.

1.4 Thesis structure

The thesis is divided into a number of parts, each comprised of two or more chapters. The structure of this thesis is depicted in Figure 1.1 below (included in pull-out figures). Parts are indicated by the horizontal partitions of the diagram. Chapters are represented by a box. The coloured arrows between boxes depict the flow of ideas. The colours of the arrows show the logical flow of ideas between the different chapters, and indicate the variety of paths that might be followed through the thesis depending on interest, existing knowledge, and time available for reading the thesis.

The three parts of this thesis are Research Context, Research Project, and Conclusions & Further Research. The contents of each part and its chapters are outlined below. A detailed overview of the research can be achieved by reading Chapters 1, 7 and 8. The impatient reader can gain an overview of Curriculum Drift and the multi-dimensional nature of curriculum by reading Chapter 7.
1.4.1 Part I – Research Context

Part I of this thesis contains three chapters that together provide the background to the research presented in this thesis.

The current chapter, Chapter 1, provides the context and scope of the study. It also sets out the aim of the research project and the questions that drove its design, as well as including an explanation of the thesis structure. Chapter 2 presents a review of the literature relating to curriculum and higher education. Understanding the literature on curriculum,
especially curriculum in higher education, is important for this project as it is against these views that I analyse the findings that have emerged from the data. Chapter 2 offers a view of the literature that highlights the confusion of understanding of curriculum, and the confused and confusing language used to describe it. It also discusses the nature of curriculum and its design. Through the literature on systems and design, Chapter 3 presents a view of curriculum as a problem of design. It argues that curriculum is a dynamic, complex adaptive system. Chapter 3 and Part I of this thesis conclude with the suggestion that the concepts of systems thinking may provide ways of understanding the dynamic nature of curriculum that will lead to improved outcomes.

1.4.2 Part II – Research Project

Part II of this thesis is comprised of three chapters that together provide details of the research project itself. They consider the selection of a research design, the findings that emerged from my analysis of the data and present a discussion of those findings.

Chapter 4 describes the rationale for the design of this project as well as providing details of the design. The need to understand curriculum and its use from the point of view of the participants drove the choice of qualitative research guided by Charmaz’ (2006) approach to grounded theory. The findings that emerged from the data are presented in Chapter 5. Included in this chapter is the participants’ story, in their words alone: their concepts of curriculum and the way they use it. Also identified are findings related to curriculum drift, which according to participants, leads to a curriculum losing balance and integrity. Chapter 6 discusses an analysis of the findings presented in the preceding chapter. It provides a synthesis of the findings, linking them to the literature. Conceptually, participants in this study saw curriculum as a problem of design. It included a design process that led to the production of a designed object – the official-curriculum, likened to a specification, which was used to guide the implementation. Reality presented an apparent paradox: conceptually viewing curriculum as a problem of design with the official-curriculum used to guide implementation but actually largely ignoring the official curriculum for both their courses and the program, and instead relying on their own experience to guide them. The final Section of this chapter discusses the role of this behaviour in causing curriculum drift.
1.4.3 Part III – Conclusions and Further Research

Part III of this thesis comprises two chapters, which provide answers to the research questions asked at the outset of this research, as well as identifying and discussing the limitations of the research and suggesting possible future research.

Chapter 7 provides answers to the four questions underpinning this research. Also considered are the benefits there may be for student outcomes when curriculum is understood as a design problem. Importantly, Chapter 7 also provides a possible explanation of how curriculum drift affects the outcomes for a program and its component courses. In providing an understanding of curriculum drift, including a possible explanation of why it occurs, and its impact, I present the notion of curriculum as multi-dimensional. The final chapter of this thesis, Chapter 8, discusses in detail the limitations of the research and presents three broad areas of possible research to extend the understanding provided by this thesis.

1.5 Summary of contribution

The research reported in this thesis contributes to the understanding of curriculum by integrating knowledge from several disciplines including: curriculum theory, engineering and software design and development, systems, system dynamics, and systems thinking. Specific contributions include:

- **Curriculum Drift**

  Curriculum drift helps explain why, despite our best efforts, university degree programs do not always graduate students with the desired attributes. Using the concept of curriculum as a complex adaptive system and the understanding of curricular behaviour provided by the notion of curriculum drift may help us develop flexible and adaptive curricula that deliver the required and desired outcomes.

- **Enhanced curricular alignment**

  Both instructional alignment (S. A. Cohen, 1987) and constructive alignment (Biggs, 1996) focus on the importance of the alignment between the desired outcomes, teaching and learning activities, and assessment. This research
enhances the concept of alignment by highlighting the importance of identifying
the purpose of a curriculum prior to determining the desired outcomes. It suggests
that not only do the teaching and learning, and assessment activities need to be
aligned to the desired outcomes, but that the outcomes themselves must be
aligned to the overall purpose of the curriculum. Furthermore, to enhance the
ability of a program curriculum to be able to meet its intended purpose, not only
must the program outcomes align to the program’s purpose, but that program
purpose and outcomes for all courses must be aligned with those of the program.

- Curriculum as design

The models presented in Figure 6.1 on page 159 and Figure 6.2 on page 164 (both
of which are included in pull-out figures) and described in Chapter 6, Sections 6.1
and 6.2, offer a unique view of curriculum as design. Design is defined as taking an
abstract idea – the purpose and outcomes we wish to achieve – and translating
that into something practical and purposeful (Design Council, 2015) – the
development of teaching, learning and assessment material and their delivery.

- A multi-dimensional model of curriculum

The proposed multi-dimensional model of curriculum presented in this thesis
provides an opportunity to develop a common understanding of curriculum that is
likely to provide heuristic support for academics as they design, develop,
implement, and maintain quality curricula that deliver desired educational
outcomes. Through suggested further research, the proposed multi-dimensional
model also provides the potential of developing a definitional framework and
associated tools that might assist academics and students in obtaining quality
outcomes.

Additionally, this thesis adds to the limited current understanding of curriculum in higher
education and the decision-making related to its design, development and
implementation, especially as that knowledge relates to the domains of higher education
engineering, software engineering, computer science and information systems academics.
Chapter 2 CURRICULUM AND HIGHER EDUCATION

Curricula in higher education are to a large degree hidden curricula, being lived by rather than being determined. They have an elusive quality about them. Their actual dimensions and elements are tacit. They take on certain patterns and relationships but those patterns and relationships will be hidden from all concerned, except as they are experienced by the students.

Barnett (2000, p. 260)

Each one of us involved with design and development of curricula brings to the task our own understanding and belief of just what curriculum is. Despite this, in our everyday transactions we talk about curriculum “with the untested assumption that [we] are speaking a shared language” (Lattuca & Stark, 2009, p. 2), yet all the while using the term to describe different, though related concepts. As the term curriculum has its origins in the Latin word ‘currer’ – I run – or perhaps ‘currere’ – to be running – and has been in use since the times of Aristotle and Plato, it is remarkable that it is a term which possesses many definitions and meanings (Kelly, 2009).

This chapter begins, in Section 2.1, with a presentation of various understandings and definitions of curriculum covering the last 65 years of curricular literature. The literature presents a confused and confusing view of curriculum, its component elements, and the relationships between those elements. I also discuss the importance of academics sharing a commonly understood and accepted view of curriculum, and the need to develop a commonly understood and accepted definition of curriculum that can be applied across the great variety of institutions, programs, and courses that characterise the domain of higher education. This first section concludes with a set of definitions of curriculum upon which this thesis is based. This is followed in Section 2.2 with a presentation of what is
meant by curriculum design. Some see it as a process; others see it as the creation of a substantive entity. This thesis adopts the view that curriculum design is the creation of a substantive entity that is the output of the design process. Included within this section is a brief presentation of the decision-making process in which academics engage when designing their curriculum, and what curricular structures educational researchers believe lead to quality learning outcomes. The chapter concludes in Section 2.3 with a brief consideration of the dynamic nature of curriculum.

2.1 Curriculum – what is it?

The curriculum is one of the most important artefacts an institution creates (Barnett et al., 2001) as it has the power to both determine and to drive educational outcomes. In fact, “there can hardly be a more significant concept than ‘curriculum’ with which to understand higher education” (Barnett & Coate, 2005, p. 6). It is, however, one of the least studied. One of the most notable results of a “review of the literature on curriculum in higher education in the UK, the USA and Australia … is the dearth of writing on the subject” (O. Hicks, 2007). The index of the United Kingdom’s Dearing Report (Dearing, 1997) on the future of higher education in the UK fails to list the term curriculum, as does Australia’s equivalent Bradley Report (Bradley, Noonan, Nugent, & Scales, 2008).

The term curriculum is also conspicuous in its absence from the indices of a number of works aimed principally at those designing courses and teaching in higher education. For example, neither of the indices of Learning to Teach in Higher Education (Ramsden, 2003) and Understanding Learning and Teaching (Prosser & Trigwell, 1999) make mention of it. While ‘curriculum’ does appear in the index of Designing Courses for Higher Education (Toohey, 1999), it is only to direct the reader to “curriculum documentation” and course structure rather than in relation to curriculum itself.

Furthermore, the literature that addresses curricula in higher education does not generally tackle the conceptual issues of curriculum (Barnett & Coate, 2005) which are the focus of this thesis. Instead it takes a “a limited ‘content’ focus” (O. Hicks, 2007) or focuses on curriculum related issues such as inclusive curriculum, learner-centred curriculum or internationalising the curriculum and assumes a common understanding of the term (O. Hicks, 2007). Likewise, the literature that addresses curriculum design largely focuses on the design of individual courses – that is, single units of study (Barnett et al., 2001) rather
than whole programs of study. Lattuca and Stark (2009) suggest this focus is caused by the more complex and diverse curricula at higher education level.

Not unsurprisingly therefore, higher education academics are largely unfamiliar with the concept of curriculum (Candy, Crebert, & O’Leary, 1994) and with its importance in determining student outcomes. Instead they develop and teach courses which reflect their own, frequently research-driven, interests and pay little heed to the need for program coherence or even to identifying the aims and objectives of their course (Felder & Brent, 2004).

The higher education academic who wishes to understand curriculum through the literature encounters a large body of work, focused mainly at school rather than higher education level, which presents a confused and confusing view of curriculum. The following sub-sections illustrate this. I begin with a presentation of the wide variety of views, definitions, and curricular elements that those writing about curriculum suggest comprise the notion of curriculum. Delving further into the literature on curriculum suggests not only a variety of definitions and understandings, but also a large number of different types of curriculum. In considering the broad acceptance of such a variety of views, I reflect on the role constructivism may play. To summarise the breadth of views presented within the literature I extract what I suggest are the key concepts encompassed within the literature on curriculum. I conclude this section with a consideration of why a common understanding is important, before stating the definitions of curriculum used within this thesis.

I shall now turn my attention to the variety of views, definitions, curricular elements, and the relationships between those elements that the literature suggests comprise the notion of curriculum.

2.1.1 A contested term

Descriptions of the term curriculum abound. A curriculum can be described as ‘a list of subjects’, a ‘set of courses’, the ‘entire course content’, ‘a set of planned learning experiences’, the ‘written plan of action’ as opposed to what is actually done in the classroom or even a ‘decision making process’ for determining educational purposes and how they are to be achieved or some combination of these concepts (Print, 1993, pp. 7-8).
Some descriptions also include details of “what teaching and instruction is to be offered” as well as “sometimes also what its purposes, its objectives are” (Kelly, 2009, p. 7).

A preliminary review of the literature made clear the range of definitions and understandings surrounding the term curriculum. When the literature is considered as a whole, the most evident theme to emerge from an in-depth review was the confused and confusing picture of just what a curriculum is. Furthermore, there was confusion about what the terms used to describe it actually mean. Most importantly, however, is that this in-depth review highlighted that within single texts, especially those focused on curriculum in higher education, often confused and confusing views of curriculum are presented.

Tackling the in-depth review chronologically, I expected to be able to discern a development of concepts, with later authors building on the work of earlier ones. This was not evident. Nor were patterns of common sets of concepts evident within the definitions obvious. What was apparent, as noted by others (Barnett & Coate, 2005; Conrad & Pratt, 1983; O. Hicks, 2007; Lattuca & Stark, 2009), was that many authors assumed a common understanding; however, where they did not, most simply offer their own view of curriculum with nothing linking it back to suggestions and definitions that had been proposed before.

The following paragraphs present a number of views of curriculum drawn from the literature. They were chosen to highlight the confusion evident within those texts as well as drawing attention to the variety and range of definitions with which an academic is presented when they delve into the literature on curriculum. Works are presented chronologically, firstly of those authors who have written books about curriculum in general and then those targeted at higher education, followed by those who have written articles relating to curriculum in higher education.

The review begins with Tyler (1949) and his seminal work Basic Principles of Curriculum and Instruction whose purpose was to “explain a rationale for viewing, analysing and interpreting the curriculum and instructional program ... [and] outlines one way of viewing an instructional program as a functioning instrument of education” (p. 1, my emphasis). Tyler does not attempt to explain his understanding of curriculum, assuming there is a single accepted definition that the reader will know; neither does he explain the
difference between a curriculum and an instructional program. It is left to the reader to
determine what the difference between the two might be.

As we progress through Tyler’s book, we find him using a variety of terms without
explanation or suggestion of how they relate to each other. For example, he talks about a
“curriculum program” (p. 5) and “planning an educational program to attain given
objectives” (p. 63) but without explanation of what the difference might be, or even if
there is a difference. Further on he talks about the importance to “curriculum
development” (p. 83) of the organisation of learning experiences, and the necessity of
identifying the “elements of that curriculum which serve as organising threads” (p. 86) as
well as “planning the curriculum” (p. 87). It is not clear, however, just what the
relationship between curriculum, curriculum development, and curriculum planning is.
Throughout his discussion of the need to evaluate how well the objectives have been
achieved he talks about the “educational program” (p. 110) but he does not explain how an
educational program relates to its curriculum. Finally, when presenting his ideas on how
to go about “curriculum building” (p. 126) he notes that “thus far this syllabus has dealt
with the problems of planning a program of instruction … not … rebuilding … [the]
curriculum” (p. 126), without telling us what he means by syllabus.

Given that when Tyler was writing the study of curriculum was not widespread, it is
probably not so surprising that he simply assumed people would understand the terms he
used and would have a common view of curriculum.

Some 25 years later, Stenhouse (1975) acknowledges the variety of understandings and
definitions of curriculum that exist. He sets out from page 1 to ensure the reader has an
understanding of the term curriculum. Firstly, he provides a dictionary definition: “a
course; especially a regular course of study as at a school or university” (p. 1). He
continues, noting that some see it as a large formal document that “lays down the ground
to be covered and to some extent the methods to be used … [and] also makes statements
about aims” (p. 1). Next, he suggests, “we appear to be confronted by two different views”
(p. 2) in the literature. On the one hand curriculum can be seen as “an intention, a plan or
prescription, an idea about what one would like to happen”, or the “existing state of affairs
… what does in fact happen” (p. 2) on the other.

Citing others, he continues by offering three “mainstream American definitions” (p. 4) of
the time. Inlow (1966) defines curriculum as “the planned composite effort of any school
to guide pupil learning toward predetermined learning outcomes" (p. 7); Neagley and Evans (1967) describe curriculum as "all of the planned experiences provided by the school to assist the pupils in attaining the designated learning outcomes to the best of their abilities" (p. 2); while Johnson (1967), "in view of the shortcomings of the currently popular definition ... stipulated that curriculum is a structured series of intended learning outcomes. Curriculum prescribes (or at least anticipates) the results of instruction" (p. 130). These three definitions have in common that curriculum sets out a plan for achieving a predetermined set of outcomes, which accords with the first view that Stenhouse suggests the literature offers.

Finally, Stenhouse proposes his own definition, saying that

a curriculum is an attempt to communicate the essential principles and features of an educational proposal in such a form that it is open to critical scrutiny and capable of effective translation into practice. (p. 4)

There is, however, no attempt to explain just what he means by "essential principles and features", nor why he uses the phraseology "educational proposal".

Although Stenhouse attempts to provide a background to curriculum and the understanding existing at the time, it is not clear that his definition builds on what has gone before. Furthermore, he uses terms without an attempt to ensure the reader possesses the same understanding. This leaves open to interpretation just what his explanation and definition means.

Writing at about the same time and also acknowledging the variety of understandings and definitions, Zais (1976) comments that "the term ‘curriculum’ ... is used in so many different ways that communication is often hampered" (p. 3) despite attempts by curriculum specialists to "limit the meaning of curriculum, disagreement still exists with respect to what constitutes legitimate definitions of the word". He also suggests, citing R. C. Doll (1970), that at the time he was writing there had been a broadening of the commonly-accepted definition of curriculum "from content of courses of study and lists of subjects and courses to all the experiences which are offered to learners under the auspices or direction of the school" (Zais, 1976, p. 8).
According to Zais, when the term curriculum is "used by specialists in the field" it is used "in two ways: (1) to indicate, roughly, a plan for the education of learners, and (2) to identify a field of study" (p. 3). The first usage of the term suggested by Zais is in accordance with the first usage and definitions suggested by Stenhouse. We are not given definitions in support of Zais' second usage claim. Zais suggests that despite recognition of curriculum as a plan, "there is significant disagreement among curriculum specialists with regard to the ingredients of the plan" (p. 3).

Zais introduces an important concept of curriculum not discussed by earlier authors: that curriculum is both an abstract construct as well as an entity. He suggests that when the term curriculum is taken to mean "a plan for the education of learners" it is referred to as "a curriculum or the curriculum" (p. 3, original emphasis). The notion of curriculum being both an abstract construct and an entity is an important one for this thesis and is developed further in Sub-Sections 2.1.4 and 2.1.5.

Although Zais provides substantial discussion of the concepts of the curriculum, he does not offer his own definition. Instead, he says, "a search for the correct definition of the term is not a very productive enterprise" (p. 13) but fails to tell us why he thinks it is an unproductive exercise, despite spending a number of pages providing different understandings of the term. Under the index entry "curriculum, definitions of" (p. 509) Zais points the reader to his discussion of the concepts of the curriculum.

Yet once more, readers are left to impose their own understanding on exactly what Zais means when he refers to curriculum.

In The Curriculum: Theory and Practice, Kelly (1977, 2009) sets out to answer the question "What is the curriculum?". In justification for asking this question, Kelly asserts that curriculum is "a term which is used with several meanings … [and] can be, and is, used, for many different kinds of programme of teaching and instruction" (2009, p. 7). Furthermore, he suggests that "quite often this leads to a limited concept of the curriculum, defined in terms of what teaching and instruction is to be offered and sometimes also what its purposes, its objectives, are" (2009, p. 7). Prior to providing his definition of the term, upon which his treatise is based, he argues that any definition of curriculum, if it is to be practically effective and productive, must offer much more than a statement about the knowledge-content or merely the
subjects which schooling is to ‘teach’ or ‘transmit’ or ‘deliver’. It must go far beyond this to an explanation, and indeed a justification, of the purposes of such transmission and an exploration of the effects that exposure to such knowledge and such subjects is likely to have, or is intended to have, on its recipients (2009, p. 9).

Based on this view, Kelly defines curriculum as “the overall rationale for any educational programme” (2009, p. 9). Once more, the reader is left to overlay personal interpretation upon the meaning of curriculum.

Print (1988, 1993) also acknowledges the variety of meanings of the term curriculum. In the first pages of *Curriculum Development and Design*, he presents a number of potential definitions for curriculum offered by a selection of curriculum specialists. All definitions have in common the concept that curriculum consists of planned activities (and experiences) though not all include the need for those activities to deliver a desired set of outcomes or goals. To these definitions Print adds that curriculum “includes not only content and a detailed statement of curriculum intent (aims, goals and objectives), but also the other curriculum elements including detailed learning activities and evaluation procedures” (Print, 1993, p. 7).

Prior to providing his own definition, interestingly he notes that the search for a definition has “become increasingly problematic … [and] rather than achieving consensus and thereby enhancing effective communication the literature reveals continued differentiation and disputation as to an acceptable definition” (Print, 1993, p. 7), which leads him to suggest that when writing and teaching about curriculum one should preface “their statements about curriculum by their interpretation of the concept” (p. 7, original emphasis). I will argue through this thesis that a commonly understood and agreed definition will not only enhance effective communication but will lead to improved student outcomes.

Print provides his definition of curriculum a few pages later. For Print, curriculum is “all the planned learning opportunities offered to learners by the educational institution and the experiences learners encounter when the curriculum is implemented” (Print, 1993, p. 9, original emphasis). The reader is left to wonder why a few pages earlier when
comparing the terms ‘curriculum’ and ‘syllabus’ (p. 7) he appears to provide a definition which is substantially changed by the time he provides his own, specific definition. If one puts the page 7 definition (noted in the preceding paragraph) and his actual definition together, one ends up with a clear, succinct definition and useful definition. It is left to the reader, however, to join the two parts of his definition into one useful definition that can be used to guide the development of their curriculum.

In the period between Print writing his seminal text and Wiggins and McTighe (2000; 2005) writing Understanding by Design, it appears there has been little movement towards a commonly understood definition when they acknowledge “that the words curriculum and assessment have almost as many meanings as there are people using the terms” (Wiggins & McTighe, 2005, p. 5, original emphasis). They follow Print’s recommendation to provide the reader with a definition, explaining that curriculum is “the specific blueprint for learning that is derived from desired results – that is, content and performance standards ... tak[ing] content ... and shap[ing] it into a plan for how to conduct effective and engaging teaching and learning” (p. 5, original emphasis). They conclude their definition with the statement that curriculum can be seen as “a map for how to achieve the ‘outputs’ of desired student performance, in which appropriate learning activities and assessment are suggested to make it more likely that students achieve the desired results” (p. 6).

Wiles (2008) in Leading Curriculum Development acknowledges the lack of agreement on the definition of curriculum while noting he “favour[s] a dynamic and adaptive definition of curriculum work” but provides no explanation of what this means in practice. Instead he launches into his own definition, stating that “the curriculum represents a set of desired goals or values that are activated through a development process and culminate in successful learning experiences for students” (Wiles, 2008, p. 2). Curriculum designers and developers are presented with another definition that is too general to provide any real guidance and one that is open to individual interpretation.

The preceding authors, while discussing curriculum in a relatively generic manner, have considered curriculum mostly as it relates to the school curriculum, both in Australia and overseas. Turning to the authors who have considered curriculum in the context of higher education, both in Australia and overseas, we find that despite higher education being “ever more important to increasing numbers of people ... there is very little talk about the
The very idea of curriculum is pretty well missing altogether” (Barnett & Coate, 2005, p. 1). As noted at the start of this section, O. Hicks (2007) echoes this sentiment.

According to Barnett and Coate (2005) there “are hardly any modern books ... that explicitly focus on the curriculum in higher education ... [and] where such books do focus on curriculum matters, they are contained within a discussion more oriented towards improving teaching” (p. 15). They too acknowledge the lack of clarity of understanding arguing, “a vocabulary of fuzziness abounds” (p. 5).

Toohey (1999), in Designing Courses for Higher Education, does not provide a specific definition of curriculum nor is she clear about whether she is discussing degree programs or individual units of study (called courses in this thesis). This leads to confusion and a lack of clarity about the relationship between curriculum and course design. For example, on page 1 she states that “design of the curriculum” is where the “creativity and power in teaching lies” as it encompasses “the choice of texts and ideas which become the focus of study, the planning of experiences for students and the means by which achievement is assessed”. The context implies she is talking about a program curriculum when she uses the term course as she later suggests the opportunities for individual teachers in higher education “to contribute to the design of the course on which they teach may be limited to those units for which they have responsibility” (p. 1). This confusion of terms and context is evident throughout.

Conversely Heywood (2005), in Engineering education: Research and development in curriculum and instruction, proposes a specific definition of curriculum. He contends that the curriculum is “the formal mechanism through which intended educational aims are achieved” (p. 3). He does not acknowledge, however, the variety of understandings that exist nor identify any antecedents, simply stating, “in order to understand the curriculum process, it is necessary to offer a definition of the curriculum” (p. 3).

Lattuca and Stark (2009) in Shaping the College Curriculum: Academic Plans in Action also provide a definition for curriculum. Like others (Print, 1993; Stenhouse, 1975; Zais, 1976), they acknowledge the variety of definitions and understandings of the term and begin with a number of possible definitions drawn from research they conducted previously. They note that not only academics but even students will be able to provide a definition for curriculum, saying students are likely to believe it is “a set of courses or experiences
needed to complete a college degree ... [and it] may include teaching methods” (p. 1). From an academic point of view Lattuca and Stark (2009) suggest that, while a variety of definitions exists, they all encompass “at least one and usually more” of the following elements:

- A college’s or program’s mission, purpose, or collective expression of what is important for students to learn
- A set of experiences that some authorities believe all students should have
- The set of courses offered to students
- The set of courses students actually elect from those available
- The content of a specific discipline
- The time and credit frame in which the college provides education (pp. 1-2)

Lattuca and Stark (2009) argue that not only are there a variety of definitions and concepts of curriculum, but also that the term curriculum is “ambiguous ... [and] has been frequently modified by several equally ambiguous adjectives such as ‘coherent’ and ‘rigorous’ or linked with processes such as integration” (pp. 2-3). Moreover, they argue, “most definitions are too general to be very helpful to faculty and administrators faced with the task of curriculum development or revision” (p. 3). Lattuca and Stark's argument is supported by many of the definitions of curriculum presented so far.

Despite this lack of a commonly accepted definition, our discussions of curriculum assume a common understanding (Conrad & Pratt, 1986). To overcome this lack of a “comprehensive definition of curriculum”, Lattuca and Stark (2009) “propose the concept of the academic plan” (p. 4). They argue that their “academic plan definition implies a deliberate planning process that focuses attention on important educational considerations ... [and] provides a heuristic that encourages a careful process of decision making” (p. 4). The academic plan requires decisions to be made about eight elements: purpose, content, sequence, learners, instructional processes, instructional resources, evaluation, and adjustment (pp. 4-5). They further contend that this “set of elements provides a definition that is applicable to all levels of curriculum” (p. 5) because
an academic plan can be constructed for a single lesson, for a single course, for aggregations of courses (for example, a program or major), for broader organizational groupings of majors (such as schools or colleges), and for a college or university as whole. (p. 5)

According to Lattuca and Stark (2009), in addition to improving communication about curriculum, there are benefits from defining curriculum as a plan because it allows “plans at these several organisational levels to be examined for integrity and consistency” (p. 5). Lattuca and Stark’s academic plan relates to the abstract notion of curriculum identified by Zais and presents a view of a curriculum. The notion that lessons, courses, aggregations of courses, and programs, all have associated curricula and that this view enables those curricula to be evaluated for integrity and consistency is an important theme within this thesis.

Many of the other books and articles which address teaching and learning within the context of higher education do not provide a specific definition of curriculum: the reader is left to extract a definition, or to overlay what they understand on what the author says. For example, Prosser and Trigwell in Understanding Learning and Teaching (1999) do not attempt to link their descriptions and suggestions on how to improve teaching and learning outcomes to the curriculum. Diamond in Designing and Assessing Courses and Curricula (2008) talks frequently and interchangeably about curriculum and course design but without providing a definition for curriculum. When he says “designing a quality course or curriculum is always difficult” (p. 5) it appears that for him at least, course design and curriculum are the same thing. Neither does Fink in Creating Significant Learning Experiences (2013) attempt to define curriculum despite her focus on how to improve the design and implementation of courses so that we provide “significant learning experiences” for our students. As each takes a slightly different approach to what they mean and what is encompassed by curriculum, the academic who reads more than one of these works is likely to be left confused by how they might apply the concepts to which they have been introduced.

Prideaux (2003), writing in the British Medical Journal, offers yet another definition of curriculum. He suggests curriculum is the “expression of educational ideas in practice .. in a form that can be communicated to those associated with the learning institution ... [and
which is] open to critique, and ... able to be readily transformed into practice”. He makes no note of other definitions nor provides background to his definition and the structural elements of curriculum he includes.

At the Workshop on Scalability Issues in Artificial Intelligence in Education, Kay and Gluga (2009), cite the Online Oxford Dictionary when defining curriculum as "the subjects comprising a course of study in a school or college". They annotate this with “synonyms [for curriculum] include degree and degree program" (original emphasis). They also provide a definition of the term syllabus. They note this is “the topics in a course of study or teaching, especially for an examination” adding the explanation that “whilst a curriculum or degree is a collection of subjects, a syllabus is a collection of the topic and outcome requirements for the curriculum. Synonyms include degree requirements and curriculum requirements” (Kay & Gluga, 2009, original emphasis). There is no further explanation of these confusing definitions.

As this research is set in Australia, I attempted to find out how Australian higher education institutions and governance bodies define curriculum. Although the term is widely used, in official documentation and websites, frequently it is without any attempt at definition. An example of this can be found on the website of the University of Queensland (UQ) Institute for Teaching and Learning Innovation (ITaLI) (UQ, 2015). One of the principal purposes of ITaLI is to “collate and analyse student data for institutional reporting, Academic Program Review (APR) and Curriculum and Teaching Quality Appraisal (CTQA)”. Their website regularly mentions the “internationalisation of the curriculum” and aims to deliver an understanding of what this means but without providing any idea of just what is meant by curriculum.

The Australian National University (ANU) University glossary notes that curriculum “covers a wide range of aspects of the student learning experience, including learning outcomes, scope and sequence of knowledge (syllabus), details of content, skills, learning experience, resources, pedagogy, assessment, evaluation and review, and reporting”. According to the ANU, curriculum is “a description of the formative experiences available to a student enrolled in a particular course of study, of the academic achievements expected of a student who successfully completes the course, and of the ways in which the student's achievements will be reported. (cf. Syllabus.)”. The glossary, however, fails to provide a definition of syllabus with which the definition of curriculum can be contrasted.
In contrast, the University of Adelaide (UoA) in its *Guidelines for Curriculum Development and Review at the University of Adelaide* (Kiley, 1994), provides a clear definition. They use Print's definition, that is, a curriculum is:

all the planned learning opportunities offered to learners by the educational institution and the experiences learners encounter when the curriculum is implemented. (p. 2)

The Australian Government sets regulations governing higher education, but the Australian Qualifications Framework (AQF) (2013) makes no mention of curriculum in its glossary of terminology. Under the definition of "program of learning", however, it says that "a program of learning is a course, curriculum, training package, units of study, or structured workplace learning that leads to the award of a qualification" (p. 98, original emphasis). This definition is so broad as to provide little guidance or assistance to an academic looking to understand exactly what is included within the framework.

What is most striking about all these definitions is the inclusion of a variety of educational concerns under the one umbrella term, which leads to the obfuscation of a clear understanding. I contend that Lattuca and Stark (2009) are aware of the confusion that arises from using a single term to mean multiple, different concepts when they propose their "academic plan". Lattuca and Stark (2009) separate the curriculum – content and sequence – and the process of curriculum development, which they refer to as "the iterative process of planning", calling the combination of both an "academic plan" rather than a curriculum.

Compounding the confusion of understanding that surrounds the term curriculum is a veritable "minefield of terminological confusion" (Allan, 1996, p. 93, citing Rowntree, 1982, p. 31). Many of the terms used when defining and describing curriculum commonly have different meanings depending upon the background of the author or the context in which they are used. Like curriculum, these terms are generally used without an attempt at definition and an assumption of a common understanding. Examples include the terms ‘course’ and ‘program’, which frequently appear to be synonyms. Confusingly, however, the term ‘course’ may also be a synonym for ‘unit’ or ‘subject’. Authors, however, often do not provide clarification of which meaning they have ascribed to these terms; they assume we all have the same understanding. Another very common example of confusing
terminology used when describing curriculum are ‘learning outcomes’ and ‘learning objectives’. They appear to be used interchangeably but it is unclear if they have different meanings or are synonyms.

Confusion also surrounds the term syllabus; another term which is widely used in connection with, and frequently confused with, curriculum. Often, the terms are used synonymously, especially when the author sees curriculum as content. It is probably safe to say that many academics would have difficulty in differentiating between the two (O. Hicks, 2007). Print (1993) states that “a syllabus is typically a list of content areas which are to be assessed ... [and is] a sub-section of curriculum and as such is subsumed within the broader concept” (p. 7).

This thesis takes the view that syllabus is an expression of one of the aspects of a curriculum and can be equated with the implemented curriculum, that is, the curriculum-in-use. For more detail on the curriculum-in-use, see Sub-Section 2.1.6.

Giving rise to significant confusion is the lack of consensus on whether the notion of pedagogy – that is, the practice of teaching, or instruction as it is sometimes referred to – is included or excluded from a definition of curriculum.

2.1.1.1 Curriculum and pedagogy – separate concerns?

Barnett and Coate (2005) suggest that for “many scholars, a curriculum is nothing except as realized” (p. 5) arguing this is because they lack clarity on where curriculum ends and pedagogy begins. For them, “curriculum is a set of educational experiences organized more or less deliberately” while “pedagogy is concerned with the acts of teaching that bring off that curriculum” (p. 5).

When others, such as Stenhouse (1975), Skilbeck (1990), or Prideaux (2003), talk about translation of the curriculum into practice, I suggest they implicitly exclude the notion of pedagogy (the practice of teaching) from their definitions of curriculum. On the other hand, Wiggins and McTighe (2005) include both notions of curriculum and pedagogy within their definition, despite their focus on planning.

The notion of separating pedagogy and curriculum is an important one for this thesis. I argue that pedagogy is a consequence of the translation or implementation of the
Not only does the literature fail to provide a commonly accepted understanding of and definition for curriculum, but it fails to provide a definitive answer as to whether curriculum encompasses both program and course-level concepts, or applies to one or the other but not both and if it applies to both, what the relationship between them is. This lack of clarity further compounds the confusion that surrounds curriculum.

2.1.1.2 The relationship between curriculum and programs of study and individual courses

Tyler (1949), in Basic Principles of Curriculum, is clear that what he is proposing relates to both programs and individual courses. Zais too in Curriculum Principles and Foundations Zais (1976, pp. 6-11) clearly implies the concepts of curriculum apply to both programs of study and individual courses, despite suggesting that specialists refer to a “program of studies” rather than curriculum when referring to a school’s course offerings.

Print (1988, 1993) on the other hand does not address this aspect of curriculum at all. However, he suggests curriculum is “all the planned learning opportunities offered to learners by the educational institution” (Print, 1993, p. 9, my emphasis). The inclusion of “all” implies Print sees curriculum as applying to a program rather than individual courses. Stenhouse (1975, p. 4) too provides no hint whether his definition applies to whole programs of study or its component parts or both. However, throughout An Introduction to Curriculum Research and Development, his language – singular verbs and nouns and use of terms such as “classroom teacher” – indicates he is more focussed at course level.

Lattuca and Stark (2009) clearly and specifically argue that their academic plan relates to all levels of curriculum from single lessons, through courses, aggregations of courses, up to programs and beyond (p. 5). Conversely, Biggs and Tang (1999) in Teaching for Quality Learning at University, Toohey (1999) in Designing Courses for Higher Education, and Fink (2013) in Creating Significant Learning Experiences all focus on curriculum design for individual higher education courses not programs. In fact, they do not even seem to consider that a course does not stand on its own, instead is but one component of the overall program and that individual courses must work together to deliver the desired outcomes of the program.
This thesis takes the view that the abstract concept of a curriculum applies across all levels from the degree program down through all the elements from which that degree program is constructed. It further takes the view that the curricula for a degree program are related to one another and form a loose hierarchy of curricula.

**Focus at individual course rather than degree program level**

Much of the literature (Barnett et al., 2001) which discusses curriculum in higher education focuses on curriculum as it relates to individual courses (for example, Biggs & Tang, 1999; Fink, 2013; Toohey, 1999) rather than to whole programs of study. Stark, Lowther, Sharp, and Arnold (1997) argue that individual academics focus their attention at course level curriculum because they are more heavily engaged in planning their courses than in planning programs. I suggest the literature also focuses at course level because the authors are themselves practitioners and so they too are more engaged in designing and developing course curricula rather than program curricula.

Importantly, however, when the focus is limited to either the program or the course, much of the complexity of curriculum is hidden. Given a degree program consists of many courses that must work together to deliver the program outcomes, if the decomposition of that program into its constituent courses is not considered, there can be little understanding of how those courses are going to work together to deliver the desired outcomes. On the other hand, if the focus is at individual course level, there is no ability to see the big picture and the part each course plays in helping to deliver the program outcomes. It is this complexity and the relationships between the different elements of curriculum and the different levels of curriculum that give rise to the dynamic nature of curriculum as discussed in Section 2.3.

If higher education is to go any way towards meeting the challenges it faces, not only must detailed attention be given to curriculum (Barnett & Coate, 2005), but the curriculum itself needs to be understood as a composite, multi-levelled whole.

Confusion is also caused because, as noted by Lattuca and Stark (2009), the term curriculum is frequently modified by an adjective. Along with providing contextual meaning, many of these adjectives suggest there are a number of different types of curriculum.
2.1.2 Types of curriculum

The literature commonly uses the following adjectives to describe curriculum (Eisner, 1985; Kelly, 1977, 2009; Print, 1988, 1993; Prosser & Trigwell, 1999; Ramsden, 2003 among others).

- **Context**
  - *entitlement* – what society believes learners should be exposed to
  - *ideal or recommended* – that proposed by scholars
  - *national* – against which the central government can assess learning
  - *systemic* – e.g. the Australian primary school curriculum
  - *school or institutional* – e.g. the Red Hill Public School curriculum
  - *subject* – e.g. the K-10 social studies curriculum

- **Institutional**
  - *available or supported* – that which can be taught through provision of appropriate resources
  - *core* – that which all learners undertaking a specific program of study must learn
  - *formal* – the activities for which time is set aside during the school, or university, day
  - *informal* – the activities that happen outside the formal school, or university day, e.g. lunch-time, what may also be known as *extra-curricular* activities

- **The curriculum**
  - *hidden* – what learners learn but which is not articulated within the curriculum (unintended outcomes, complying with the ‘norms’ of the discipline, organisation or course)
  - *implemented* – that which is actually taught
  - *intended or written or planned* – that which is set out in a syllabus or prospectus, what organisations develop showing what students should be taught
  - *null* – that which is ignored, or specifically not taught, thus sending the message it is unimportant. This is often related to the hidden curriculum
  - *received* – that which the students actually experience, often referred to as the ‘student experience’.
Rather than identifying different types of curriculum per se, these adjectives are needed to provide clarification because of the confusion of understanding surrounding the exact meaning of the term curriculum. Adding a qualifying adjective is one way of notionally clarifying the meaning of a term for which many implicitly understand a variety of understandings exist.

Print (1993, p. 7) suggests that the need to qualify the term curriculum relates to the different perceptions individuals bring to the notion of curriculum rather than to the lack of a common understanding. While individual academics will always bring their own perceptions to the notion of curriculum, a commonly understood, clear definition of curriculum would largely remove the need for adding such adjectival descriptors.

Importantly I suggest these different ‘types’ of curriculum are much more than simply different perceptions individuals have of curriculum. I suggest they are in fact the different layers of curricular concepts that come into being as the curriculum is implemented. (For more detail, see Sub-Section 6.1 below.)

The concept of constructivism may provide an explanation for the existence of this variety of conceptions, definitions, and understandings of the term curriculum.

2.1.3 Constructivism and the multiple understandings of curriculum

The multiple perceptions of the term curriculum and our assumption that we all have a common understanding may be explained using the notions of radical constructivism (von Glasersfeld, 2010). We assume words themselves carry meaning and that meaning is shared by other speakers of our language (von Glasersfeld, 2010). However, the meaning an individual gives to a word, especially one used to describe a concept, is subjective, determined by the individual’s own experience. As our experiences and interactions cause us to modify or to create new concepts we are largely unaware of the change in conceptual understanding this causes because our interpretation still fits within our conceptual understanding of the world (von Glasersfeld, 2010). It is only when the context in which a word is used conflicts with our understanding that we are forced to question our understanding, and possibly to modify that understanding (von Glasersfeld, 1983).

Just how academics perceive the term curriculum and what is meant when they use it depends largely upon both their perceptions and the context in which it is used. According
to Lattuca and Stark (2009; 1993) disciplinary differences are evident in both the intent and meaning of curriculum. University academics are trained in a knowledge domain, such as engineering, medicine, law, and this domain as well as their experiences affect their concepts of curriculum and the decision making process in which they engage when working with their curriculum (Lattuca & Stark, 2009, p. 77).

As can be seen from the preceding sections of this chapter, the literature provides a broad variety of conceptions and definitions of curriculum. While many definitions share attributes, there are no common sets of attributes around which to categorise definitions. Notwithstanding an inability to group and categorise the various definitions and understandings of curriculum presented in the literature, I suggest that explicitly identifying and defining the concepts included in the notion of curriculum will facilitate better understanding.

2.1.4 Concepts of curriculum

An analysis of the literature on curriculum presented above enabled a number of concepts to be extracted from those definitions. I suggest the term curriculum encapsulates some or all of the following concepts:

- **a concept** – that is how one thinks about a curriculum in the abstract or meta-level – identifiable when one talks about a curriculum (any curriculum), rather than the curriculum (for a specific program or course). Description of the abstract notion of curriculum is likely to refer to “curriculum elements” as in “the arrangement of curriculum elements” (Print, 1993, p. 24; 1993) or the “components or elements included in a curriculum” (Zais, 1976, p. 16);

- **an artefact** – a set of documents (for implementation), the curriculum, e.g. the written, published, planned, intended curriculum – that “lays down the ground to be covered … the methods to be used for each subject … [and includes] statements about aims” (Stenhouse, 1975, p. 1), which is represented in documents (Print, 1988, 1993) “of several levels of generality” (Glatthorn, 1987, p. 1) and is open to critique and translation into practice (Prideaux, 2003; Stenhouse, 1975), or implemented (Glatthorn, 1987; Kiley, 1994;
Print, 1988, 1993; Skilbeck, 1990). Furthermore, it can be seen as a plan that is likely to provide a “prescription” of what one would like to happen (Stenhouse, 1975) or provide a “guide” to the desired learning (Glatthorn, 1987);

• a body of knowledge –
that is the content (that is to be transmitted, delivered, taught) –
often identified as “topics in a course of study” or a “collection of subjects” (Kay & Gluga, 2009), or simply content (ANU; Kelly, 1977, 2009; Lattuca & Stark, 2009; Stenhouse, 1975) and knowledge (Kelly, 1977, 2009), which may be implied by a “field of study” (Zais, 1976, p. 3), and “the choice of texts and ideas which become the focus of study” (Toohey, 1999);

• a process –
the life cycle of curriculum planning, design, development and implementation, i.e. the iterative, non-linear process that incorporates the phases of inception, design, development, delivery (teaching), evaluation, change and retire – as clearly identified by Zais (1976), Lattuca and Stark (2009) and Wiles (2008). While many of those writing about curriculum do not specifically identify a process, I suggest that describing curriculum as a plan (Glatthorn, 1987; Saylor, Alexander, & Lewis, 1981; Stenhouse, 1975), a set of plans (Barnett & Coate, 2005; Eisner, 1985), or suggesting the curriculum is planned (Inlow, 1966; Kiley, 1994; Neagley & Evans, 1967; Print, 1988, 1993; Tyler, 1949), implies a process, as does the use of the term design in association with curricular activities (Diamond, 2008; Toohey, 1999);

• a product –
which can be seen as an attempt to achieve certain objectives through the structure and organization of the elements of a curriculum and then the testing of performance –
and is represented in the literature variously as “a structured series of intended learning outcomes” (Johnson, 1967, p. 130), “the planned composite effort … to guide pupil learning” (Inlow, 1966, p. 7), “sets of learning opportunities” (Saylor et al., 1981), “a set of educational experiences organised more or less deliberately” (Barnett & Coate, 2005, p. 5), and “a set of experiences … some authorities believe all students should have, the set of courses offered to students” (Lattuca & Stark, 2009, p. 1). It usually includes the notion of a “series of planned events” (Eisner, 1985) captured in the sequencing of “the subject matter and experiences intended
to lead to specific outcomes for learners” (Lattuca & Stark, 2009, p. 4) and these products can then be measured or evaluated. The concept of product may be expressed by the artefact;

- **a practice (pedagogy or praxis)** –
  an approach to delivery (of content to achieve certain objectives) –
  including “the methods to be used” (Stenhouse, 1975, p. 1), the “actualisation of those plans in the classroom” (Glatthorn, 1987), leading to “classroom experiences” (Wiles, 2008) and “experiences resulting from implementing that [curriculum] document” (Print, 1993). For many, this concept may be subsumed into the concept of process. I have left it as a distinct concept because it encapsulates the approach to delivery rather than the delivery itself, but more importantly, in some definitions pedagogy is explicitly excluded.

Barnett and Coate (2005) explicitly remove teaching practice, or pedagogy, from their definition of curriculum, arguing that the “curriculum sets out the aims and pedagogy looks to realise those aims in the most efficacious way” (pp. 5-6). I suggest that when Skilbeck (1990) talks about “designs … and the implementation of these” and when both Stenhouse (1975) and Prideaux (2003) suggest that the curriculum is translated into practice, they too see teaching methods (pedagogy or praxis) as concepts sitting outside a definition of curriculum.

Others include pedagogy within their concepts of curriculum. For example, Glatthorn (1987) explicitly includes pedagogy saying “curriculum includes instruction”. He argues that the view “curriculum is what is taught and instruction is how it is taught” does not make sense because “such a separation … divides two entities that are almost inseparable. Almost all curriculum guides include suggestions for teaching – that is instruction” (p. 2). When Glatthorn (1987) says “almost all curriculum guides include suggestions for teaching” it is merely a defence of the status quo. That almost all guides include suggestions for teaching does not make it a correct or valid assertion, it is just common practice, which may, or may not be, based on a fallacy.

To overcome the issue of whether pedagogy is included in curriculum or is external to it, Zais (1976, p. 12) proposes a continuum that bridges the divide between the curriculum and pedagogy and which tends to support Glatthorn's (1987) claim that the entities of curriculum and teaching are “almost inseparable” (my emphasis). Zais' continuum is
based upon Taba's premise that "distinctions need to be drawn between aspects of learning processes and activities that are of concern in curriculum development and those that can be allocated to the realm of specific methods of teaching" (Taba & Spalding, 1962). Zais suggests curriculum sits at one end of the continuum and is "ultimate-general" while instruction sits at the other end and is "immediate-specific" and describes the continuum as something "along which subjective judgments are made to determine the curricular or instructional nature of educational phenomena" (Zais, 1976, p. 12, original emphasis).

Such a continuum permits the drawing of a hazy distinction between the activities related to curriculum and those related to pedagogy and instruction. It also enables the argument to be made that within the curriculum document "prescribed content should be specific enough to provide a focal thrust for the teacher, but general enough to allow for specific content and materials to be selected according to the teacher's personality and teaching style, and the students' needs and interests" (Zais, 1976, p. 13).

In this thesis, I argue that the official-curriculum contains high-level details of what is taught and why, while the implementation of that curriculum determines the detail of what is taught and importantly, how it is taught. The official-curriculum sits on the left of Zais' continuum and is "ultimate-general". The lifecycle process of curriculum causes it to move along the continuum to become ever more "immediate specific" and leads to the creation of layers of curriculum (see 5.2.7 below).

The lifecycle process begins with the design of the official-curriculum – curriculum-as-artefact – which is translated into the curriculum-in-use. (Section 2.1.6 below provides definitions for curriculum-as-artefact and curriculum-in-use.) The curriculum-in-use is then implemented, that is it is taught and evaluated. This process is represented in Figure 2.1, which is an adaptation of Zais’ diagram.

![Curricular Continuum](See Pull-Out Figure 2.1)

Importantly, however, if the curriculum is to be “practically effective and productive” (Kelly, 2009, p. 9), it must go beyond a simple statement of content or knowledge that is to
be taught, transmitted or delivered “to an explanation, and indeed a justification, of the purposes of such transmission”. It must provide “the overall rationale for any educational programme” (Kelly, 2009, p. 9) and must enable the delivery of “a set of purposeful, intended experiences” (Knight, 2001). When discussing how others may define curriculum Stenhouse (1975) also makes note of this important aspect saying the curriculum might “also make statements about aims”. Interestingly, however, he does not include this within his own definition instead saying that the curriculum communicates “the essential principles and features of an educational proposal” (Stenhouse, p. 4). Others do not make mention of it at all.

I suggest, including within the curriculum itself the rationale behind the “set of desired goals or values” (Wiles, 2008, p. 2) is particularly important as the rationale effectively records which might be called ‘corporate knowledge’. It documents for those who are not involved in the development of the curriculum, the reasons driving the choice of goals or values and desired outcomes.

As humans make decisions based upon what they believe to be the truth (Sinek, 2009), if we possess a variety of understandings of a situation or thing, then our curricular decisions and behaviour will vary according to what it is we understand curriculum to be. If academics are to collaborate meaningfully on the design, development, and implementation of curriculum then it is important they all possess a similar understanding.

2.1.5 The importance of a common understanding

Print (1993) notes that “the search for an appropriate definition of the term ‘curriculum’ has become increasingly problematic over time” leading to his recommendation “that those writing ... about curriculum are well advised to preface their statement ... by their interpretation of the concept” (p. 7, original emphasis). As both Conrad and Pratt (1986) and Lattuca and Stark (2009) observe, despite lacking a commonly understood definition, those writing about curriculum as well as those involved with its design, development and implementation regularly do not first provide their interpretation of the concept. Instead, they talk about curriculum as if we all have the same, well-accepted view of the concept. I suggest that this lack of a commonly understood and widely accepted definition of curriculum leads to the loss of “course cohesion” (Bahr & Lloyd, 2011).
The way we perceive curriculum determines our approach to it, not only the decisions we make, but the processes we engage in when designing, developing, implementing and evaluating it (Ornstein, 1987). “We make decisions based on what we *think* we know” (Sinek, 2009, p. 11, original emphasis); what we perceive to be the truth. The assumptions upon which we base our decisions are often grounded on incomplete or incorrect information (Sinek, 2009). Our mental models of the world are based on these assumptions and perceived truths. An individual’s mental models, however, limit their ability to see other possibilities because “most people are drawn to take in and remember only the information that reinforces their existing mental models” (Senge et al., 2000, p. 67).

Without a commonly understood and accepted definition of curriculum the likelihood of designing a quality curriculum, that facilitates the achievement of its desired outcomes, drops. Even if we do to design a quality curriculum exhibiting the desired characteristics of coherence, cohesion and alignment (as discussed in Sub-Section 2.2.2 below), without a common understanding, it is unlikely that we will be able to maintain that quality of design over the life of the curriculum (Bahr & Lloyd, 2011).

Furthermore, Lattuca and Stark (2009, p. 2) argue that when academics do not possess a common view of curriculum they rarely link elements into an integrated definition of curriculum. Instead, they are most likely to think of separate processes and tasks related to determination of the credit-value or weight of a course, content to include, teaching approach to adopt, or desired student outcomes and assessment. Without an integrated view of curriculum, the outcomes achieved will be less than they might otherwise be as it is likely to be impossible to develop a coherent, cohesive, and aligned curriculum.

To overcome the problems caused by different understandings, Lattuca and Stark (2009) suggest a widely understood and accepted “definitional framework” needs to be developed. Such a framework would facilitate “productive discussions and wise decisions ... [and] inform curricular revisions” (pp. 2-3).

If it is to be effective, a definitional framework must relate to the concept of a curriculum – what I have called *curriculum-in-the-abstract*. The domain of higher education is typified by a wide variety of institutions, degree programs, and individual courses that meet the diverse needs of those societies, institutions, and students. What is required is “a
definition of curriculum that can be applied across these differences” (Lattuca & Stark, 2009, p. 4).

So long as such a definitional framework relates to a curriculum, “defining the term curriculum does not mean that everyone must agree on the content to be studied, how it should be studied, or who should study it. It does not mean that everyone must agree on the specific skills or outcomes students must achieve” (Lattuca & Stark, 2009, pp. 3-4, my emphasis). Nor does it mean that everyone must agree on teaching approaches. A definition simply means “a statement of the exact meaning of a word” (OED, 1995).

Unless academics possess a clear and well-understood definition of the elements that comprise a curriculum, when they create the curriculum it is likely that the ability of the official-curriculum to facilitate communication of its intentions with students and others will be diminished. It is likely also that it may be less cohesive, coherent and aligned, and that it will make it more difficult to effectively evaluate its success or otherwise and that over time there will be a loss of “course cohesion” (Bahr & Lloyd, 2011).

To overcome the issues identified in this chapter that spring from a lack of a common understanding of curriculum and from not providing a clear definition for the reader, I provide a set of definitions of curriculum upon which this thesis is based.

2.1.6 Definitions of curriculum used in this thesis

Given the multiple perceptions, conceptions and definitions of curriculum it is important I provide a clear description of curriculum as used throughout this thesis. As noted in the Sub-Section 2.1.4, one can talk about a curriculum and the curriculum, as well as the translation or implementation of the curriculum. This requires three separate definitions.

The first, *curriculum-in-the-abstract*, provides a definition of the concepts included in a curriculum. The second, *curriculum-as-artefact*, provides a definition of the curriculum, the official, or written curriculum. The third, the translated and implemented curriculum, provides a definition for the *curriculum-in-use*, the curriculum that is being presented to students. All definitions apply to whole programs of study, but apply equally to the building blocks – courses, units, modules, majors – that make up that program.
Curriculum-in-the-abstract – the concepts comprising ‘a curriculum’ –

Incorporates the three curricular elements of (1) purpose, including the rationale for that purpose, (2) desired or intended learning outcomes, and (3) content, and is presented in a manner such that it is open to critical scrutiny and capable of effective translation into practice, and is also represented formally in writing.

Curriculum-as-artefact – The curriculum – the published, planned curriculum, the official-curriculum, and is the instantiation, the making concrete of the abstract concept, of a curriculum.

Using the curricular elements contained within curriculum-in-the-abstract, to create the official-curriculum that is developed by an organisation and is what should be taught by the teachers and learned by students in that institution. It includes the overall rationale; high-level descriptions of purpose, learning outcomes, and content; and is expressed in a form that can be translated readily into practice and can be communicated clearly to those associated with the institution.

Curriculum-in-use – the translated and implemented curriculum – ‘the official-curriculum’ that has been translated into ‘the curriculum-in-use’ and implemented by teachers of the organisation

It includes detailed descriptions of intent, learning outcomes, learning activities, and associated content, as well as methods of delivery and assessment of learning. It is expressed in a manner that it can be readily critiqued and evaluated, and can be communicated to those associated with the institution.

Syllabus is a sub-component of this aspect of curriculum and provides the structure, the sequencing of topics and activities identified within the implemented curriculum.

A ‘translated’ curriculum will then be implemented: it will be delivered, taught.

Accepting that the curriculum is one of the most important artefacts created by higher education institutions (Barnett et al., 2001), then those working with it must not only understand what it is but they must also understand what it means to design and
implement a high quality curriculum that will help maximise desired outcomes. I now turn my consideration of the literature to these aspects of curriculum. Firstly, I consider curriculum design, next I turn my attention to the aspects of curriculum design and implementation that educational research has shown lead to improved educational outcomes and finally I consider how the (official) curriculum is translated or implemented.

2.2 Curriculum design, excellence and implementation

Within the literature there appears to have been little consideration given to understanding how higher education academics actually design, develop, implement and make use of curriculum (Barnett & Coate, 2005; Stark, 2000). On the other hand, much has been written about what needs to be covered within the curriculum for specific fields of study (for example, Gorgone et al., 2003; McGettrick, Theys, Soldan, & Srimani, 2003; McLaughlin, Doezema, & Sklar, 2002; Shaw, 2005). Much has also been written about how curriculum might be implemented for greater effect (for example, Biggs, 2009; Chickering & Gamson, 1987; Chickering & Gamson, 2000; Lattuca, Terenzini, Volkwein, & Peterson, 2006; Savery, 2006; Tran, Le Ngoc Thanh, & Phuong, 2013). A great deal of this literature addresses how to improve student outcomes by improving higher education academics’ understanding and use of pedagogy (Barnett & Coate, 2005) rather than developing their understanding of curriculum and its impact on outcomes.

Compounding this situation caused by a lack of focus on curriculum within the literature, a large number of academics entering the academy “are not fully prepared for their role as educators” Ambrose and Norman (2006, p. 25). Many lack formal education related to teaching and learning (Felder & Brent, 2004; Postareff, Lindblom-Ylänne, & Nevgi, 2007) and most read little regarding the educational process (Stark et al., 1997; Van Der Vleuten, Dolmans, & Scherpbier, 2000), often being unaware that the literature even exists (Van Der Vleuten et al., 2000). Moreover, they do not discuss curriculum out of fear that such discussions will lead to a loss of academic freedom (Barnett, 2000) which they use “as a licence for self-indulgence” (Knight, 2001). Consequently, research-based evidence hardly affects their role as teachers and instead they rely on their intuition and tradition (Van Der Vleuten et al., 2000). Not surprisingly then, although many institutions have curriculum development committees these committees “lack the conceptual resources to construct curricula on an informed basis” (Barnett, 2000, p. 262).
Despite increasing numbers of higher education academics completing courses in teaching and learning there is little evidence that this training is making a difference (G. Gibbs & Coffey, 2000). Many still design their courses based on topics they think are important and often students do not actually develop the desired skills and understanding because of poor assessment and learning activities (Ambrose & Norman, 2006).

In order to achieve curricular excellence and enhanced student outcomes, we need to understand what is meant by curriculum design.

2.2.1 Curriculum design

Curriculum design, or what is sometimes also called curriculum organization, is the "arrangement of the elements of a curriculum" (Print, 1993, p. 94). Developing a curriculum design is concerned with deciding what those elements are, the relationships between them, how they work together to create a unified curriculum and the production of a "substantive entity" (Zais, 1976, p. 16).

This thesis adopts the view that curriculum design is the arrangement of the elements of a curriculum, the nature of those elements and the relationships between them leading to the creation of a unified entity, the official-curriculum. In other words, curriculum design is the implementation of the abstract concept of a curriculum. It must be noted, however, that surrounding the design of a curriculum, is a process of design, because the development of a design involves a decision-making process. (For detail on the process of design, see Chapter 3, especially Section 3.1.)

The curriculum design process takes the elements and relationships set out in a curriculum, perhaps as represented by a definitional framework (curriculum-in-the-abstract) and, through a tailoring process of deciding what is appropriate for the specific curriculum being designed, creates the official-curriculum (curriculum-as-artefact). (For definitions of curriculum-in-the-abstract and curriculum-as-artefact, see Section 2.1.6 above.)

This thesis takes the view that the process of designing the curriculum for a degree is the determination of which elements, and the nature of those elements, are appropriate in that particular instance and how they are going to work together to deliver the intent or purpose of the curriculum. The design of a specific program curriculum represents the
outcome of the design (decision-making) process that has determined, for example, whether majors and/or minors will form part of the program organisation, how many courses are needed to complete a program, which courses are compulsory and so on – and the relationships between those elements. The design represents the structure of the program.

Curriculum design may be seen as the tailoring of a template. The design process involves selecting appropriate elements from the whole, available set. The determination of the relationships between those selected elements will define the structure of the designed curriculum that is the output of the process. It is the structure that determines whether the purpose of the curriculum can be met.

However, because there is a lack of a common understanding of curriculum, "consensus about the relationships between the curriculum elements, their order and their exact nature has largely evaded those writing in the field" (Print, 1993, p. 63). The lack of both a common understanding of curriculum and consensus about its elements and the relationships between them, have led to the development of a variety of potential approaches to curriculum design, that is the design process leading to the creation of the official-curriculum and what elements should be included within the official-curriculum itself.

Current approaches discussed in the literature include “Backwards Design” (Wiggins & McTighe, 2001, 2005, n.d.); instructional design, including ADDIE (ATD, 2015; Molenda, 2003) and “The Dick and Carey Systems Approach Model” (Dick, Carey, & Carey, 2009); Lattuca and Stark's (2009; 1997) “Academic Plans”; and in engineering education, the Conceive, Design, Implement, Operate framework known as CDIO (CDIO.org; Crawley, 2002). These curriculum design approaches provide guidance on how to put the elements of curriculum together leading to the creation of a substantive entity, the official-curriculum, as well as suggesting how to address the decision-making process itself.

Higher education academics regularly do not use a documented approach to curriculum design (Stark, 2000) as many lack knowledge of these formal, educational approaches to curriculum design (Adams, 2002; Felder, Brent, & Prince, 2011; Fink, 2013; M. Hicks, Smigiel, Wilson, & Luzeckyj, 2010). This lack of knowledge can be explained, at least in part, by history. Until recently, discipline expertise was "the most respected feature of a university teacher" (Postareff et al., 2007). Sitting alongside respect for discipline
expertise, was the assumption that expert knowledge came with an ability to convey that knowledge to students (Speck, 2003).

In recognition that developing expert knowledge does not also develop an ability to convey that knowledge to others, there has been a trend in the past 15-20 years towards requiring educational training of higher education teaching academics (Postareff, Lindblom-Yläne, & Nevgi, 2008). The focus of this training, however, has been largely to improve educational outcomes through improving academics’ knowledge and application of pedagogy (Postareff et al., 2007; Speck, 2003) as well as “fine-tuning of well-defined behavioural classroom skills” (G. Gibbs & Coffey, 2000) rather than developing knowledge of curriculum design. Consequently, despite increased numbers of higher education academics possessing some form of pedagogical education, they still frequently have insufficient experience with curriculum models, both practically and theoretically to make use of them, as was noted by Print (1993).

Compounding the lack of knowledge of formal curriculum design approaches, a large number of higher education academics lack the time, motivation and incentive to enquire and learn about, or even to apply these approaches to curriculum design and development (Biggs, 2014; Fink, 2013; Lattuca et al., 2006). Such effort often not only goes unrewarded and unappreciated, but it may also harm their chances for promotion (Felder, Stice, & Rugarcia, 2000). Additionally, support from colleagues is seldom offered when attempting to follow a formal approach to curriculum design (Lattuca & Stark, 2009; Print, 1993).

Understanding what curriculum design is and how to go about it is not enough. Academics also need to know how to put their chosen curricular elements together and what the relationships between those elements need to be if they are to create an official-curriculum, which when implemented will maximise the potential for students achieving the desired outcomes. Despite the overall lack of research into curriculum in higher education, there has been significant research into curriculum itself and into what makes a quality curriculum: one that enhances learning.

2.2.2 Curricular excellence

Since Tyler (1949) proposed his “objectives based” approach to education in schools there has been more or less focus on achieving successful educational outcomes using curriculum design and its translation into practice.
When consideration is given to the curriculum, the search for educational excellence is often associated with instructional alignment. Instructional alignment is the strength of the alignment between “intended outcomes, instructional processes, and instructional assessment” (S. A. Cohen, 1987, p. 16). Research has shown that outcome driven design with the goals clearly determined before developing the instructional material itself, leads to a more aligned curriculum, which in turn produces better learning outcomes (S. A. Cohen, 1987; Lattuca & Stark, 2009). Despite this knowledge, in the United States at least, “criticisms of colleges have emphasized apparent lack of coherence and integrity of the programs of courses students take” (Stark et al., 1997).

The literature of the past 15 to 20 years concerned with educational excellence has built on the notion of instructional alignment. Today, it is suggested that educational excellence is more likely to be achieved when a curriculum is, among other things, coherent (Schmidt et al., 2002), cohesive (Allen, 2004) or constructively aligned (Biggs, 1996). I argue that the curriculum of a program can only exhibit integrity and be coherent and cohesive if it is also strongly aligned. This means that not only must all curricular elements – the intent, aims, goals and objectives (Diamond, 2008; Print, 1988, 1993; Zais, 1976) – of the program curriculum be aligned; all curricular elements for each and every course from which the program is built must also be aligned with those of the program. In other words, the product of the outcomes of the courses from which that program is constructed determines the outcomes for a higher education program of study.

Frequently, however, consideration of alignment, especially constructive alignment (Biggs, 1996), is at individual course rather than program level. Without considering the individual courses from which a program is constructed within the context of the overall program, I suggest it is difficult to be certain that the overall outcomes of the program can be adequately delivered. The development of a definitional framework for curriculum may assist with both evaluating and maintaining the alignment and integrity of a program as it would identify the relationships between the different levels of curriculum, between course outcomes and program outcomes.

2.2.2.1 Curricular alignment

To evaluate curricular alignment, curriculum mapping is frequently used. Curriculum mapping is "the process of indexing or diagramming a curriculum to identify and address academic gaps, redundancies, and misalignments for purposes of improving the overall
coherence of a course of study and, by extension, its effectiveness” (Great Schools Partnership, 2013). The principal purpose behind curriculum mapping is to help academics and students visualise and understand the relationships between the key elements of a curriculum (Harden, 2001).

Curriculum mapping can be simple: a matrix approach that identifies gaps within a curriculum. It can also include a more complex implementation, providing contextualisation of how and where the attributes are embedded and assessed and, through the use of technology, may well include some form of visual representation of the relationships (Oliver, Ferns, Whelan, & Lilley, 2010; Uchiyama & Radin, 2009). In addition to mapping across individual courses – horizontal mapping – curriculum mapping is frequently used to map graduate attributes across courses that run in sequence – vertical mapping (Uchiyama & Radin, 2009).

Curriculum mapping is also associated with a culture of compliance (Oliver et al., 2010; Uchiyama & Radin, 2009) through quality assurance and accreditation processes (Bath, Smith, Stein, & Swann, 2004). In Australia, curriculum mapping activities are often associated with curriculum renewal processes in response to increased focus on quality assurance through the Tertiary Education Quality Standards Agency (TEQSA) (Oliver et al., 2010). Despite documented successes, however, more challenges than successes are usually reported (Oliver et al., 2010). According to Willett (2008) “the greatest challenges appear to concern demand for time and human resources”.

Curriculum mapping can also be used to help determine another aspect of curricular excellence identified in the literature, that of curricular coherence.

2.2.2.2 Curricular coherence

The concept of coherence (Angere, 2008) requires that the building blocks of the curriculum – from lessons through courses to aggregations of courses into majors or minors – all support each other to develop the goals and outcomes at each level and together support the goals and outcomes at program level. A coherent curriculum is one where over time content and outcomes develop from broad, surface knowledge and skills to deeper knowledge and more complex skills as students progress through the curriculum (Schmidt et al., 2002). A coherent curriculum is logical and consistent; it forms
a united entity rather than being composed of a collection of unconnected or only loosely connected courses. Importantly, it displays integrity.

Knight (2001, p. 369) argues, however, that “curriculum coherence is not widespread”. Gardiner (1966) (cited in Diamond, 2008, p. 85) makes a stronger argument, stating “most curricula are unfocused … [with] a notable absence of structure and coherence”. Without coherence, our curricula cannot support complex learning (Knight, 2001). When a curriculum lacks coherence and integrity, it is difficult to know whether what has been planned has been delivered, understood, and learned by students. Curricular coherence ensures that content and pedagogy – approaches to teaching and learning, and assessment – fit together.

When considering the evaluation and determination of the quality of program curricula, sometimes another concept closely related to curricular coherence is encountered; the notion of curricular cohesion.

2.2.2.3 Curricular cohesion

A cohesive curriculum is one that exhibits coherence, provides synthesising experiences, allows students ongoing practice of skills and provides systematically created opportunities to develop increasing sophistication and apply what is learned (Allen, 2004). Thus, a cohesive curriculum can be described as one where the pieces, for example the courses, fit together without unnecessary overlap or gaps, just as with a jigsaw.

Without focus on curriculum design – that is without an understanding of what is entailed by curriculum design – how to achieve quality design and what the impact of poor design is, it is likely higher education will be unable to deliver the quality of learning that is required for the 21st century.

When looking to improve the likelihood of students achieving the desired outcomes from a program, the final consideration is how to translate and implement the official-curriculum. For many, this is an integral part of what they see as curriculum design. This thesis takes the view that curriculum design relates to the creation of the official-curriculum while this final consideration relates to the movement along the curricular continuum (see Figure 2.1 above – included in pull-out figures) from the “ultimate-general” of the official-curriculum to the “immediate-specific” of the delivered curriculum-in-use. Also at this point those working with their curriculum take the relatively high level and abstract descriptions
included in the official-curriculum and begin the process of implementation; taking the abstract notions and turning them into concrete entities.

2.2.3 Curriculum implementation – Moving from the abstract to the concrete

Despite largely ignoring the conceptual notions of curriculum, the literature relating to curriculum design frequently includes consideration of the concepts of Constructive Alignment (Biggs, 1996, 1999a, 2002, 2003), Bloom’s Taxonomy (Krathwohl, 2002) and more recently also the SOLO taxonomy (Biggs, 1999b; Biggs & Collis, 2014). In my opinion, these are not approaches to curriculum design per se because they do not provide guidance on the choice of elements and the relationships between those elements; rather they are principles of, and tools that assist with, curriculum development. Bloom’s taxonomy is a principle academics can use to help develop the official-curriculum once it has been designed, constructive alignment is a tool for use when implementing the official-curriculum, and the SOLO taxonomy (Biggs & Collis, 2014) is a tool to help evaluate the quality of student learning.

Since 1956 and the publication of what has become known as “Bloom’s taxonomy” (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956), Bloom’s taxonomy has been used by academics to help write learning outcomes and / or develop assessment items as it provides a “carefully developed definition” (Krathwohl, 2002, p. 212) of categories of cognitive outcomes for learning (Coates, 2000). Bloom’s taxonomy is a tool used to assist decision making not only when writing outcomes, but also when designing learning and assessment activities.

Biggs (1996) proposed constructive alignment as a theory for curriculum design that would improve student learning-outcomes by optimising the conditions from which deep learning would emerge. According to Biggs, a constructively aligned curriculum integrates all aspects of teaching and assessment activities and aligns those with the intended learning outcomes (Biggs, 1996, 1999a, 2003). Intended learning outcomes are a statement of the qualities that students should exhibit by the end of the period of study. Constructive alignment bears strong resemblance to the approach recommended by Tyler (1949).
During the translation of the official-curriculum into practice, that is development of the *curriculum-in-use*, constructive alignment can play an important role. Constructive alignment is a “framework to guide decision-making in all stages in instructional design” (Biggs, 1996) which guides the determination of appropriate teaching and learning activities that will achieve the intended learning outcomes and then the assessment of the achievement of those objectives. Constructive alignment requires the translator to pay attention to the design of the learning activities and methods of assessment of learning delivered by those activities, such that they both work together to help deliver the intended learning outcomes (Houghton, 2004).

In his description and explanation of constructive alignment, Biggs does not identify the principles that should guide the choice of intended learning outcomes. Constructive alignment appears to assume that the intended learning outcomes have already been defined through some other process. Furthermore, although not something Biggs proposes, I suggest that during curriculum translation, ideally the concepts of constructive alignment should help the curriculum designer determine the alignment of the course intended learning outcomes with the goals or purpose of the official-curriculum.

Moreover, while Biggs and others do not generally suggest constructive alignment can be applied at higher education *program* level, I contend that depending on the model of curriculum one uses there is no reason it could not be applied to aspects of a lesson, whole lessons, and aspects of a course, individual courses, and even whole programs of study. In a recent paper Biggs (2014) implies that constructive alignment may be applied across institutions but not specifically across individual degree programs. Furthermore, much of Biggs’ and others’ writing about constructive alignment provides a pedagogical rather than a curricular focus.

While there are many other decisions required of academics when developing their curriculum design to meet the curricular intent and outcomes as set out in the official-curriculum, I do not consider them as they are outside the scope of this thesis. These might include deciding upon detailed content such as teaching examples, cases etc., determining pedagogical approaches appropriate to the time available, equipment availability, cost, student background, and deciding on and creating appropriate assessment activities and so on.
The ever-changing array of academics and students who are engaged in and with curriculum over time means curriculum changes throughout its life. It changes as academics and students change; it is a dynamic entity.

2.3 The dynamic nature of curriculum

Recognition of the dynamic nature of curriculum is what led Abrahamson (1978) to argue that the curriculum is “alive” (p. 952). When Bahr and Lloyd (2011) talk about the “elusive goal” of maintaining what they call “course cohesion” they too acknowledge curriculum dynamics. Lattuca and Stark (2009) also understand the dynamic nature of curriculum and reflect this in their concept of an “academic plan”. Diamond (2008) in his approach to curricular revision acknowledges its dynamic nature too.

Using systems terms to describe the curriculum, it may be characterised as a self-organising, non-linear, feedback system and as such its behaviour is inherently unpredictable: it is a complex adaptive system (Jackson, 2002). However, the Tyler model (Tyler, 1949) upon which constructive alignment (Biggs, 1996) is based, is the opposite: it is “prescribed, ordered, assessed and monitored” (Morrison, 2003, p. 280). Organisations, accreditation and governmental bodies see great benefit in this model as it is more likely to provide the stability and certainty they desire, but unfortunately it also tends to stifle creativity and excellence in teaching and learning (Morrison, 2003).

Many of those designing and developing as well as writing about curriculum do not understand the dynamic nature of curriculum and it is this lack of understanding which can lead to a loss of “course cohesion” (Bahr & Lloyd, 2011). Taking a systems view of curriculum helps in recognising and understanding the dynamic nature of curriculum and helps academics work with the system, rather than against it, to develop a curriculum that is dynamic and flexible, yet stable.

The following chapter presents an overview of the literature relating to the concepts of design, and systems and their nature, supporting my claim that curriculum is a dynamic entity. The chapter also discusses approaches to understanding system dynamics used within the domains of systems and software systems development. It suggests their use in relation to curriculum may provide greater understanding of the dynamic nature of curriculum and so lead to improved educational outcomes.
Chapter 3  SYSTEMS AND DESIGN

A problem never exists in isolation; it is surrounded by other problems in space and time. The more of the context of a problem that a scientist can comprehend, the greater are his chances of finding a truly adequate solution

Attributed to Russel L. Ackoff

The world of engineering and design has been dealing with highly complex problems for decades. Consequently, it has developed ways of dealing with such issues. One of those ways relates to systems, specifically system dynamics and systems thinking. Systems provide a way of viewing our environment and ourselves and understanding what is happening and, importantly, why. Taking a systems view of education helps us “understand the true nature of education as a complex, open and dynamic human activity system that operates in ever-changing multiple environments and interacts with a variety of societal systems” (Banathy, 1992, p. 17).

As I suggested in the preceding chapter, curriculum is a dynamic entity, leading to change throughout its life. In this chapter, I discuss the value academia may derive from treating the curriculum as a problem of design and from viewing curriculum as a dynamic, human activity system. Section 3.1 explains the difference between problem solving and design and draws parallels between the design and implementation of software and of curriculum. Section 3.2 presents the view of curriculum as a system – a dynamic, complex adaptive system – and explains how a systems view of curriculum will lead to an improved understanding of it and its behaviour. I explain why, when dealing with something as important and complex as curriculum, taking a reductionist view instead of a systems, big picture view, will lead to over-simplification of the problem and so give rise to a new set of problems. System dynamics, presented in Section 3.3, provides a means of understanding and explaining both the behaviour of complex adaptive systems, and the difficulty
experienced when attempting to control them. In Section 3.4, I use modelling approaches adopted by software developers to show how their use in curriculum development may bring greater clarity and understanding to curriculum. Finally, in Section 3.5, I show that understanding curriculum as a complex adaptive system and understanding the importance of design underpinning the development of curriculum may facilitate improved learning outcomes in a way that focusing attention on pedagogy alone cannot.

I turn first to the question of design and provide an explanation of what it is, especially when related to engineering and software design and development, which I relate to the design and development of curriculum.

3.1 Design

Design can be many things to many people, according to context or the background and interests of the individual (Bucciarelli, 1988). Blumrich (1970) describes design as a process to help define solutions for problems not solved before, as well as to provide better solutions for problems previously solved and is concerned with “creating the best ideas, systems and solutions within a set of context and constraints” (Estrin, 2014). It is an iterative process and includes all the activities from inception or conceptualisation through to implementation.

Problem solving and design are often considered to be the same thing. However, while one may say “completing an engineering design is solving a problem, ‘problem solving’ is not engineering design” (Dekker, 1995). Design is a problem-solving process, because the focus of design, like that of problem solving, is on “changing existing situations into preferred ones” (Herbert A Simon, 1996, p. 111). What differentiate the two are the activities that take place. Problem solving is something we all do regularly. For example, when the car does not start, we follow the steps of problem solving to resolve the issue. Resolving the issue of your car not starting is not design, however, because it doesn’t include conceptual and detailed design both of which are integral to the process of design (Dekker, 1995). Problem solving also frequently omits planning and reflection (Dekker, 1995) which are also both key steps in the process of design, especially engineering design.

Generally, the purpose of design is the creation of ‘things’. These ‘things’ include tangible objects such as buildings, bridges or machines; works of art such as music, sculpture or
paintings; and processes and procedures such as a manufacturing process, a science experiment or the plans for a marketing scheme or organisation (Dym & Little, 2004).

While design is fundamental to what engineers do, engineers are not the only professional designers. Design is an intellectual activity that is at the core of all professional training because “the solution to a design problem may be a plan for human activity, not an object” (Davis, 1998). Engineers, architects, business managers devising a new sales plan for a company, a bureaucrat developing social welfare policy for a state, doctors prescribing remedies for the sick, teachers, and lawyers among others, are all concerned with the process of design (Herbert A. Simon, 1988). In his keynote F. P. Brooks (2012a) reasoned that teaching itself is design. He explained that “the teacher’s job is to design learning experiences, not principally to deliver information” (F. P. Brooks, 2012b, pp. 9, 25) arguing that “mak[ing] learning happen … is a design task” (F. P. Brooks, 2012a).

Engineering design extends the conventional concept of design to include a generally agreed set of activities and artefacts that are produced as output from the design process. One of the biggest challenges facing engineering designers is the problems they encounter are most often open-ended and ill-structured (Dym & Little, 2004) which adds significant complexity to the task of design. Engineering has developed processes that facilitate the management of these challenges.

### 3.1.1 Engineering design process

Engineering design requires the blending of creativity and technical knowledge (Engineers Australia (EA), 2011) and “isn’t about perfect solutions; it’s about doing the best you can with limited resources” (Pausch, 2008, p. x). It is the mental process of conceiving of an idea and then communicating that idea, or ideas, to others in a form that is easily understood (Beroline & Wiebe, 2003). This too, should be the function of the curriculum designer and the curriculum itself. The curriculum designer conceives of the plan to achieve a desired purpose and then captures that design in the curriculum in such a manner that others can easily understand it. Engineering design is a cognitive process and for successful engineering design, heuristics and knowledge of design are essential ingredients (Bucciarelli, 1988). Again, I contend that this should be the process underlying the design of a curriculum.
Early in their study to become engineers, most students are introduced to a variety of models of the engineering design process, sometimes also called the engineering product lifecycle (Pahl, Beitz, Feldhusen, & Grote, 2007). Perhaps the best known is the four stage process model proposed by French (1998) shown in Figure 3.1 below (image reproduced with permission). The circles represent stages reached while the rectangles represent work in progress (French, 1998, p. 1).

![Engineering Design Process](image reproduced with permission)

French also wrote from an engineering perspective. He suggested, "The analysis of the problem is a small but important part of the overall process. The output is a statement of the problem, and this can have three elements:
- a statement of the design problem proper
- limitations placed up the solution,
  e.g. codes of practice, statutory requirements, customers' standards, date of completions
- the criterion of excellence to be worked to."

The conceptual design phase "takes the statement of the problem and generates broad solutions to it in the form of schemes. It is the phase that makes the greatest demands on the designer, and where there is the most scope for striking improvements. It is the phase where engineering science, practical knowledge, production methods and commercial aspects need to be brought together . . . ."

In the third phase, "schemes are worked up in greater detail and, if there is more than one, a final choice between them is made. The end product is usually a set of general arrangement drawings. There is (or should be) a great deal of feedback from this phase to the conceptual design phase.

In the detailing phase, "a very large number of small but essential points remain to be decided."

Figure 3.1 – Engineering Design Process (French, 1998, as cited in Dubberly, 2004, p. 31)
Image reproduced with permission
(See Pull-Out Figure 3.1)
An important aspect of engineering design is the requirement to communicate complex information precisely and unambiguously. In such situations, engineers and technologists principally use diagrams, models, and sketches. Visual modelling enables the multidisciplinary teams typical of engineering projects to convey complex information unambiguously.

Importantly, engineering drawings and models support the thinking process (Blumrich, 1970; Cross, 2008). Just as qualitative researchers use diagramming to support the thinking process and to capture ideas as they develop (Corbin & Strauss, 2008), so engineering diagrams and models are an integral part of the process of working iteratively through interventions and evaluating potential impact before actually implementing the proposed solution. For more detail about modelling, see Sub-Section 3.4 below. I suggest that modelling our curricula as they are designed, developed, and maintained will provide organisations with similar value.

Rompelman and Graaf (2006) argue that “the paradigms of design methodology and systems engineering ... [are] suitable for both analysing existing education and designing new curricula” (p. 215). The development of a new course, degree program or the innovation of an existing curriculum can also be seen as design task (Romiszowski, 1981; Rompelman & Graaf, 2006; Thom, Crossley, & Thom, 2002; Waks, 1995).

Although Lattuca and Stark (2009) have not specifically made a connection between their academic plan and engineering design I suggest that the process described when developing an academic plan could be mapped onto the basic engineering design process. Additionally, Lattuca and Stark (2009) identify the important role constraints play in curriculum design and development, arguing that “academic plans” exist in a sociocultural context that influences (or constrains) the educational environment in which the academic plan exists. Furthermore, they suggest that “a plan for any endeavour incorporates a total blueprint for action, including purposes, activities, and way of measuring success” (p. 4).

As noted above in Figure 3.1, the design process produces working drawings used to guide the implementation of the chosen solution. I argue that the official-curriculum carries the same function within the educational domain.

It is important to see curriculum design and development as design rather than problem solving (Lovat & Smith, 2003; Print, 1993). Taking a problem solving approach may mean the focus is on the idea that the problem can be solved rather than continuing to consider...
the ability of the curriculum to meet its specified goals over its lifetime. Engineering design takes account of the complete lifecycle from inception through to disposal and has constant iteration through all phases of the process (Rompelman & Graaf, 2006). Given the dynamic nature of curriculum, if our curricula are to support development of the best learning opportunities possible, it is important their fitness for purpose be assessed throughout their life (Faulconbridge & Dowling, 2009).

Surprisingly, engineering and computer science academics seldom seem to put their design skills into practice when they are faced with the task of developing a new course or program, or the innovation of an existing curriculum (Barnett, 2000; Rompelman & Graaf, 2006; Thom et al., 2002). Rompelman and Graaf (2006) suggest that as a systems approach can be applied to all sorts of design problems “it makes sense to apply this method to curriculum design” but they have been unable to “identify examples of such an approach” (p. 217). Banathy (1967, 1992) applies the concept of systems and suggests taking a systems approach to the larger domain of ‘education’ of which curriculum is a sub-system (see Section 3.2 for a general discussion of systems and sub-systems). Diamond’s (2008) suggested approach to curriculum design and implementation, as well as ADDIE (Molenda, 2003) and the Dick and Carey approach (Dick et al., 2009) among others, take a systems approach to the design and development of curriculum. In 2009 Faulconbridge and Dowling suggested the application of the systems engineering "VEE process" (Forsberg & Mooz, 1991) to the design and development of engineering curricula and associated teaching and learning materials. Others (W. E. Doll, 2008; Morrison, 2003, 2006; Tosey, 2002) suggest that curriculum is a complex adaptive system, but do not specifically apply those concepts to the design and development of curriculum.

While engineering design is largely involved with creating ‘things’, software design deals with the abstract. Software development deals with abstract concepts and is a knowledge intensive activity (Hickey & Davis, 2003) that develops “thought products” such as algorithms, analytic engines and software solutions (Petre, 2009). These thought products “are abstract, complex, and hard to observe ... and software designers must reason not just about software properties, but also about software’s behaviour over time – behaviour which is potentially complex” (Petre, 2009). Curriculum too is abstract, complex and hard to observe (Barnett, 2000) and its behaviour changes over time.
3.1.2 Software design and development

Software design and development may be conceived as being conceptually similar to curriculum design and development. Both develop an abstract representation of their purpose – what they are setting out to achieve and why, represented in the software requirements specification (SRS) and the official-curriculum respectively. After a process of design and development, both the SRS and the curriculum go through another process, that of translation as they are implemented. The output from the two systems is also largely abstract, with the impact of the software or the education hard to observe and measure (Rompelman & Graaf, 2006; Van Der Vleuten et al., 2000), and certainly almost impossible to measure immediately upon implementation in the case of software or immediately following examination in the case of education. Hence when Shaw (2005) characterises software as “design-intensive … symbolic, abstract, and constrained by intellectual complexity rather than by fundamental physical laws” she could have been characterising curriculum.

According to F. P. Brooks (1987)

the hardest single part of building a software system is deciding precisely what to build. No other part of the conceptual work is as difficult … No other part of the work so cripples the resulting system if done wrong. No other part is more difficult to rectify later.

This could apply to curriculum design. Curriculum both determines and drives outcomes (Barnett et al., 2001) and quality learning outcomes are achieved when curricula are well planned and exhibit strong coherence and integrity (Stark et al., 1997). I suggest, therefore, if we do not focus at least some attention on the design of our curricula then the outcomes they achieve will be restricted and cannot be put right by simply focusing more and more attention on the pedagogy. According to the theory of systems (see Section 3.2 below), it is the underlying structure of the system and the relationships between the entities that determines the behaviour of the system, not the entities themselves. To focus our attention on pedagogy without also looking at the underlying structure is, in my opinion, akin to dealing with the symptom rather than looking for and improving the situation that gave rise to the underlying cause.
Just as F. P. Brooks (1987) argues in relation to software, I submit that the essence of the curriculum is both “a conceptual construct [that] is the same under many different representations... [and] is nonetheless highly precise and richly detailed”. Thus, the official-curriculum can be, and needs to be sufficiently detailed that those responsible for translating and implementing it understand precisely the rationale and the goals they are setting out to achieve and what they need (content) to help deliver those goals. Within this construct and within the constraints of the institution, they then have complete freedom to implement it (pedagogical approach, and learning and assessment activities) how they desire. (For more detail on this aspect, please see Sub-Section 2.1.4, especially Figure 2.1, above, included in pull-out figures). Consequently, the same official-curriculum could be implemented completely on-line, completely face-to-face or some combination of both and the outcomes achieved by students studying under any of the implementations should be sufficiently similar that they would be within the bounds of tolerance levels.

Curriculum, like software, is largely "pure thought-stuff" (F. P. Brooks, 1987, p. 12). Consequently, it can be changed heedlessly as it is “infinitely malleable” (F. P. Brooks, 1987, p. 12). Changing something within a course does not affect immediately and directly other courses from which the curriculum is constructed. The change can be made without reference to the program and the courses that come before and after it. Even adding or removing a course does not immediately affect the overall program. In fact, there is little immediate effect except upon the individual making the changes or perhaps on human resourcing levels.

Additionally, as it is “pure thought-stuff” curriculum, like software, is invisible, largely unable to be visualised. It is tempting to see curriculum in the form of the curriculum – the official, written curriculum – as concrete. However, in that form it is only a representation of the curriculum, just as the SRS is a representation of what the software may be when it is implemented. What is invisible, are the relationships between the curricular elements of the implemented curriculum. As explained in Section 3.2 below, the relationships between curricular elements give rise to a curriculum’s unique behaviour and enable learning to emerge. These relationships and their relationship with the emergent learning properties are invisible.

Like curriculum, software is changed as it is used. Maintaining software, especially complex software, is not an easy task; changes often lead to design inconsistencies where
the original functional and non-functional design principles and constraints are violated (Eick, Graves, Karr, Marron, & Mockus, 2001). When changing code without fully understanding the original design principles, software developers inject into it hidden underlying assumptions that increase its complexity (Belady & Lehman, 1976) and cause the software to age or decay (Parnas, 1994). Such “ignorant surgery” (Parnas, 1994) means that no longer can the software be relied upon to perform as it should and it becomes increasingly expensive to maintain (Eick et al., 2001) as it affects the conceptual integrity of the software.

The concepts of ignorant surgery and software ageing apply equally to curriculum. Academics changing their courses without understanding the role the course plays in delivering the desired outcomes of a program is, I argue, equivalent to ignorant surgery. This behaviour leads in turn to ‘curriculum ageing’: the loss of curricular integrity and the desired characteristics of an excellent curriculum and so losing coherence, cohesion, and alignment (see Sub-Section 2.2.2 above).

F. P. Brooks (1987) argues, “conceptual integrity is the most important consideration in system design” (original emphasis) saying

it is better to have a system omit certain anomalous features and improvements, but to reflect one set of design ideas, than to have one that contains many good but independent and uncoordinated ideas (F. P. Brooks, 1995).

I contend that the “conceptual integrity” to which F. P. Brooks (1995) refers when talking about software is the “course cohesion” to which Bahr and Lloyd (2011) refer when talking about curriculum in higher education.

As discussed in Sub-Section 2.2.2 above, education research has recognised the importance of curriculum cohesion in delivering quality learning outcomes. It is, therefore, more important for a curriculum to be a cohesive whole and to omit some aspect of content, or not to develop a certain learning outcome, than it is to be comprised of random sets of content and learning outcomes. However, unless academics take a holistic view (see Sub-Section 3.2.1 below) of the program curriculum and are aware of the role their course plays within the program, cohesive curricula will largely elude us. Even then,
unless curriculum design and development is a collaborative activity it will be difficult to achieve both coherence and cohesion.

To cope with the abstract nature of software and to provide a means of both capturing and explaining the conceptual operation of software systems, systems and business analysts frequently use visual modelling to assist them in understanding the problem space, eliciting requirements and communicating with stakeholders at all stages of development. Given the abstract nature of curriculum, it is likely that those working with curriculum would gain similar benefits from models of the curriculum as software designers and developers do. For more detail on modelling, see Section 3.4 below.

To deal with the increasing complexity of the problems encountered in the domains of engineering and software and the emergence of “wicked problems” (Churchman, 1967) von Bertalanffy (1968) proposed his general system theory. Since then theories relating to system complexity and dynamics have been developed. Understanding curriculum in terms of a complex system is likely to lead to better understanding of curriculum.

### 3.2 General Systems Concepts

Human beings intrinsically understood complex systems long before the development of theories relating to systems and complexity. Much traditional wisdom, expressed as proverbs addresses the concepts of complex systems. For example, “a stitch in time saves nine” indicates our innate understanding of a negative feedback loop caused by the impact a delay in receiving feedback may have, leading to the situation where by the time the problem is apparent the problem is even more difficult to resolve. “The rich get richer and the poor get poorer” acknowledges our understanding of a positive feedback loop, whereby an individual is rewarded in some manner, which in turn provides the means for that individual to continue to be rewarded. When we say, “don’t put all your eggs in one basket” we are recognising that systems with diversity and redundancies are more stable and less vulnerable to shock than a more uniform system (Meadows, 2008, p. 3).

A system is “a set of things – people, cells molecules or whatever – interconnected in such a way that they produce their own pattern of behavior over time” (Meadows, 2008, p. 2). That pattern of behaviour is classified as the system’s “function or purpose” (p. 188). The most basic system is a network of elements that work together to produce an outcome relevant to the system’s purpose. However, because the elements work together “systems
can accomplish things that would be impossible if the same elements were put into random relationships, or no relationships at all” (Ackoff, Addison, & Carey, 2010, p. 6). In other words, “a system is more than the sum of its parts” (Meadows, 2008, p. 188), which means the “properties of the whole may not be found in any analysis the parts” (Banathy, 1997). Understanding the relationship between a system's structure and its behaviour enables us to develop an understanding of how systems work, why they produce poor outcomes and what is required to improve those outcomes (Meadows, 2008, pp. 1-2).

A system may be composed of elements aggregated into any number of sub-systems. The relationships between systems and their subsystems form a nested collection of interacting elements, each of which is part of a more inclusive whole (Meadows, 2008; Skyttner, 2001; von Bertalanffy, 1962). The relationships between the various elements comprising a system determine that system's behaviour – how it responds to both internal and external stimuli. While outside factors may influence a system's behaviour, its response is unique to itself. Systems with few relationships tend to achieve equilibrium while those of greater complexity, with dense connections, are frequently unstable and sometimes chaotic (W. E. Doll, 2008, p. 85). When complex systems balance chaos and order they are said to be “chaordic”4 (Hock, 1995).

Systems display integrity and possess methods and mechanisms that work to maintain that integrity. Should one of the elements or components of a system be removed or changed then the system will not function as originally intended. For example, an organisation is made up of many administrative and management functions, products, services, groups and individuals. If one part of the organisation – the system – is changed, for example by changing administrative or management approaches, or the services or products offered, the nature of the overall system is often changed, as well. Importantly, if there is a change in purpose, for example if an educational system changes from only offering on campus education to offering only on-line education or some combination of the two, the system will change dramatically even though all the elements and relationships remain unchanged (Meadows, 2008).

There are two basic kinds of systems: natural systems and designed systems (Banathy, 1992). Natural systems are those that occur in nature: such as the solar system, weather

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4 Hock (1995) invented the term "chaord" – taking the first syllable of each of chaos and order – because he wanted a term that crossed the boundaries between both physical systems and human institutions and was not unique to either domain.
and climatic systems, biological and all living systems. Many natural systems work together to form ecosystems comprised of plants and animals that interact with each other and their physical environment – land, climate, soil, water, and nutrients. Designed systems are those created by humans and comprise three major types. These are: (a) designed physical systems – such as man-made artefacts and hybrid systems involving both man-made and natural systems, such as a hydro-electric plant; (b) designed conceptual systems – such as theories, philosophies and mathematics – and abstract conceptual systems – such as books and models; and (c) human activity systems (Banathy, 1992, pp. 11-12). A human activity system is a "notional purposive system which expresses some purposeful human activity" (Checkland, 1981, pp. 115, 314). Human activity systems are intangible and describe sets of complex activities carried out by people with the goal of achieving a particular purpose (Checkland & Scholes, 1999, p. 26). Human activity systems include families, communities, organisations, as well as the education system. Curriculum falls into this category.

Systems and sub-systems are conceptual in nature and their boundaries are determined by each individual’s “world view” (Checkland, 1981; Senge et al., 2000). The curriculum of a degree program could be viewed as a system. It exhibits all the properties of a system: a set of elements that are in relationship with one another; those elements work together to produce a set of desired outcomes and each element has a set of attributes or properties; it has an operating environment; and if one of its elements is changed or removed, its behaviour will change. I might describe the curriculum of a course as a sub-system and aggregations of courses that make up majors as larger sub-systems. On the other hand, someone else, just as Banathy (1967, 1992) does, might see curriculum as a sub-system in a larger system comprising the curriculum, the teachers and students and the institution. Neither view is right nor wrong. Each depends upon the view of the individual describing it and most importantly on the purpose underlying the determination of the boundary.

For the purposes of this thesis, the official-curruculum of a degree program is identified as a system. Aggregations of smaller units from which the program is constructed, such as majors, minors and courses are sub-systems at different levels. For this thesis, the smallest individual sub-system is a module or lesson.
Systems sit on a continuum from simple to complex. Where they sit on this continuum is determined by two basic dimensions – predictability of behaviour and the effort it takes to understand them. As shown in Figure 3.2, sitting between these two dimensions are the elements from which the system is composed and the relationships between those elements. The more elements and the more networked the relationships between those elements, the more effort it takes to understand the system and thus the further up the scale from simple to complex the system moves. Systems possessing large numbers of interconnected and interacting elements are described as complex (W. E. Doll, 2008).

To explain the difference between systems that are simple, complicated and complex, I shall use some simple cases. Baking a cake is simple. It takes little effort to understand – there are few elements and the relationships are mostly linear. Provided one follows the recipe it is reasonable to expect the same outcome each time one makes the cake. On the other hand, building a car is complicated. A car involves a large number of elements and the relationships between them tend to form networks. It is possible, however, to understand the purpose of a car and to devise a recipe-like set of instructions that enable the building of the car. There is high certainty that following those instructions will result in the same outcome each time. The more complicated the issue, the more experts are needed to devise the "recipe", but by following a set process it is highly likely the same results will be achieved time after time. This is the basic principle underpinning
manufacturing. On the other hand, the behaviour of a complex system is not predictable; instead, its behaviour is non-linear and unable to be predicted by prior knowledge. The relationships between the parts or components of a system are not always the same and the behaviour that emerges from those relationships is unpredictable and is unique to that system. Such problems are sometimes called “messes” (Ackoff, 1981) or more commonly, “wicked problems” (Rittel & Webber, 1973). Curriculum fits within this category.

Social and human activity systems are complex – they have numerous subsystems and the subsystems are arranged in integrated hierarchies to accomplish the goals of the overall system. They may be open or closed (see Section 3.3 below). Each subsystem has its own boundary, and includes various inputs, processes, outputs, and outcomes geared towards accomplishing an overall goal for the subsystem. Human and social systems, such as universities and schools or the curricular system that is the topic of this thesis, are complex and their behaviour is unpredictable.

Frequently, when we need to understand complexity we reduce the problem or situation with which we are faced to its component parts. In other words, we take a reductionist approach to understanding. This approach overlooks the fact that “a system is a whole that cannot be divided into independent parts or subgroups of parts” (Ackoff, 1994, p. 175, my emphasis) and assumes that if the components are well managed, then the system will behave as expected (Meadows, 2008; Senge et al., 2000).

3.2.1 Understanding the whole rather than the parts

The problem with this approach is that one can manage one, or even many components perfectly and yet disable or even destroy the system. The relationships between the elements of a system give rise to the behaviour of the system and the behaviour of a system and not the ‘things’ from which it is comprised is what concerns us. Because a reductionist approach considers each part of the whole as an independent entity it ignores the relationships between the part one is attempting to understand and the rest of the system. Consequently, it is easy to lose sight of the maxim that “no part of a system should be changed without understanding its effect on the whole and determining that this effect is beneficial” (Ackoff, 1999, p. 9). Furthermore, “descriptions of ... [an] entity that abstract away its complexity often abstract away its essence” (F. P. Brooks, 1987, p. 11).
Having said that, both a reductionist and a holistic view have their place in understanding complex systems (Sinha, 2010). Which view is appropriate is determined by the purpose that is driving the quest for understanding. To help explain the impact of a reductionist view as opposed to a holistic one, I have used Sinha's (2010) three images of the Mona Lisa in Figure 3.3 – Figure 3.5 (images reproduced with permission).

Figure 3.3 – Systems level, or holistic view of the Mona Lisa
Image reproduced with permission

Figure 3.3 presents a systems level, or holistic view of a representation of the historic work of art, the Mona Lisa. In this image, it is clear that we are looking at a representation of the Mona Lisa. Even though we can see that it is composed of multiple smaller entities, we are not aware of exactly what those entities are nor how they work together to represent the Mona Lisa, just that they do.

Figure 3.4 – Sub-systems level view of the Mona Lisa
Image reproduced with permission
The second image, Figure 3.4, shows the representation of the Mona Lisa from a closer perspective. In this image, it is still obvious that it is a representation of the Mona Lisa. At this level, one is more aware of the individual elements from which it is comprised, but still not exactly, what they are. One can see they are circular entities of slightly different shades and colours placed in such a way that the relationship between each works to create the image of the Mona Lisa.

Figure 3.5 shows a truly reductionist view. No longer is it obvious what you are looking at. All you are aware of is a large number of containers of slightly varying colours, perhaps mugs of coffee with different proportions of milk and coffee. By this stage, we have lost all concept not only of the image – the system itself – but also, of how the individual mugs of coffee work together to create it. If we were to change the colour of a few mugs of coffee, we would affect the ability of the individual pieces to work together to create the image of the Mona Lisa.

When we view the curriculum for a course without also considering its place within the curriculum for the program of which it is part, we end up with a similar view to that in Figure 3.5. We can see the things from which that course is constructed, but we cannot see the role that course plays in helping create the whole, that is the program curriculum. This is likely to limit our ability to create a coherent, cohesive, and aligned curriculum. I contend Diamond (2008) also has this view when he says:

as we teach our courses, we tend to lose sight of the fact that each course is but one element in a learning sequence defined as a curriculum. The closer the relationships are among courses, curriculum, and planned out-of-class activities,
the more effective the learning experience will be for our students. So, whether you are working on the design of a single course or of a curriculum, it is imperative that you keep in mind the relationship between the two. (p. 83)

As noted above, there are many kinds of systems ranging from simple to complex: biological systems (the heart), mechanical systems (a thermostat), human/mechanical systems (riding a bicycle), ecological systems (predator/prey) and social systems (groups, supply and demand, friendship) (Meadows, 2008). In fact, "every person we encounter, every organization, every animal, garden, tree and forest is a complex system" (Meadows, 2008, p. 3). Curriculum is a human activity system that by its very nature is complex.

### 3.2.2 Complex adaptive systems

Complexity can be described as a situation that is "integrated and yet too rich and varied for us to understand in a simple mechanistic way ... complexity deals with emergence, innovation, learning and adaptation" (Jackson, 2002). Complex systems are open systems as they interact with their environment (Meadows, 2008). For an explanation of an open system, see Section 3.3 below.

A high-functioning system continually exchanges feedback between its various elements to ensure they remain closely aligned and focused on achieving the goal of the system. The interaction between the elements of a system cause the system to exhibit behaviour or properties that could not have been predicted by prior knowledge of those elements or the starting state of the system. The previously un-exhibited behaviour or property is said to 'emerge'. The concept of emergence facilitates the development of an understanding of continuity and change, of the non-linear behaviour of complex systems (Mason, 2008).

The number of elements in a complex system such as higher education is impossible to know. Trying to determine the nature of the relationships between those elements is even more problematic. These systems constantly adapt to the unpredictable changes in society and the community, or environment, within which they operate. Regardless of the number of experts one engages it is highly unlikely one could devise a 'recipe' that could be followed which would result in a reasonably certain outcome time after time (Meadows, 2008; Morrison, 2006; Tosey, 2002).
Appreciating the curriculum as a complex adaptive system brings with it an awareness of the need to view curriculum as a whole rather than its individual parts. This knowledge helps explain why our students do not always arrive in our courses with the assumed prerequisite knowledge or why they may graduate unable to exhibit all the skills, knowledge, and behaviour the degree program set out to develop in them.

When attempting to understand complex systems, the concepts of system dynamics and systems thinking provide us with the “ability to explain behavior that can’t be explained in purely mechanistic terms” (Senge et al., 2000, p. 61). For more information of each of these concepts, see Sections 3.3 and 3.5 respectively.

The higher education systems of Australia, the UK, the USA and other western nations, are complex socio-political systems known as complex adaptive systems (Stacey, Griffin, & Shaw, 2000; Tosey, 2002).

3.2.2.1 Curriculum as a Complex Adaptive System

The design and development of higher education curricula is one element of that complex system and is itself a complex activity. I contend that more than being a complex activity, the design, and development of a cohesive yet dynamic curriculum may be described as a wicked problem. Wicked problems are complex in nature, have many competing stakeholders, cannot be described definitively nor can outputs be determined with certainty, and frequently the proposed solution can be worse than the problem one is trying to alleviate (Buchanan, 1992; Head & Alford, 2008; Rittel & Webber, 1973).

Complicating what is already a complicated situation are the rapid advances in knowledge, changes in professional practices, societal expectations and conditions.

The need for malleable, responsive academic programs is particularly a concern in scientific and technological fields where the growth of knowledge is exponential. However, education in every academic field must adapt to accommodate changing student interests, new approaches to teaching and learning ... Educational programs designed to prepare students for a dynamic future must be dynamic themselves, or they will become increasingly unpopular and irrelevant. (Baldwin & Baumann, 2005, p. 89)
Curriculum is a complex, non-linear system: its outcomes are determined not only by the individual behaviour of its elements but also by the interaction of those elements with other elements within the system and by interactions with the environment in which it operates. It is influenced by, and it influences, the environment in which it exists. As discussed in detail later in this thesis, the curriculum of a course has a relationship with the program curriculum of which it forms a part. It also has relationships with other courses within that program. Curricula for programs and their individual courses are in relationships with the institution in which they are offered and with the domain of the subject matter. These curricula and their institutions have relationships with the tier of education to which they belong and the society of which the institution is part.

In the last 20 years or so, some of those writing about curriculum have depicted curriculum as a complex system (W. E. Doll, 2008; Jackson, 2002; Morrison, 2006; Tosey, 2002). On the other hand, Banathy (1967) has been taking a systems view of education for over 50 years. Others, such as Stenhouse (1975), Zais (1976), and even (Dewey, 1916), who have not used a systems lens to study and discuss curriculum have included many systems concepts. They see the interrelatedness of the elements from which it is constructed, the influences of external entities upon it, and describe a process. For example, Stenhouse (1975) offers his "process model" as an approach to the design and development of curriculum which he likens to a recipe, which "is first imagined as a possibility" and is "then the subject of experiment" because "within limits, a recipe can be varied according to taste. So can a curriculum" (Stenhouse, 1975, pp. 4-5). The process Stenhouse describes can be mapped onto the design process described in Sub-Section 3.1.1 above, though Stenhouse views curriculum as a complicated rather than a complex system. Lattuca and Stark (2009) present curriculum as both a complex system and a design activity. While they too do not use systems terms to describe what they call "academic plans" their model of "academic plans in sociocultural context" (Lattuca & Stark, 2009, p. 5) is clearly a system model with sets of interrelated elements with feedback loops. The field of instructional design and its approaches, such as ADDIE (Molenda, 2003; M. Thomas, Mitchell, & Joseph, 2002), Dick and Carey (Dick et al., 2009) and the approach suggested by Diamond (2008) are also clearly systems-based models.

Complexity theory focuses on the larger system or environment and the relationships between the elements of those systems of which it is a part (Mason, 2008). The focus is holistic rather than reductionist. This approach means one looks not only at the cause of
an event and where the effects of that event might be felt but also at the impact of the event itself (Senge et al., 2000). I suggest that taking such an approach to curriculum design, development, implementation, and delivery might help academics recognise that implementing what appears to them to be a small change to one learning outcome in a single course may well have a significant impact on the overall outcomes of the program of which the course is part. Furthermore, that effect may extend outside the curriculum to industry and society where the graduates of that program are going to work and live. Such an approach to curriculum design, development, implementation, and delivery requires curriculum to be viewed as multi-dimensional in nature.

**The multi-dimensional nature of curriculum**

As discussed in Sub-Section 2.2.2 above, the literature which focuses on how to improve student learning outcomes through improved curriculum design has identified three principal features: strong alignment (Biggs, 1996; Toohey, 1999; Tyler, 1949), coherence (Schmidt et al., 2002) and cohesion (Allen, 2004). Coherence and cohesion have also been described in terms of horizontal and vertical organisation. Zais (1976, p. 395) described horizontal organisation (cohesion) as “scope and integration” which is achieved through integrating the content and learning activities of a set of courses, while vertical organisation (coherence) is the concept of one course building upon the skills developed in another course.

A systems view of curriculum explains that these three aspects of a quality curriculum do not exist in isolation. Instead, there exist strong relationships between each, which mean when one aspect is changed it will affect and bring about change in the other two aspects. Using the relationships between them to link these three aspects of a quality curriculum enables the creation of a 3-dimensional view of the curriculum for a degree program as shown in Figure 3.6 which I suggest is a more valuable approach to understanding curriculum.
A holistic or systems view of a curriculum helps explain why attempting to deal with one aspect in isolation will not necessarily deliver the intended outcomes. The relationships between the three quality characteristics give a curriculum its integrity. While we cannot predict the behaviour of complex systems, using the concepts of system dynamics (Forrester, 1961, 1969) we can understand which parts of a system might be affected and what might happen in a given situation.

### 3.3 System dynamics

“Everything we do as individuals, as an industry, or as a society is done in the context of an information-feedback system” (Forrester, 1961, as cited in Meadows, 2008). It is important to note, that the study of a dynamic system will not enable prediction of what will happen, instead it facilitates exploration of what might happen given a certain set of driving factors.

von Bertalanffy (1962) classified systems as either “open” or “closed”. While both open and closed systems have relationships with things outside themselves, closed systems function toward a pre-set goal, such as a thermostat whose purpose is to keep a room’s temperature fixed at a pre-set level. Open systems are “systems exchanging matter with the environment” (von Bertalanffy, 1968, p. 32) while closed systems are “systems which are considered to be isolated from their environment” (von Bertalanffy, 1968, p. 37). In educational terms, W. E. Doll (2008) suggests that “closed systems transfer and transmit, open systems transform” (p. 197). W. E. Doll (2008) also suggests that different teaching approaches reflect either open or closed systems. “Direct instruction, with its simplicity, would exemplify a closed system approach while interpretative inquiry, with its complexity, would exemplify an open systems approach” (p. 197).
System dynamics facilitates understanding how the components from which a system is composed interact with each other and with the outside environment. The interfaces between components determine how well those components work together to deliver the system’s purpose. In curriculum terms, if we consider a program curriculum, the interfaces are the articulated pre-requisite knowledge and skills, and intended learning outcomes for each of the courses from which the program is comprised. How well those interfaces are determined and implemented will determine the level of coherence, cohesion and alignment the curriculum exhibits. They also determine how likely a student is to enter a second or subsequent course in a sequence possessing the required knowledge and skills.

Relationships between the components of a system and with things outside the system cause what is known as feedback and control loops. Feedback loops work to maintain equilibrium within the system. Within a system, there are two kinds of feedback loops: balancing and reinforcing (Meadows, 2008). A balancing feedback loop maintains system performance within an acceptable range. In contrast, a reinforcing feedback loop causes run away change in one direction, either positive or negative, with increasing change in the same direction each time a system passes around the loop. Feedback loops and the interaction between them are what cause the operation of systems to be non-linear and to have their own behaviour (Meadows, 2008). This behaviour can be modelled using causal loop diagrams (CLD) as shown in Section 3.4 below.

Within the curricular system, feedback is received from many sources. These might include receipt of student evaluation scores, reviews of the curriculum occasioned by accreditation visits, and student examination results. Feedback might also include unsolicited comments from colleagues, or when an individual academic reflects upon the course they have just taught, attends a conference dealing with educational matters, attends an education-focused seminar or reads some educational research. Feedback might also be received directly from industry through industry advisory boards, or indirectly through evaluation of graduate recruitment. Changes may be made to the curriculum in response to that feedback. Those changes will themselves cause feedback and so the cycle of change continues. Changing the curriculum will provide feedback to other systems with which it interacts. This may cause change within those systems, which, in turn, may cause feedback to the curriculum that may induce further change within the curriculum.
The aim of systems control is to use feedback to keep the system's response within acceptable limits. The acceptable range of these limits is known as tolerance.

### 3.3.1 Tolerance

Tolerance is defined as "the positive and negative deviation" (Kossiakoff, Sweet, Seymour, & Biemer, 2011, p. 435) from desired behaviour. For example, when working with a heating system controlled by a thermostat, the tolerance level is the number of degrees above or below the selected temperature, which determines when the heating turns on, or off.

Tolerance levels are used by systems designers to keep systems in a state of 'disequilibrium' where they can respond to and transform in response to changes in their environment. Delay in receiving and responding to feedback is what causes system oscillation. Shortening the feedback loop minimises the amplitude of system oscillation. Balancing loops within the system maintain system behaviour within tolerance levels. Tolerance in natural systems, such as eco-systems, is often called resilience and indicates the bounds beyond which permanent change occurs and which limits the eco-system's ability to recover and survive. When conducting statistical analyses, tolerance is referred to as the confidence level in relation to reported findings.

Our curricular, and teaching and learning systems also operate within a tolerance range. Whatever the measure used to determine satisfactory performance, such as student course evaluation or students possessing the required level of knowledge and skills, so long as the value of that measure is within a pre-determined acceptable range then there is unlikely to be external pressure for change. Once that range of tolerance is breached then it is likely that action will be taken in an attempt to cause system behaviour to once again fall within tolerance levels.

To help understand the dynamic nature of systems, engineers and software developers use a variety of different models or diagrams.

### 3.4 Modelling

When you imagine how an event might unfold or make a projection, you are running some form of model. It is, however, an implicit model whose assumptions are hidden from all,
untested, and with the consequences of those assumptions unknown. Writing our models down – using natural language, simple diagrams or some form of explicit modelling language – makes the assumptions upon which the model is based explicit and therefore able to be evaluated. An explicit model enables us to understand what might happen if variables, constraints or assumptions are changed (Epstein, 2008).

Creating a visual model of the official-curriculum may assist academics to understand the big picture and to see the role their course plays in the overall program. It could help visualise the relationships between the various curricular elements and to understand the impact that a change in one course will have on the overall structure of the program and so to maintain curricular integrity through the qualities of curricular excellence – cohesion, coherence, and alignment (see Sub-Section 2.2.2 above).

While the best models are connected to reality, they are not reality; they are simply one view of reality. Conceptually, a system is a model. A system may be defined as a part of the real world, conceived as being an entity with well-defined interactions with its environment but it is nonetheless a model. Models help simplify reality but avoid taking a reductionist approach to the problem. (For more detail on reductionism versus holism, see Sub-Section 3.2.1).

By forcing us to make our assumptions explicit, modelling helps clarify our thoughts. Modelling imposes a rigour of thought, compelling us to focus on what is important, to identify the key elements, the relationships, the behaviour, to work through the logic, and allows inductive exploration (Corbin & Strauss, 2008; Epstein, 2008). Frequently models help uncover new questions, things one had not thought of, and help highlight uncertainty. They can be used to offer options and to demonstrate trade-offs or efficiencies (Epstein, 2008). Importantly, however, models help explain concepts, behaviour and relationships and understand what might happen in certain scenarios (Corbin & Strauss, 2008; Epstein, 2008). Creating a model of curriculum enables examination of the elements from which it is constructed and facilitates understanding of the relationships between them (Print, 1993).

Visual models of our curricula may help academics understand the relationships between the elements, during the processes of both planning and review. Visual models may also provide a method of more readily understanding the big picture of the curriculum, as they will help visualise the relationships between the various elements from which it is
constructed. This could be especially important for someone who did not participate in the original curriculum design process.

3.4.1 Visual language

Meadows (2008, p. 5) argues that using words to describe systems and their behaviour is problematic because “words and sentences must, by necessity, come only one at a time in linear, logical order” while "systems happen all at once". Systems are composed of networks of connections and so to discuss them properly we need to use a language that shares some of the same properties. “Pictures work for this language better than words, because you can see all the parts of a picture at once” (Meadows, 2008, p. 5).

A language – natural, artificial, programming – consists of a syntax (the notation) together with its semantics (the meaning). Depending on the type of language, the syntactic elements can be words, clauses, sentences, diagrams, models and so on. “In a theoretical sense, textual languages and visual or diagrammatic ones have no principal difference” (Harel & Rumpe, 2004). One of these languages, which is both human readable and executable by computer, and so has a rigor and formality to it, is Executable UML (\$T\UML) (Mellor & Balcer, 2002).

As I have suggested earlier, academics may be able to extract real educational value from using visual models of the curriculum. To show how visual models improve understanding and communication, I shall look briefly at two aspects of two visual modelling languages. \$T\UML, to understand the entities from which a system is composed and the relationships, and governing rules that exist between those entities; and Causal Loop Diagrams (CLD) to provide a fundamental understanding of the behavioural dynamics of complex systems caused by the relationships between those entities.

3.4.1.1 Executable UML (\$T\UML)

\$T\UML is used in the field of software engineering generally and embedded systems specifically. It provides a complex set of diagrams that can be used to visualise and simulate different aspects of the software system’s operation and the concepts upon which it is structured prior to writing any code.

The \$T\UML diagram used to visualise entities and their relationships is called an Information Model, or sometimes a class diagram. This model is composed of elements
called classes, which represent the entities comprising the system, and associations, which represent the variety of relationships that may exist between those entities. Information models are used, as their name suggests, to capture information about the domain one wishes to understand. A well-constructed information model provides more than just “a pretty picture … [It] will nail down subtle, yet critical, constraints … [and] will expose hidden rules and assumptions” and so affords “transparent, unambiguous precision” (Starr, 2012).

**Classes and relationships**

In an information model, each conceptual entity within the system being modelled is abstracted into a class. Classes represent the ‘things’ within a system. They can be tangible objects such as books, planes, trains; or abstract concepts such as roles like librarian, pilot, or driver; incidents representing an occurrence or event that happens at a fixed time such as a flight or journey; and relationships between two classes, such as a loan capturing the relationship between a book and the person borrowing that book. Each class may stand for any number of things of the same type and has a set of attributes associated with it. In the case of a borrower class, the attributes might be borrower ID, name, borrower type (e.g. child, young adult, adult), and contact details.

Classes can be conceived as tables and the attributes as column headings. Each row in the table denotes a single instance of the ‘thing’ represented by the class. Classes representing relationships will have a new row added to the table each time a new relationship is created, for example each time a new loan is made.

The layout of the diagram is governed by readability; location on the page is irrelevant to the meaning of the model. Verb phrases describe relationships, help with readability, capture and explicitly express rules, and force the modeller to consider the multiplicity and conditionality of the relationship and so increase the precision of the model.
A simplified $S/1$ UML model of a library might look something like Figure 3.7.

![Simplified UML model of a library](image)

Figure 3.7 – Simplified $S/1$ UML model of a library

To read an information model, we start with any class, say Library, and then move along the line representing the relationship to the next class, in this instance Librarian. At the end of the line is a verb or verb phase that characterises the relationship and a representation of the multiplicity and conditionality of the relationship, in this instance ‘1..*’. This indicates there will always be at least one instance of the class Librarian associated with the Library class, but that there may be an infinite number of instances of the class Librarian. This makes explicit the corporate knowledge that the library will always employ at least one librarian but will likely employ more than one librarian.

Looking the other way along the line representing the relationship between the two classes Library and Librarian, we see ‘1..1’ which tells us that each instance of the class Librarian always relates to one, and only one, instance of the class Library. In other words, librarians are always employed by a single library and the library always employs one or more librarians. The relationship between the classes Book and Borrower captures the information about books borrowed from the library. In this instance, the multiplicity is ‘0..*’ indicating that this relationship does not always exist, it is conditional. Because a Book may not always be out on loan, a Book is lent to zero or more Borrowers, also a Borrower may not always have a Book out on loan. Each time a Borrower borrows a Book, an instance of the relationship between a Book and a Borrower is created (i.e. a new row is
added to the table representing a loan). This relationship is represented by the Loan class. The Loan class captures the information about the loan itself – which book has been borrowed by which borrower and on which date.

Applying the $\chi/T$ UML modelling concepts I have just described to one of Print’s characterisations of curriculum – that of “curriculum as intention” (Print, 1993, p. 6) enables the creation of the model shown in Figure 3.8. Print suggests that early curriculum planners made use of intentional strategies “through the vehicles of aims, goals, and objectives” (p. 6). These statements are modelled in Figure 3.8 but are based clearly upon my assumptions and interpretations of Print’s statement, as he gave no indication of the relationships between “intentional strategies” and “aims, goals and objectives”. If Print himself were to develop a model, it may well look different because he would be forced to make explicit the assumptions upon which his statement is based.

![Figure 3.8 - $\chi/T$ UML model of Curriculum as Intention (Print, 1993, p. 6)](image)

Reading the model of Curriculum as Intention, as shown in Figure 3.8, we arrive at the following description. Curriculum as Intention is comprised of a statement of intent that determines one or more aims. Those aims are interpreted by one or more goals that are translated into one or more objectives. It could also be expressed as Curriculum as Intention is comprised of a set of one or more objectives that meet a set of one or more
goals, which are derived from one or more aims which, in turn, reflect the one, and only one, expressed intent of the curriculum.

Developing a visual representation of Lattuca and Stark's (2009) academic plan (p. 5), as shown in Figure 3.9, forces me to make explicit the assumptions I had to make when interpreting their textual model. Although they provide significant detail relating to the development of academic plans and the decision making this entails, they do not make clear the assumptions upon which their model is based. My assumptions are based upon the description of the decisions that need to be made about the eight elements of an academic plan (pp. 4-5). I have assumed that the elements “instructional processes”, “evaluation”, and “adjustment” are part of the academic planning process and that “learners” are constraints on the academic plan rather than an element of it.

![UML model of Lattuca & Stark's (2009, p. 5) Academic Plan](image)

Figure 3.9 - UML model of Lattuca & Stark's (2009, p. 5) Academic Plan

According to my model of Lattuca and Stark's Academic Plan as shown in Figure 3.9, an academic plan, which is the output of the academic planning process, can be described as follows. An academic plan will always have a set of one or more Purposes capturing the knowledge, skills, and attitudes students should exhibit on satisfactory completion of the educational opportunity represented by the Academic Plan. Each Purpose always determines one or more pieces of Content, or subject matter that is to be covered. Pieces of Content are sequenced with each piece of Content following and / or preceding another piece of Content. Each articulated Purpose always guides the development of one or more Instructional Resources, which in turn are developed using one or more pieces of Content.
An X/T UML Information Model alone cannot capture and model the dynamic nature of system behaviour. There are a number of different visual languages and diagramming tools used by software and systems developers that deal with the dynamics of system behaviour. Each meets a slightly different purpose.

As complex systems are dynamic and their behaviour is non-linear, attempting to understand their behaviour using natural language which is linear and static not only limits our ability to understand, but may cause us to make inappropriate simplifications. When attempting to understand the behaviour of a complex system, system modellers often use Causal Loop Diagrams (CLD).

3.4.1.2 Causal Loop Diagrams (CLD)

CLDs “provide a language for articulating our understanding of the dynamic, interconnected nature of our world” (Kim, 1992). In effect they are visual sentences “constructed by linking together key variables and indicating the causal relationships between them” (Kim, 1992). Within a system, there are two kinds of feedback loops: balancing and reinforcing (Meadows, 2008). A balancing feedback loop maintains system performance within an acceptable range, within the limits of tolerance and is often known as a goal-seeking loop or process. In contrast, a reinforcing feedback loop causes run away change in one direction, with increasing change in the same direction each time a system passes around the loop. (Sections 3.2 and 3.3 above provide detail related to feedback loops.) Combining a number of loops enables the creation of a “coherent story about a particular problem or issue” (Kim, 1992).

A CLD consists of variables connected by arrows that represent the causal connections of feedback throughout the system. Arrows are labelled to show how one variable affects another. An “s” is used to indicate a change in the same direction and “o” to represent a change in the opposite direction. Within each loop, an “R” indicates a reinforcing loop and a “B” indicates a balancing one. The infinite number of combinations enables the modelling of all kinds of systems.

The provision of formative feedback to students gives rise to a balancing, or goal-seeking process as shown in Figure 3.10 below. This CLD depicts a simple balancing loop that represents the process an educator is likely to engage in when attempting to get students in their class to achieve a certain learning outcome. To do this, an activity is designed to
help students achieve a particular goal and the educator then engages in a continuous loop of formative feedback to ensure students understand and achieve the desired outcome. Once students have undertaken the activity, the educator assesses how well the student’s activity demonstrates achievement of the goal, which in turn influences the feedback provided to the student as the educator attempts to bring the student’s level of achievement of the desired outcome up to the required standard. The student then acts upon that feedback. After a time-delay, which may be short or long depending on the activity, the student’s behaviour changes and so the gap between the desired outcome and the current outcome narrows. If there is still a gap between the desired outcome and the current outcome, the educator and the student will engage in another round of the process of providing formative feedback and acting upon that feedback.

Figure 3.10 – CLD representing the provision of formative feedback to students

An “s” indicates a change in the same direction; an “o” represents a change in the opposite direction; and a “B” indicates a balancing loop.
Figure 3.11 depicts the processes Lattuca and Stark include within their model of an academic plan (Lattuca & Stark, 2009, p. 5) – paths A, B and C. Path A depicts the evaluation and adjustment process for a plan, while Path B depicts the same process for the educational environment. Lattuca and Stark note that the educational environment “may itself be affected by the outcomes of academics plans” (p. 6). Path C represents the influences that “external and internal audiences” may exert upon academic plans due to their “perceptions and interpretations of the educational outcomes” (p. 6). Within Lattuca and Stark’s academic planning system, the feedback loops are reinforcing.

Figure 3.11 – CLD of System Dynamics in Lattuca & Stark’s Academic Plan
An “s” indicates a change in the same direction; an “o” represents a change in the opposite direction; and a “R” indicates a reinforcing loop

3.5 Systems thinking

System dynamics and Systems Thinking have much to offer those faced with understanding and dealing with complex problems (Richmond, 1994). Systems Thinking is based on the theory of systems, complexity, and the behaviour of feedback within a system leading to the growth, stability, or decline of a system.

Our natural language structure, which is linear in construction – noun–verb–noun – leads to problems being understood in terms of “x” causes “y” and so leads us to “focus on linear causal relationships rather than circular or mutually causative ones” (Anderson & Johnson, 1997, p. 17). Systems Thinking provides, not only a language, but also a set of
tools to enhance our understanding of such problems. Underpinning Systems Thinking are the concepts of seeing the 'big picture', recognising the dynamic, complex and interdependent nature of systems, allowing for measurable and non-measurable factors, and remembering we are all part of the systems so we both influence those systems and are influenced by them (Anderson & Johnson, 1997).

Furthermore, Systems Thinking facilitates a better understanding of interdependency and change and therefore helps identify the forces that play a part in shaping the consequences of those actions (Senge et al., 2000). It looks for and at relationships, observing the related whole rather than seeing unrelated parts; process rather than structure; patterns of relationships rather than content; and the context of the situation or problem (Ackoff et al., 2010). Taking this approach to understanding a “problem situation” (Checkland, 1981) facilitates uncovering the underlying patterns that connect them rather than observing a situation as a series of unrelated events. Problem situations are identified as just one part of a larger system, the whole of which must be understood before attempting to find a solution. Systems Thinking also focuses on understanding “feedback loops” and the impact that these have upon system behaviour (Meadows, 2008; Senge et al., 2000).

By encouraging a move away from the traditional view of systems centred on simple, linear cause and effect where a small change causes a small effect and a large change causes a large effect, a Systems Thinking approach mitigates against the problem of potentially creating unintended consequences caused by reacting to a single part of the system. Instead, it encourages a focus on the cyclical rather than linear nature of cause and effect and recognises the emergent nature of behavioural change (Ackoff et al., 2010; Banathy & Jenlink, 2003; Checkland, 1981; Churchman, 1967, 1968; Senge et al., 2000).

Taking a systems thinking approach to the problem of curriculum requires consideration of the problem within its environment, which is “the set of variables that can affect the behavior of a system” (Ackoff, 1994, p. 175), such as the students, the academics, the institution, advances and changes in technology, industry and society. Ignoring one aspect of a problem in favour of another will not resolve the problem and may even cause harm (Senge et al., 2000). Systems thinking enables me to argue that focusing on pedagogy while largely ignoring the curriculum (Barnett & Coate, 2005) as is often done (for example, Prosser & Trigwell (1999), and discussed in Section 2.3) is the reason the sought after improvements in outcomes have not been achieved (G. Gibbs & Coffey, 2004; Postareff et
al., 2007, 2008). Equally, focussing solely on curriculum while ignoring the implementation of the curriculum (the pedagogy), also will not deliver the sought after improvements.

Ignoring the context of the problem has created the circumstance where many academics have inadequate and unconnected knowledge, which in turn has led to attempts to improve the situation with disjointed tinkering around the edges (Banathy, 1992).

To improve student outcomes in higher education there needs to be equal attention given to both aspects of the problem: to developing and applying improved knowledge and understanding of curriculum as well as pedagogy. The focus of the research reported in this thesis is to develop improved knowledge and understanding of how curriculum is perceived and used by a sub-set of higher education academics, and to understand what the implications of that understanding and use might be.

Part II, which follows, provides a description of the research methodology adopted as well as presenting the findings that emerged and a discussion of those findings.
Part II. Research Project

We can’t solve problems by using the same kind of thinking we used when we created them

Albert Einstein
Chapter 4  RESEARCH DESIGN

The most serious mistakes are not being made as a result of wrong answers. The truly dangerous thing is asking the wrong questions.

(Drucker, 2010, p. ix)

The aim of the research project discussed in this thesis was to determine how academics conceive of curriculum; the activities they undertake and the processes they engage with when designing, and developing curricula; and the implications of those practices and processes. The study was set within a context of Australian higher education. Participants were drawn from three universities that offer professionally accredited undergraduate and / or master level degree programs in engineering, software engineering, computer science, information technology, and information systems. The research design was based on grounded theory data collection and analysis.

The following questions informed the research design:

1. How do engineering, software engineering, computer science, and information systems academics conceive of curriculum? What do they perceive to be
   a. the key elements of a curriculum,
   b. the relationships between those elements, and
   c. the nature and importance of those relationships?

2. What processes do they engage with when designing, developing and implementing both course and program curricula?
   a. Do they follow a specific approach to design, development, and implementation?
   b. Does their knowledge of engineering, software engineering, computer science, or information systems design inform their approach to the design and development of their curricula?
Engineering the Curriculum: Towards an Adaptive Curriculum

3. What is the output of the design and development process and how is it shaped?
   a. Is there a difference between program and individual course curricula?

4. What are the implications of these conceptions and practices?

This chapter describes in detail the research design adopted for this project. Section 4.1 describes the research context, including information about the human ethics approval sought and obtained. Section 4.2 provides the rationale leading to the adoption of Charmaz’ (2006) approach to grounded theory. The final and largest section of this chapter, Section 4.3, explains the detailed research design and the methods adopted, which are presented in line with the phased approach taken. A pictorial synopsis of the research design and the methods adopted are presented in Figure 4.1 below (included in the pull-out diagrams). Sub-Section 4.3.1 – coded yellow in figure 4.1 – explains the selection of research sites and participants; sub-section 4.3.2 - coded red in figure 4.1 - describes the methods used to collect the data, including both a rationale for the implemented design and a description of how data collection was conducted. Also included is detail of both the methods adopted for each phase and the mechanisms used to support the collection of quality data. Section 4.3, and the chapter itself, concludes with Sub-Section 4.3.3 – coded purple in figure 4.1 – which presents the rationale underpinning the data analysis methods adopted plus a description of how these methods were implemented.

4.1 Research Context

As the literature suggested that the updating and innovating of an existing curriculum is essentially a design (Diamond, 2008; Romiszowski, 1981; Waks, 1995) or problem solving activity (Lovat & Smith, 2003; Print, 1993) participation was limited to a sub-set of academics teaching coursework programs in engineering, software engineering, computer science, and information systems. It was assumed these academics were likely to have had
at least some exposure to the concepts of design and problem solving. While participants could have been drawn from other domains such as Art and design, or Architecture, convenience sampling dictated the exclusion of these other domains because the three local universities do not all teach these subjects.

Limiting participation to academics, who had some exposure to formal design and problem solving was done with the intention of allowing the collection of more consistent data. As with all research involving human subjects, ethics approval was sought and obtained.

4.1.1 Ethics approval

Prior to commencing data collection, approval to carry out the study was sought from the ANU Ethics Committee. Approval was granted, as noted in ANU Human Ethics Protocol 2010-438 (copy at Appendix A, see also Appendices B, C and D). The ethics protocol approved the collection of a small amount of personal and demographic data – see Appendix E for details of the exact data collected. Appendix E contains a collated summary of the data provided by participants.

Owing to the small number of participants involved, I was aware it might be possible to identify individuals despite my best efforts to de-identify the data. Reporting of the data has been handled especially carefully to minimise the risk of identifying individuals. I have been careful not to draw relationships between gender, educational profile, and / or role played within an organisation and paid careful attention to phrasing and exactly what was revealed so that my research does not have unintended deleterious effects upon participants. This risk was recorded in the ethics application and was drawn to participants’ attention at the time of interview or focus group session.

Having provided the context of the research, I shall now turn my attention to the rationale behind the choice of a qualitative research design, especially the incorporation of Charmaz’ (2006) approach to grounded theory.

4.2 Methodological approach

In accordance with best practice, the nature of the research problem guided the determination of a suitable research design (Charmaz, 2011; Strauss & Corbin, 1998). To
ensure the research design had an appropriate conceptual fit (Jones & Alony, 2011; Walsham, 2006), my epistemology (discussed on page 90 below) which informed the theoretical perspective underpinning the research design, was also kept in mind (J. S. Brooks & Normore, 2015; Crotty, 2003). Another important consideration was choosing an approach that I understood, because an approach a researcher gets is most likely to lead to quality outcomes (Jones & Alony, 2011; Walsham, 2006).

As the motivation behind this study was to understand how academics conceive of curriculum, and what they actually do when engaged with its design, development, and implementation, it was imperative the participants’ points of view were heard. The chosen research design had to facilitate collection of data that provided an in-depth understanding from the participants’ points of view.

It was decided that a qualitative research design was appropriate for this project since qualitative research provides mechanisms to understand meanings, concepts, characteristics, and the why of things, through the collection of well-informed, abundant descriptions and explanations of human processes (Miles, Huberman, & Saldaña, 2013, p. 4). Qualitative research brings an in-depth focus to a small number of individuals or situations (Chism, Douglas, & Hilson Jr, 2008). By focusing on understanding people’s experiences of real life, qualitative research affords a holistic view of the situation, and has great potential for revealing complexity (Miles et al., 2013; Strauss & Corbin, 1998).

Within the field of education research, a number of qualitative approaches to research design are regularly adopted. The domain of engineering education research, for example, includes case study, grounded theory, ethnography, action research, phenomenography, discourse analysis and narrative analysis (Case & Light, 2011). There is no single right approach: the choice of approach is related to the questions the researcher is trying to answer (Punch & Oancea, 2014).

The goal of the research was to discover how academics understand and use curriculum, as well as the implications of that understanding and use. This seemed particularly well matched to adopting a grounded theory approach. Grounded theory is especially useful for explaining how the ‘actors’ within the domain of study respond to a set of conditions as well as uncovering the consequences of that behaviour (Corbin & Strauss, 1990).
Use of grounded theory to discover concepts and generate theory in the field of education is particularly appropriate where problems have been identified from professional practice. In this situation, the more traditional approach of hypothesis testing is not appropriate as the problems identified are new, emerging from changes in professional practice and organisational contexts and so no theory exists against which the data can be tested (Borrego, Douglas, & Amelink, 2009; Punch, 2009).

Another strength of grounded theory that made its selection appropriate is its ability to facilitate the interpretation of what is happening in complex, social situations (Charmaz, 2006; Corbin & Strauss, 1990; Dunne, 2011; Starks & Trinidad, 2007). More than just discovering what participants say they do, grounded theory assists the researcher to uncover participants’ tacit knowledge and the assumptions upon which their behaviour is based (Charmaz, 2006). This strength was closely linked to the research imperative to obtain in-depth understanding from the participants’ point of view.

The final reason that a grounded theory approach was adopted for this project was that a preliminary review of the literature suggested higher education academics did not have a common and consistent view of curriculum, and that they did not possess an in-depth understanding of or a common language with which to discuss it (Barnett, 2000; Barnett et al., 2001; Print, 1993). Grounded theory is a particularly suitable research approach to adopt when there is little knowledge of the domain of enquiry (Dunne, 2011).

The theoretical perspective this research adopted was systems thinking which bears a very close similarity to grounded theory. Grounded theory and systems thinking are both a research approach – a methodology – and a data analysis method (Anderson & Johnson, 1997; Punch, 2009). Both are particularly suited to generating an explanation, or theory, of a system’s behaviour derived from the views of participants (Creswell, 2007; Meadows, 2002).

For all these reasons, Charmaz’ (2006) approach to grounded theory research and data analysis was chosen for this project. Charmaz’ (2006) methodology with its acceptance of uncertainty, making assumptions explicit, uncovering the unexpected, and the emergence of understanding or theory grounded in the data, fits closely with the concepts underpinning systems thinking and using systems thinking to promote understanding (Durant-Law, 2005; Laws & McLeod, 2004).
The final section of this chapter addresses the research methods adopted. Within this section, I present the data sampling, collection, and analysis methods adopted.

4.3  Research design

Both theory and the research design itself are emergent properties of grounded theory research (Chism et al., 2008). Grounded theory and its associated abductive analysis result in the research method evolving as the research progresses rather than following a detailed plan determined prior to commencement of data collection (Charmaz, 1995), which leads to the research design being modified in relation to decisions made as the study progresses (Chism et al., 2008, p. 17). Figure 4.1 below (included in the pull-out figures) provides a diagrammatic representation of the overall conceptual framework adopted.

Importantly for successful grounded theory analysis, the researcher must minimise pre-conceived ideas about the problem and the data (Chism et al., 2008; Suddaby, 2006). The researcher also needs to be constantly mindful and aware of their pre-existing conceptions of the topic under study (Suddaby, 2006). To help minimise the potential for consciously or unconsciously testing a hypothesis, it is generally recommended that a detailed review of the literature be conducted after the data analysis (Charmaz, 2006; Glaser, 1998; Glaser & Strauss, 2009). Recent research, however, points to the value gained by undertaking a preliminary review of the literature as it can “enhance theoretical sensitivity and rigor and may lead to innovative insights” (Giles, King, & de Lacey, 2013, p. E29). During data collection and analysis, this preliminary review should be followed up with an in-depth review of the literature that either expands the preliminary review or is a new, secondary review (Giles et al., 2013).

Following the suggestion of Giles et al (2013), three separate reviews of the literature were conducted at different stages of this project (see Figure 4.1 below, included in the pull-out figures). Each review of the literature was more focussed and targeted than the preceding review.
Figure 4.1 – Diagrammatic representation of the conceptual framework adopted
*(See Pull-Out Figure 4.1)*

Research Design 88
Literature on curriculum, especially as it related to higher education, was reviewed prior to commencement of the project. This preliminary review of the literature provided an understanding of the context of curriculum, its use in higher education, and highlighted the contested nature of the term. Understanding gained through this preliminary literature review guided formulation of the questions underpinning the project as well as helping to determine an appropriate research design. It also informed the data analysis process conducted throughout the data collection and analysis phase of the project.

After the data collection and analysis was completed, a second review of the literature was conducted. This occurred as I reflected upon and tried to make sense of the findings as they emerged. The focus of this second review was to assist me in my understanding and explanation of, the emergent findings.

The final in-depth review of the literature occurred as I prepared the review of the literature presented in chapters two and three. Prior to undertaking this final in-depth review, details of the literature to which the discussion and the implications of the findings referred, were extracted. The in-depth review began with this literature and expanded as necessary to provide a complete and comprehensive context for the study. Consequently, the findings that emerged from this study in part informed and guided the final review of the literature as presented in Chapters 2 and 3.

Although the in-depth literature review was conducted after Chapters 5 (Findings) and 6 (Discussion) were written and so the literature, as reported in Chapters 2 and 3 did not significantly shape the data analysis, researcher bias cannot be ruled out completely. My background is systems analysis and modelling within Government organisations in Australia and both small and large business in Australia and the United Kingdom, which may have led me to identify more strongly with elements of the data reflecting the concepts of systems and system dynamics. Throughout the process of data analysis, as described in Section 4.3.3, I took precaution as much as possible to not allow my own views to influence the findings that emerged from the data.

The remainder of this chapter provides detail of the design and approach, describing and explaining why each of the steps were taken. Figure 4.2 below (included in the pull-out figures) provides a pictorial synopsis: sub-section 4.3.1 Research sites and participant selection is coded yellow; sub-section 4.3.2 Data collection is coded red; and sub-section 4.3.3 Data analysis is coded blue.
Figure 4.2 – Visual synopsis of the research design
(See Pull-Out Figure 4.2)
4.3.1 Research sites and participant selection

Qualitative research relies largely on theoretical (Morgan, 1997) or purposeful (Chism et al., 2008) sampling. In theoretical or purposeful sampling, the researcher chooses a set of characteristics closely related to the research question which it is anticipated will provide the most relevant information and uses those characteristics to select participants (Chism et al., 2008; Côté-Arsenault & Morrison-Beedy, 2005). Despite this, convenience sampling, where participants are chosen for their easy access, is probably the most commonly used approach in qualitative research (Chism et al., 2008, p. 19).

The sampling approach used for this study was both purposeful and convenience. Potential participants were invited to participate based upon the set of characteristics deemed most likely to provide rich data, that is detailed and complete accounts of the situation being studied (Creswell & Miller, 2000; Onwuegbuzie & Leech, 2007) as well as their proximity and accessibility.

Given the focus of the study was within the realm of higher education, purposeful sampling required that participants be drawn from this domain. Convenience sampling led to limiting participation to higher education academics from local universities. Based upon the suggestion in the literature that curriculum work was a design (Diamond, 2008; Romiszowski, 1981; Waks, 1995) or problem solving activity (Print, 1993) it was decided to limit participation to those academics who were likely to have some knowledge of the concepts of design and problem solving. As all three local universities taught programs in engineering, software engineering, computer science, and information systems and as it was assumed that higher education academics teaching in those fields were also likely to have had at least some exposure to the concepts of design and problem solving the study was limited to these academics.

The aim of limiting participants to this sub-set of higher education academics was to collect data that were more consistent. It was thought this sub-set of academics might also provide insight into whether they used basic approaches to design when working with curriculum as the initial review of the literature had suggested that many higher education academics do not have knowledge of curriculum nor pedagogical education.

Finding appropriate participants and then securing their participation is not always easy and is often time consuming (A. Gibbs, 1997; Morgan, 1996). While time consuming,
adequate numbers of suitable participants were sourced relatively easily. Potential participants were selected from the names on publicly available web sites of the participating universities. When recruiting participants with specific interests, recruitment is often via word of mouth, advertising or poster campaigns or through the researcher's social networks (A. Gibbs, 1997). In this instance, a personalised email invitation was sent to all academic and professional staff teaching engineering, software engineering, computer science, and information systems courses at the three universities (Appendix J). Prior to sending the invitation, I sought and obtained permission from the appropriate Dean or Head of School to approach his or her staff (Appendix K).

22 academics and professional teaching staff participated; three took part in both phases of data collection. It was not clear there was any significant impact on the data collected from these three participants taking part in both phases of data collection, though it is possible that if these individuals held strong views, these views may have been repeated in the focus group sessions.

No rewards were offered for participation but depending on the time of day focus groups met, participants were offered either a light lunch or wine and cheese as an incentive to attend and as a means of facilitating easy interaction between participants. Even when incentives, such as refreshments or stipends, are offered for participation no-shows can be a problem (Grudens-Schuck et al., 2004). There was only one instance of a participant no-show, though this participant expressed interest in taking part in a later focus group session if that were possible.

Six participants, drawn from a single Australian university, took part in phase one of the study. Sixteen academics and professional staff took part in phase two. Five focus group sessions were conducted, and each group met once only. The number of focus groups held was not limited by availability of participants. More groups were scheduled than were actually convened.

Convenience sampling meant that I knew many of the participants, some of them very well. This had the potential to influence participants’ responses, especially in the one-to-one interviews. To help avoid this, I took care to stress to participants that there were no right or wrong answers, and that I wanted to know what they thought and did, not what they thought they should do or what they thought I expected them to say. During focus group sessions, the potential impact of the relationship between researcher and participant was
almost non-existent because once I had explained the purpose of the sessions to participants, I rarely had to intervene, except to ask participants to explain or confirm points the group was making.

I shall now turn my attention to data collection methods adopted. Different methods of data collection were used for each phase. The rationale and detailed method of data collection adopted is presented according to the phase in which it was used.

4.3.2 Data collection

As shown in Figure 4.2 above (included in the pull-out figures), the project was conducted in two phases such that the analysis informed and guided further data collection. As is usual when undertaking a qualitative study, especially one that incorporates a grounded theory approach to the research design and data analysis, the findings from the first phase informed the design and conduct of the second phase (Charmaz, 2006; Chism et al., 2008; Glaser & Strauss, 2009). Data was collected between January and December 2012.

It was planned initially to collect all the data through a series of around 30 one-to-one, semi-structured, qualitative interviews as it was anticipated interviews would be a free-flowing narrative discussion. As most participants seemed to find it difficult to reflect on curriculum in the manner required by the study, interviews were not free-flowing, and instead required me to continually ask questions to ensure data of sufficient depth was collected. Consequently, after only six interviews, the decision was made to collect the remainder of the data using small focus group interviews, designed to reduce the risk that any findings would be unduly influenced by my views. I set up six small focus groups, but in the end only collected data from five, as it appeared data saturation had been reached by the end of the fifth focus group.

Both phases of data collection were audio recorded. (A. Gibbs, 1997; Krueger & Casey, 2002, 2014) and transcribed as soon as possible afterward. Additionally, focus group sessions were video recorded. Transcripts were verified against the audio recordings. Focus group transcripts were also verified using the video recordings. Interviews and focus session groups all took place during the working day at a time and location convenient to participants (A. Gibbs, 1997; Krueger & Casey, 2002, 2014; McLafferty, 2004).
All interviews and focus group sessions began with the same brief overview of the research project and details of how data were to be anonymised and stored. Participants were given a copy of the information statement (Appendix C). They signed the informed consent form (Appendix B) and provided a small amount of personal and demographic data (Appendix E). As participants arrived and completed the informed consent, they were encouraged to make themselves comfortable and to collect any food and drink that they desired. During this time conversation of a general and social nature took place.

Participants were encouraged to see the interview or the focus group sessions as a guided conversation and it was stressed that participants needed to describe what they understood and what they actually did and where possible to provide examples. Given the literature suggested that academics did not possess a common understanding of curriculum, as much as possible, everyday terms were used rather than those with specific meaning for curriculum studies.

The following two sub-sections describe in detail the approach adopted to data collection for each phase. Figure 4.1 above which provides a pictorial synopsis of the research design, shows data collection in blue.

4.3.2.1 Phase One

Phase one data was collected during January to March 2012, from six one-to-one, semi-structured, qualitative interviews. Interviews lasted from between 30 minutes to one hour. Convenience sampling meant I commenced data collection with colleagues from my own university. Furthermore, it was decided to collect data from a single university for this phase as it was assumed these data may have been more consistent.

Semi-structured interviews were determined to be an appropriate method of data collection because of their ability to allow both participants and researcher to seek clarification and for participants to express their views using their own language.

Semi-structured, qualitative interviews

Interviews were organised around a set of open-ended questions that defined the topic (Britten, 1995; DiCicco-Bloom & Crabtree, 2006). Open-ended questions, which are the hallmark of semi-structured interviews, were designed to enable respondents to answer from their own frame of reference, using their own words and thought-structure (Creswell, 2007). Additionally, the conversational nature of semi-structured interviews
allowed the researcher to probe deeply, to seek clarification, and to ensure there was shared understanding (Arksey & Knight, 1999; Barriball & While, 1994, p. 330; L. Cohen, Manion, & Morrison, 2000, pp. 267-292; Ritchie, Lewis, Nicholls, & Ormston, 2013, pp. 138-169). This was an important consideration as it was likely that participants and I did not use the same terms nor have the same understandings.

In addition to the foregoing reasons, semi-structured interviews were chosen because they provide the researcher with the ability to gather in-depth material from a small number of participants (Britten, 1995; Goguen & Linde, 1993), which facilitated the sampling strategy adopted (see Sub-Section 4.3.1 above). Furthermore, as the literature had suggested that curriculum was a complex problem, their use would assist in exploring participants’ perceptions and views (Britten, 1995; DiCicco-Bloom & Crabtree, 2006). Finally, they are a usual and useful method of data collection when they are the sole source of data (Britten, 1995; DiCicco-Bloom & Crabtree, 2006) which was the case for this project.

Data collection using heavily structured interviews was deemed unsuitable because the stimulus-response model of heavily structured interviews assumes that interviewees will always understand the question (the stimulus) in the same way as intended by the researcher (Gideon, 2012, p. 233; Mishler, 1991, pp. 9-34). Questionnaire surveys were also deemed unsuitable despite the possibility of posing open-ended questions. In this situation, responses are limited to explanations of perspectives that have been chosen in advance by the researcher, and they do not allow exploration of respondents’ own perspectives (Arksey & Knight, 1999, p. 6). Neither do they provide the flexibility to explore the participants’ understanding that semi-structured and unstructured interviews do (L. Cohen et al., 2000; Creswell, 2007). Additionally, due to the time it takes to develop and pilot, questionnaire surveys do not allow the researcher to make changes in response to issues uncovered as the data is collected and analysed (L. Cohen et al., 2000; Creswell, 2007).

It is important that interviewees feel at ease and sense that they are being listened to and that their thoughts will presented fairly and without bias (Leech, 2002). In this regard, I had the advantage of knowing all the Phase One participants well and all were keen to assist with my research. Nonetheless, prior to the interview commencing, I attempted to put participants at ease, with general conversation about things happening at work, what
they had been up to outside work, what courses they were teaching, students and other such things.

Although semi-structured interviews with their open-ended questions facilitate elicitation of greater detail and at greater depth from fewer interviewees than might otherwise be possible (Britten, 1995; Goguen & Linde, 1993), data analysis is made complex because of their free flowing nature, going where the conversation takes them. To improve data analysis, an outline of questions to be covered – an interview protocol – was prepared prior to interview (Jacob & Furgerson, 2012; Ritchie et al., 2013). Preparation of an interview protocol facilitated the collection of more systematic and comprehensive data than would have been possible through an informal, unstructured interview. Using the protocol also helped keep the interview more on topic as the protocol set out the topics to be covered (Jacob & Furgerson, 2012; Ritchie et al., 2013).

**Interview protocol**

The interview protocol (copy at Appendix G) outlined what should be said to participants when:

- setting up the interview;
- providing participants with brief background information about the study;
- ensuring that participants were aware of and provided informed consent;
- completing the pro forma demographic questionnaire;
- beginning and concluding the interview; and
- explaining that I would be recording the interview and taking notes and would provide them with a copy of interview transcript if they desired (Jacob & Furgerson, 2012; Ritchie et al., 2013).

The protocol also included a reminder to turn on the recorder and to check it was recording before the interview commenced (Jacob & Furgerson, 2012).

The interview protocol listed four principal questions:

1. What do you think of when I say the word curriculum to you? Please, describe what the word curriculum means to you.
2. What do you do when you take over an existing course, one that has already been taught by somebody else? Why?
3. What do you do when you create a new course? Why?

4. What knowledge do you have of the College/School curriculum development process?

Associated with each question was a set of dot points that provided additional stimulus questions and ideas to draw upon in case the response did not provide enough detail (Jacob & Furgerson, 2012; Ritchie et al., 2013).

The goal of the initial question was to get participants to think and talk about curriculum as an abstract construct. The question aimed to elicit what they understood the term curriculum to mean. It quickly became obvious that most participants were not used to talking about curriculum, nor thinking about it as an abstract concept. When clarification or further detail was required, to minimise the possibility of leading or confusing the participant, the terms the participant had just used were rephrased and used (DiCicco-Bloom & Crabtree, 2006).

Although I attempted not to direct the flow of the conversation too much, interviews generally followed the order of questions listed above. At times, participants were unable to answer the question or gave single sentence answers. In this situation, the stimulus questions were used to elicit more detail. Stimulus questions were also used as a gauge to determine whether adequate detail had been collected for a particular question (Jacob & Furgerson, 2012). When there were questions among the stimulus questions that did not have an answer, these were asked to ensure sufficient and sufficiently in-depth responses were elicited from each participant.

**Questions that emerged from Phase One**

After six interviews had been completed, an in-depth analysis was conducted. Detail relating to this data analysis is covered in Sub-Section 4.3.3 below. A number of questions emerged from this analysis, which shaped the questions that were the focus of Phase Two. These questions were:

1. Does a background in systems, requirements, and design incline the academic to see curriculum-as-artefact as some sort of specification?
2. Is there a relationship between how curriculum as an abstract notion is viewed and how academics approach the process of design and development and the role the official-curriculum plays in that process?

3. Is the different language used indicative of something or just lack of awareness of ‘correct’ terms?

The first two questions helped shape the questions asked in Phase Two. Specifically, question 1 above led to the inclusion in the questioning route of question 2 concerning curricular alignment and influenced the detail sought in question 3 concerning the processes in which participants engaged when working with their curricula. Question 2 above helped shape the details sought in question 3 of the questioning route. The third question on the other hand, was one asked of the data during analysis, and is discussed in more detail in Section 6.1 below.

As is usual with qualitative research, especially grounded theory research, the research design emerged as the project progressed (Charmaz, 1995; Chism et al., 2008). Instead of using in-depth, one-to-one interviews as in Phase One, Phase Two data was collected using small, focus group interviews. The following paragraphs provide an explanation for this decision. The following sub-section provides details of the rationale for and the data collection methods adopted for Phase Two of the project.

4.3.2.2 Phase Two

Phase two data was collected during November and December 2012.

During the in-depth, one-to-one interviews, rather than participants providing a relatively free-flowing narrative description of their understanding of the concepts of curriculum and what they did when working with curriculum, it was often necessary to keep prompting and rephrasing questions in order to elicit a sufficiently detailed response. The requirement to prompt participants and to rephrase questions led to a significant risk that if the project continued to use this approach to data collection my views, concepts, and terminology may overly influence the nature of data collected.

To ensure the project accurately and fully documented participants’ understanding it was imperative they used their own terms and expressions to explore their own concepts of curriculum. Using their own words, they needed to describe and explain what they
thought, what they did, and why they did what they did. It was crucial to the credibility of
the study to be able to explore these areas without influencing participants’ terminology
and description. This situation required a change of approach to data collection.

All forms of interview, whether they are focus group, group, or one-to-one, are used to
gain insights into people’s thoughts, attitudes, or feelings about a particular topic or event,
but there is an important difference between group and focus group interviews. While
both involve interviewing a number of people at the same time, the key feature that
separates focus group interviews from other forms of group interview is the data
produced when participants interact with each other (Colucci, 2007; Kitzinger, 1995). This
interaction between participants provides valuable insights that enable researchers to
better understand how participants think and feel about the topic under study (A. Gibbs,
1997).

Focus groups, through group interaction, often remove the need for questions to be
explained and reworded. Focus group interviews are an approach to qualitative data
collection that enables participants to “explore and clarify their views in ways that would
be less easily accessible in a one to one interview” (Kitzinger, 1995). It was decided
therefore, to use small focus groups to collect data for Phase Two.

During focus group interviews, usually at least one participant responds, leading to
general discussion, sharing of anecdotes, and sometimes questioning each other and
arguing about their different views. This allows the moderator to sit back and take a
“structured eavesdropping” (Kitzinger, 1995, p. 301) role, only speaking up to encourage
discussion of inconsistencies between or clarification of participants’ views, or to
encourage debate to continue. Group dynamics can influence how much intervention is
required by the moderator to keep the discussion flowing. As part of the group process the
comparisons that participants make between their views eliminates the need for the
researcher to aggregate one-to-one interview data in order to speculate about the
differences or similarities between views expressed. This feature is a singular strength of
focus groups (Morgan, 1996, p. 139).

Small focus groups were determined to be an appropriate approach to adopt for Phase
Two data collection despite Britten's (1995) claim that one-to-one interviews enable more
in depth data to be collected. His assumption assumes that with one-to-one interviews,
each individual has more time to express their own views and the interviewer can use
more subtle cues to direct the flow of the conversation. This assumption relies on the notion that each individual has a lot to say. However, when dealing with a topic about which participants do not usually think in detail or one that may be habit-ridden, it is likely participants do not have large amounts to say. In this situation, focus group interviews have an advantage as they allow participants to ask questions of each other and to re-evaluate their own thoughts and experiences (A. Gibbs, 1997). This interaction enables the researcher to understand better the gap between what participants think and say they do, and what they actually do (A. Gibbs, 1997; Kitzinger, 1994).

Adoption of this approach enabled data collection without the data being overly influenced by my views and helped to overcome the "say do problem" (Goguen & Linde, 1993), where people find it hard to describe something they regularly do, which was encountered during Phase One data collection.

**Small focus groups**

During focus group sessions, participants were encouraged to talk to one another, to ask questions of each other and to comment on others’ points of view (Kitzinger, 1995) which minimised the need for input from the researcher. Focus group interviews are also particularly effective where there is likely to be active and easy interaction between participants (Kitzinger, 1995). Participants for this project were recruited from a relatively small community and it was likely they all knew one another.

Because focus group interviews provide access to data related to the interaction between members of the group, it is important that all participants take part (Morgan, 1997), including quieter, more reflective participants. It is also important that focus group sessions engage participants and keep them engaged throughout while maintaining minimal intervention from the facilitator (Colucci, 2007). Sessions should commence with a question that leads into the topic to be covered and shapes the direction of thinking about the topic (Krueger & Casey, 2014).

For these reasons, it was decided that the first question of each session would be a group activity. Activity-oriented questions or exercises are enjoyable and productive supplements to collecting verbal data (Colucci, 2007). Additionally, they encourage participation of more reflective participants, help keep the group's attention on the core topic and make subsequent analysis more straightforward (Colucci, 2007; Kitzinger, 1994).
Using a magnetic white-board, coloured pens, and pre-prepared tags participants were asked to create a model of their concepts of curriculum. The introduction to the task explained that the terms appearing on the tags were drawn from an analysis of the earlier one-to-one interviews as well as from the literature. Tags included terms such as “aims”, “content”, “goals”, “graduate attributes”, and “learning outcomes”. It was also explained to participants that when necessary they should create new tags using terms that were more meaningful to them. A complete list of pre-prepared and participant created tags is included at Appendix H.

The discussion that took place during model creation highlighted different views and understandings, and generally without intervention from the moderator that discussion also clarified different views. Once the model was created, instead of answering a question just with words, participants often used their models to help describe and explain their understanding and the processes in which they engaged. Consequently, throughout the session the model was refined and elaborated, as participants discussed and debated their concepts of curriculum that it documented.

Although focus groups allow for the efficient collection of data they are harder to control than one-to-one semi-structured interviews (Morgan, 1997) as participants frequently take control of the flow of the conversation (A. Gibbs, 1997). To help maintain consistency across groups and to improve data analysis, I created and used a prepared set of questions in the form of a “questioning route” (Krueger & Casey, 2014), which is discussed in more detail later on in this sub-section. The questions and approach were informed by the data and my experiences in Phase One.

The design of the focus groups themselves can have an important impact upon the quality of data collected (Krueger & Casey, 2002, 2014; Morgan, 1996). Five focus group sessions that lasted between 90 minutes and two hours, and met only once, were conducted. Groups comprised three or four participants drawn from at least two of the subject domains of engineering, software engineering, computer science, and information systems. Participants for each focus group were sourced from a single institution and participants from all institutions took part in Phase Two.

A number of heuristics for design of focus groups have emerged from the most common decisions made by researchers. According to Morgan (1997) projects based on focus groups to collect data, consist of three to five groups in total, groups should be made up of
six to ten homogeneous strangers, and sessions should be relatively structured with high moderator involvement (pp. 35-36). He notes, however, his “rules of thumb” describe how focus groups are most commonly enacted rather than describing a standard about how they should be done.

The following paragraphs provide the rationale for the decisions behind the design of the focus groups used with this project. They culminate with a description of the design and use of the “questioning route”.

**Length of time**

Focus group sessions lasted for between 90 minutes and two hours. Although focus group sessions might sometimes last an afternoon or take place over a series of meetings, it is generally recommended sessions last no longer than one and a half to two hours (Grudens-Schuck, Allen, & Larson, 2004; Kitzinger, 1995; Krueger & Casey, 2014; Morgan, 1997). It is important to allow groups adequate time to discuss the topic in sufficient depth, but not so long that focus is lost (Morgan, 1997). Additionally, longer sessions may limit availability and willingness of potential participants to take part.

A period of 90 minutes was determined to be sufficient time to allow the groups to develop a model and to explore the topic in enough depth (Morgan, 1997). It also provided adequate time to include unplanned probes related to each question or distinct topic area should they be needed.

**Group size and homogeneity**

It was decided that groups should be comprised of three or four participants. To ensure both homogeneity and diversity, participants were drawn from a single institution and I attempted to ensure each group had two participants from different subject domains. As participants needed to select meeting times that were suitable for them I was unable to ensure there was a mix of experience and gender in all groups.

Within the literature, there is no agreement on the appropriate size of focus groups. Group size is largely determined by the context of the research and the subject matter. Groups may be as small as four (Kitzinger, 1995), or have six to ten participants per group (MacIntosh, 1993). Others have successfully used groups of between eight and 15 participants (Goss & Leinbach, 1996), while some other researchers suggest the ideal focus group size is 10-12 people (Krueger & Casey, 2014). “Mini-focus groups” consisting
of as few as three participants may be used to obtain more in-depth information (Onwuegbuzie, Leech, & Collins, 2010). In terms of size, what is important is that groups are large enough to generate sufficiently diverse ideas, but small enough that everyone has a chance to participate equally (Krueger & Casey, 2002).

Smaller groups were deemed more appropriate for this project, as the research design required high levels of participant engagement. Smaller groups also gave each participant more time to discuss their views and experiences (Morgan, 1996), which enabled a clear impression of each participant’s views and understanding to be developed. The smaller group size also enabled participants to be aware of small differences of opinion or understanding and to query each other and so be required to explain their views.

While the purpose behind focus group interviews is not to seek consensus neither is it productive to create a situation in which dissent is likely to arise. It is important to determine which will be more productive in terms of data generation: mixed or homogenous groups (Morgan, 1997). It is likely a group composed of participants with highly different characteristics will decrease the quality of the data (Grudens-Schuck et al., 2004), although there needs to be sufficient diversity of characteristics within a group to ensure a variety of opinions is revealed (A. Gibbs, 1997).

Another important consideration is whether participants should be strangers or acquaintances as the dynamics of focus group discussion can be influenced by how well people know each other (Kitzinger, 1995; Parker & Tritter, 2006; Williams & Katz, 2001). Sometimes close relationships facilitate more open responses (Williams & Katz, 2001) as participants can relate to comments and experiences and may even challenge other participants’ statements (Kitzinger, 1995). At other times, due to societal and cultural norms, focus group interactions are based upon “patterns of social relations” (Parker & Tritter, 2006, p. 27).

Within each focus group, participants knew each other. Some worked closely together, and some were even supervisor and subordinate. Perhaps because of the personalities of participants or maybe just because of the academic environment, despite at times the supervisor and subordinate taking part in the same group, there were no issues discernible that related to patterns of social relations.
Diversity of participation while achieving a relatively homogenous group was achieved through segmentation (Morgan, 1996). Segmentation consciously varies group composition by constituting groups by category of characteristic. Acknowledging the need for groups to be both homogenous and diverse at the one time, focus groups were comprised of participants drawn from a single institution but included participants drawn from at least two of the domains of engineering, software engineering, computer science, and information systems education.

**Number of groups and sessions**

Five focus groups, which each met once, enabled collection of data that were sufficiently detailed and comprehensive for data saturation to be reached (Fusch & Ness, 2015) so it was not necessary to convene the sixth group which had been established.

The number of groups required is in direct proportion to the diversity of either the participants themselves or the topics to be covered and has a direct relationship to the quality of data collected (Morgan, 1996, 1997). Most research studies that collect data using focus groups require only a small number of groups before no new insights are presented. As there is no formula that enables prediction of the required number of groups, the suggested number of groups likely to be required to achieve data saturation ranges from three or four (Krueger & Casey, 2002), no more than four or five groups (Kitzinger, 1994) or up to six groups (Morgan, 1996, 1997).

Regardless of study related design issues, often the simple availability of suitable participants willing and able to take part governs how many focus groups will be used within a study (Morgan, 1997). It is, however, important to have more than one group. When only one group is used, it is impossible to tell whether the findings relate to the composition or the dynamics of the group. Just two groups provide more reliable data (Morgan & Krueger, 1993).

The number of times groups meet is dependent upon the diversity of the topic being researched, leading to studies that use only one meeting with each of several focus groups (Burgess, 1996) and others that use multiple meetings (A. Gibbs, 1997). Reconvening focus groups on multiple occasions can be difficult, added to which people and situations change with time which adds additional complexity to reconvening focus groups to discuss the same topic (Parker & Titter, 2006).
\textit{Group participation}

Individual participation in each group was dependent on the personalities and experience of the individuals in each group. Where experience was similar, for example focus groups A and C, conversation was very free-flowing and the group explored ideas with little intervention. On the other hand, when groups were composed of less outgoing participants and those with less experience, for example focus group D, then the conversation and ideas explored did not flow as readily and required greater moderator involvement.

\textit{Moderator}

I decided to take on the role of moderator for all groups. Firstly, I have experience running requirements elicitation, project planning and risk management workshops, and secondly, focus groups are more productive and effective, and participants have more fun if the moderator is the researcher (Goss & Leinbach, 1996).

The role of the moderator is important to the success of focus group research (Morgan, 1997) as they must be able to provide a clear description and explanation of the research, and build a comfortable and trusting environment where participants feel at ease (A. Gibbs, 1997). They must also possess an ability to listen, to know when to probe and to direct interaction (A. Gibbs, 1997; Williams & Katz, 2001). Interaction with participants must be in a non-threatening manner, questions must be open-ended and promote discussion, and the moderator needs to be able to guide the discussion without disrupting the interaction.

The moderator can be someone skilled as a moderator or it can be the researchers themselves. Carey (1994) suggests that the researcher is not always the best person to take on the role of moderator as they may lack the requisite skills. On the other hand, Millward (1995) suggests that there is benefit in the researcher acting as moderator as they understand the issues and the need for methodological rigour even if their facilitation skills are not so finely honed.

\textit{Structure}

It was decided to adopt a structured approach to counter the acknowledged difficulty in controlling focus group discussion that arises from the free-flowing nature of focus group discussions (A. Gibbs, 1997; Morgan, 1997). Taking a more structured approach to questions helps keep the discussion on topic, ensures coverage of the topics on which data
needs to be collected, provides greater consistency across the focus group interviews, and assists with the data analysis (Morgan, 1997). When a structured approach is taken it is recommended that the researcher create an interview guide (Morgan, 1997; Williams & Katz, 2001).

Focus groups where the moderator plays a controlling role, managing group dynamics and interactions, and directing discussion through questions and moving it away from other topics, are called “more structured” (Morgan, 1996). As it had been decided to take a “more structured” approach a “questioning route” (Krueger & Casey, 2002, 2014) was developed instead of a less detailed and more informal “topic guide” (Barbour, 2005; Krueger & Casey, 2014; Morgan, 1997).

The questioning route included the questions to be asked as well as an introduction to the research and sessions. It also included suggested timing for the activity and questions. Had the questions been asked of individuals, it is likely that the interview would have been completed in less time than that taken for the focus groups. The nature of groups is that one person’s response may provide a cue for another, which, while it helps explore perceptions, takes more time (Krueger & Casey, 2014).

**Focus group protocol – Questioning route**

It is recommended that focus group moderators follow some form of guide that is followed more or less in the same order in each group (Barbour, 2005; Krueger & Casey, 2002, 2014; Morgan, 1996, 1997). There are essentially two formats for the guide: an informal “topic guide” and a more detailed “questioning route” (Krueger & Casey, 2014). A topic guide, as its name suggests, is a list of discussion topics that are only loosely phrased as questions (Morgan, 1997). When topics are “on target” it may not even be necessary for the moderator to ask specific questions, instead controlling the flow of the discussion by using cues such as “That’s something we’re definitely interested in hearing more about. What can any of you tell us about that?” (Morgan, 1997).

It was decided to use the more detailed and structured questioning route rather than a “topic guide” because this approach required me to think carefully about the questions and the words I would use prior to running the session (Krueger & Casey, 2014) as well as deciding how long I thought each question would take (Krueger & Casey, 2002). The questioning route (see Appendix K) was couched in everyday, conversational language with questions expressed in the form they were asked (Krueger & Casey, 2014). Basing the
guide on questions rather than topic areas provides greater control over the topics covered and the direction of the discussion, which leads to more consistency across groups (Morgan, 1997).

As recommended by Barbour (2005), prior to running the first focus group the questioning route was piloted, outside of this research study, with a group of colleagues. They also provided feedback on the wording and sequencing of questions. Additionally, piloting the questioning route provided an opportunity to confirm that the technology, the video camera especially, worked as expected. It also allowed me to practice my facilitation skills. No data were collected during this piloting exercise.

To help participants think about the abstract notion of any curriculum, the first question was an activity, as described above. When the modelling appeared to be complete, the groups were asked to explain their model. Following on from this, the remaining questions were asked. Groups and individuals frequently referred to their models when describing and explaining their response to questions. High-level descriptions of questions covered in the questioning route were:

1. What participants understood curriculum alignment to mean, how they applied those notions, and how those notions fitted with the model they had just created.
2. What did they do when they took over an existing course, one that had already been taught by somebody else and why?
3. What did participants do when creating a completely new course? Why?
4. How did they approach the design and development of the curriculum for a degree program? Was it different from the design and development of the curriculum for a course?
5. Did they knowingly follow an approach to design when working with their curricula and was that approach informed by their background knowledge of engineering or computer systems design?

4.3.2.3 Transcription

Each focus group session was fully transcribed by a transcription service. Transcriptions were verified and corrected. At times, both the audio and video recordings were required for verification purposes.
Although transcripts were verbatim accounts, in an attempt to record as much as possible of what transpired during focus groups, transcripts also recorded as accurately as possible interruptions, broken sentences, incorrect grammar, silences, and laughter. Capturing this additional information is important to provide a valid account of what transpired because without this additional information none of the emotional context and non-verbal communication is recorded (Poland, 1995).

Data collected during both phases of the project were analysed using Charmaz’ (2006) approach to grounded theory. The following sub-section provides the rationale for and describes the methods used to analyse the data.

4.3.3 Data analysis

As explained in Section 4.2 above, it was decided that a qualitative study incorporating many of the concepts of grounded theory was both an appropriate research design and data analysis method. Figure 4.2 (included in the pull-out figures) which provides a pictorial synopsis of the research design, shows the data analysis process in blue.

By its nature, grounded theory data analysis is abductive. It is an iterative process consisting of at least two phases or cycles (Charmaz, 2006; Creswell, 2007; Saldaña, 2009) and usually informs data collection (Charmaz, 2006; Corbin & Strauss, 1990; Glaser & Strauss, 2009). The process aims to condense raw text that is frequently extensive and varied into some form of summary to establish links between findings and the research question(s) and then to develop a model or theory based on the experiences and processes evident in the raw data (Richardson & Kramer, 2006; D. R. Thomas, 2006).

Grounded theory data analysis does not attempt to match the data to preconceived categories. Instead, the categories emerge from the data as it is analysed, and are said to be grounded in the data (Charmaz, 2006). Such analysis can be seen as ‘bottom up’ rather than ‘top down’ as the researcher is not setting out to prove or disprove a particular theory or hypothesis. The theory that emerges is said to be grounded in the data, with the theory emerging from the data analysis (Charmaz, 1995).

The approach to grounded theory analysis proposed by Charmaz is more flexible than that originally proposed by Glaser & Strauss and has its roots in social constructivist epistemology (Chism et al., 2008, p. 12; Creswell, 2007, p. 65). Charmaz’ (2006) approach
does not focus on the emergence of a single core category but takes a social constructivist perspective instead that allows for multiple realities, and a diversity of views and actions to emerge (Creswell, 2007, p. 65). This approach relates closely to the concepts of systems and systems thinking (Durant-Law, 2005).

Like data collection, data analysis was conducted in two distinct phases. While the tools used to assist with data analysis changed between the two phases of data analysis, the general approach did not. Each of the two project phases adopted three distinct steps in the data analysis process: familiarisation or holistic coding; initial or open coding; and focussed coding. In the following paragraphs I describe this process.

Data analysis began with data familiarisation (Charmaz, 2006), sometimes also called holistic coding (Saldaña, 2009), where the researcher looks at the data as a whole. This holistic approach to the data enabled basic themes or issues within the data to be uncovered (Saldaña, 2009, p. 118). Data familiarisation began immediately following each interview or focus group session when impressions of key points were noted and continued as interviews and focus groups were conducted and transcribed.

The second step in the data analysis process was “initial coding” (Charmaz, 2006), also known as “open coding” (Creswell, 2007). During this step, transcripts were coded using participants’ own terms, that is “in vivo” codes (Charmaz, 2006). Initial coding followed Charmaz’ (2006) recommendation that a careful word-by-word and line-by-line approach be adopted. This assisted in breaking down the data analytically, categorising it, and ensuring that the codes adopted were relevant and reflected the data (Charmaz, 2006; Creswell, 2007). Throughout the process of initial coding, the raw data and the categories already identified were compared to uncover similar concepts, to group them logically and to identify new categories.

Once these comparative, provisional codes grounded in the data were identified, “focussed coding” (Charmaz, 2006, p. 57) was conducted. During this third step in the data analysis process, transcripts were recoded. New codes and categories were developed as data were synthesised and explained, and decisions made about which of the earlier codes made the most analytic sense. This process led to the development of codes that were more focused and conceptual than the earlier, usually in-vivo codes. The process of focussed coding was not only iterative but recursive, as analysis progressed through a process of abductive reasoning that allowed concepts to emerge from data.
codes emerged from an analysis of the in-vivo codes. These codes, representing conceptual categories, were used to group in-vivo codes logically. At times, the in-vivo codes belonged to more than one conceptual category.

It is during focused coding that Charmaz’ (2006) approach differs from traditional grounded theory approaches. Charmaz’ (2006) argues that axial coding, where the categories identified during open coding are grouped into hierarchies of categories and subcategories, (Corbin & Strauss, 1990) encourages researchers to apply an analytic frame that limits what and how they learn and restricts the codes they construct (p. 62). In traditional grounded theory approaches, this stage is called selective coding, and the categories are unified around a single, core category from which the hypothesis or proposition that interrelates the categories in the model is developed. Charmaz (2006) argues that using constant comparison instead of grouping codes into hierarchies helps clarify and extend the analytic power of emerging ideas. Eventually, through the process of constant comparison that is at the centre of focussed coding, the data coalesces around a couple of these categories.

During all steps in the data analysis process, memos were recorded using the online tool Blogger. Memos (Appendix Q) were used to capture, for example, thoughts and impressions that related to connections between the interview or focus group being analysed and earlier ones, or participants’ different uses of terms or concepts. Those made during familiarisation also noted when a new issue had been raised or when something was said that contradicted what had been said in earlier interviews or focus groups and so should be followed up in subsequent interviews or focus groups. Memos were referred to and elaborated as the analysis progressed and as codes and categories emerged. They were especially important when writing the findings and discussion chapters as they allowed apparently random thoughts to be captured and connected to ideas that had emerged at other times.

In the following sub-sections, I discuss the approach to data coding taken for each phase, followed by an explanation of the themes, categories, and codes that emerged during data analysis.

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5 https://www.blogger.com/about
4.3.3.1 Data coding – Phase One

Data collected from the six one-to-one interviews was analysed in detail and the outcome of that analysis shaped the approach to data collection in phase two. The approach to data analysis and coding for phase one is described here.

Interview transcription and holistic coding was conducted between each interview. After six interviews had been conducted it was decided to undertake detailed analysis. Following Saldaña’s (2009) advice, initial coding was conducted manually. Interview transcripts were printed and then, taking a careful word-by-word and line-by-line approach (Charmaz, 2006), words and phrases were highlighted, and categories noted on a separate sheet of paper which were later transferred to a spreadsheet. A variety of memos were made during this process, usually relating to participants’ use of different terms to describe what appeared to be conceptually the same thing.

The spreadsheet helped uncover patterns within the data by providing a ready ability to group and re-group codes. The spreadsheet was also used to facilitate understanding the ‘strength’ of the various concepts, for example, by counting how often a participant spoke about curriculum and content synonymously, as opposed to curriculum as a framework or guide.

As the spreadsheet did not provide adequate assistance to help understand the emerging patterns in the data “focussed coding” (Charmaz, 2006, p. 57) was conducted using the mind-mapping software TheBrain⁶ for support. The mind-mapping software provided a clear visual representation of clustering of the various codes and categories.

Following Charmaz’ approach, during focused coding all interview transcripts were coded into a single diagram using TheBrain software (see Appendix L) that enabled groupings of codes to be visualised. The software is interactive and facilitated viewing the diagram according to the primary codes and identifying relationships between codes and categories. This diagram simplified making sense of the complex relationships between the various concepts identified. The next step was to take an even more focused approach to the codes that had emerged so far. Using TheBrain software the highly complex single diagram was viewed as separate diagrams, one for each interview. These separate diagrams enabled focused coding to be conducted and relationships between the data.

⁶ https://www.thebrain.com/
were identified (see Appendix M). This coding of the interview transcripts centred on three themes: individual understanding of the term ‘curriculum’, the informal process that each academic engaged in when developing and teaching a course, and engagement with and knowledge of the formal process for handling curriculum change.

To record this analysis, a document summarising the analysis for each interview was created. This document (see Appendix N) highlighted where the data were explicit about relationships and where questions arose from the data.

4.3.3.2 Data coding – Phase Two

As was done after each interview, a summary of key points for the session was made immediately following each focus group. The summary noted impressions related to contextual issues, group interactions and so on, and made note of things that were unlikely to be reflected in the transcripts. As with the notes made after interviews, the notes made after focus groups (see Appendix O) were not formally analysed. These notes were part of data familiarisation and provided a reflection on the conduct of each session and informed the following session.

Due to the large quantity of data focus group sessions produced, it was decided to use NVivo7 software to help manage the process of data analysis during Phase Two. In Phase Two of the project, all transcripts, both interview and focus group, were considered as a composite set of data. Interview transcripts were reanalysed and recoded as part of the Phase Two data analysis process.

Data familiarisation was especially important for Phase Two data analysis as focus group sessions were transcribed by a transcription service. At times, the recordings were not easy to understand because of participants’ accents or because of over-speaking. As part of data familiarisation, the transcripts were verified and where necessary corrected using both the audio and video recordings. Once the sessions were transcribed accurately, holistic coding was undertaken using the same approach adopted for Phase One data analysis.

As for Phase One, a careful line-by-line approach to initial coding was used during Phase Two data analysis. This approach helped mitigate against the tendency to allow the

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7 [http://qsrinternational.com/](http://qsrinternational.com/)
understanding and ideas that had developed through Phase One analysis to colour perceptions and the codes generated through Phase Two analysis (Charmaz, 2006).

The video recordings of focus groups provided an invaluable resource to verify what participants were referring to when they said, for example, “up here” or “over here” or “this” and so on when referring to their models. Coding of focus group transcripts typically was a process of reading the transcript while listening to the audio recording, then watching the video while reading the transcript before returning to the transcript to identify a code.

As well as transcripts, Phase Two data included models created by participants. During focus group sessions, photos were taken of the models as they developed (see Appendix P). Analysis of these models was conducted using two approaches.

To analyse and code the data contained within the focus group models, the tags used by participants were coded alongside the codes that emerged from the transcripts. New data from the models was entered into NVivo. Next, a digital representation of the model recorded in the photos was created. Where necessary these digital models were elaborated based on transcript data (see Appendix R). Once the digital model for a focus group was created it was then compared with previous models looking for common elements, relationships, and attributes. After each comparison, a new composite, digital model was created containing the key elements. Each focus group model was compared with the new composite model and with other focus group models. This constant comparison of one model against another eventually allowed a composite model to emerge that contained the key elements, as reported in the following chapters.

Analysis of the data collected gave rise to a set of categories, codes and themes. The final Sub-Section of this chapter provides detail of the themes and categories that emerged from the data analysis process.

4.3.3.3 Emergent categories, codes and themes

During data familiarisation, holistic coding (Saldaña, 2009) was conducted. Through this process the categories and codes listed in Table 4.1 emerged.
### Table 4.1– Holistic coding – Categories and codes

<table>
<thead>
<tr>
<th>Categories</th>
<th>Codes</th>
</tr>
</thead>
</table>
| Concepts   | Complex connections between program and course outcomes  
Confused language and understanding  
Curriculum as specification or guideline  
Describe curriculum and surrounding process as design  
Program and course curricula in some form of hierarchy  
Structure and teaching methods equal implementation  
Unfamiliar with concept  
Written curriculum is designed object |
| Behaviour  | Change courses without discussion  
Content reflects individual interest  
Course design is solitary  
Focus at course level  
Lack coherent view of program  
No big picture |
| Incongruity | No explicit design process  
Don't use curriculum to guide design |

During open coding (Creswell, 2007) over 100 codes were generated. A sample of these codes is shown in Table 4.2.

### Table 4.2– Sample codes generated during open coding

<table>
<thead>
<tr>
<th>Academic experience</th>
<th>Accreditation</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual object</td>
<td>Actually learn</td>
<td>Add up to a whole</td>
</tr>
<tr>
<td>Aims</td>
<td>Align through structure</td>
<td>Aligned</td>
</tr>
<tr>
<td>Appropriate delivery mechanisms</td>
<td>Appropriate evaluation</td>
<td>Artefacts from design</td>
</tr>
<tr>
<td>Assessed</td>
<td>Assessment</td>
<td>Assumed prior knowledge</td>
</tr>
<tr>
<td>Assumptions</td>
<td>Attribute of a course</td>
<td>Balance</td>
</tr>
<tr>
<td>Being funded for</td>
<td>Benefits</td>
<td>Body of Knowledge</td>
</tr>
<tr>
<td>Break it down</td>
<td>Build on year after year</td>
<td>Building block</td>
</tr>
<tr>
<td>Capabilities</td>
<td>Change</td>
<td>Collaborate</td>
</tr>
<tr>
<td>Comparator Institution</td>
<td>Competencies</td>
<td>Complexity</td>
</tr>
<tr>
<td>Concept</td>
<td>Constrained</td>
<td>Constraint</td>
</tr>
</tbody>
</table>

Following open coding, focused coding (Charmaz, 2006) was conducted. This led to the coalescing of codes around categories and the emergence of three themes – curricular concepts, participant behaviour, and curriculum drift.
The categories and codes for each theme are contained in Tables 4.3 - 4.5 below. Table 4.3 provides categories and codes related to the curricular concepts theme; Table 4.4 provides details related to participant behaviour theme; and Table 4.5 provides details related to the theme of curriculum drift. The third theme – curriculum drift – emerged from the paradox arising from participants’ explanation of what they actually did compared with their concepts of curriculum and the process that surrounds curriculum design and development.

Table 4.3– Focused coding – Curriculum Concepts theme – Categories and codes

<table>
<thead>
<tr>
<th>Curricular Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Confusion</strong></td>
</tr>
<tr>
<td>Concepts</td>
</tr>
<tr>
<td>• Included / Excluded</td>
</tr>
<tr>
<td>Language</td>
</tr>
<tr>
<td>• Purpose</td>
</tr>
<tr>
<td>• Content</td>
</tr>
<tr>
<td>• Outcomes</td>
</tr>
<tr>
<td><strong>Designed Object</strong></td>
</tr>
<tr>
<td>Purpose</td>
</tr>
<tr>
<td>• Goal / Rationale</td>
</tr>
<tr>
<td>Content</td>
</tr>
<tr>
<td>• Topics / Body of knowledge (BoK)</td>
</tr>
<tr>
<td>Outcomes / objectives</td>
</tr>
<tr>
<td>Relationships</td>
</tr>
<tr>
<td><strong>Design Process</strong></td>
</tr>
<tr>
<td>Design problem</td>
</tr>
<tr>
<td>• Clear purpose and goals</td>
</tr>
<tr>
<td>• Constraints</td>
</tr>
<tr>
<td>• Imposed structure</td>
</tr>
<tr>
<td>• Lecturers / Students</td>
</tr>
<tr>
<td>• Resources – Dollars / Human</td>
</tr>
<tr>
<td>• Subject matter</td>
</tr>
<tr>
<td>Lifecycle</td>
</tr>
<tr>
<td>• Design / Development / Implementation / Verification</td>
</tr>
<tr>
<td>Language of design</td>
</tr>
<tr>
<td>• Artefacts</td>
</tr>
<tr>
<td>• Implement</td>
</tr>
<tr>
<td>• Specification / guideline</td>
</tr>
<tr>
<td><strong>Implement</strong></td>
</tr>
<tr>
<td>Curricula Layers</td>
</tr>
<tr>
<td>• Official-curriculum / Curriculum-in-use / Delivered curriculum</td>
</tr>
<tr>
<td>• Other</td>
</tr>
<tr>
<td>Sequence</td>
</tr>
<tr>
<td>• Imposed</td>
</tr>
<tr>
<td>• Program / course / lecture</td>
</tr>
<tr>
<td>• Subject matter</td>
</tr>
</tbody>
</table>
### Curricular Concepts

<table>
<thead>
<tr>
<th>Structure</th>
<th>Teaching approach / method</th>
</tr>
</thead>
<tbody>
<tr>
<td>• External</td>
<td>• Course delivery</td>
</tr>
<tr>
<td>• Passed from one instantiation to another</td>
<td>o Face to face / On-line / Intensive</td>
</tr>
<tr>
<td>Same curriculum different implementation</td>
<td></td>
</tr>
</tbody>
</table>

### Complexity

<table>
<thead>
<tr>
<th>Hierarchy</th>
<th>Relationships</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Program / course / lecture</td>
<td>• Difficult to understand / Hard to keep in your head</td>
</tr>
</tbody>
</table>

### Table 4.4 – Focused coding – Participant Behaviour theme – Categories and codes

<table>
<thead>
<tr>
<th>Participant Behaviour</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Focus</th>
<th>Change</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course level</td>
<td>Course</td>
<td>Course name</td>
</tr>
<tr>
<td>Lack coherent view</td>
<td>Existing</td>
<td>Knowledge</td>
</tr>
<tr>
<td>Solitary work</td>
<td>On-going</td>
<td>Experience</td>
</tr>
<tr>
<td></td>
<td>o Lecturer interests</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Limited discussion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Limited reference to official-curriculum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Program</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• More formal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• More collaborative</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Vested interests</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Political</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Program</td>
<td>Existing material</td>
</tr>
<tr>
<td></td>
<td>• More formal</td>
<td>Colleague, from another university</td>
</tr>
<tr>
<td></td>
<td>• More collaborative</td>
<td>Comparator university courses</td>
</tr>
<tr>
<td></td>
<td>o Vested interests</td>
<td>Model curricula</td>
</tr>
<tr>
<td></td>
<td>o Political</td>
<td>Official-curriculum</td>
</tr>
<tr>
<td></td>
<td>Program</td>
<td>Text books</td>
</tr>
<tr>
<td></td>
<td>• More formal</td>
<td>What they learned</td>
</tr>
<tr>
<td></td>
<td>• More collaborative</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Vested interests</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Political</td>
<td></td>
</tr>
</tbody>
</table>

### Research Design

116
Table 4.5– Focused coding – Curriculum Drift theme – Categories and codes

<table>
<thead>
<tr>
<th>Curriculum Drift</th>
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<tbody>
<tr>
<td><strong>In balance</strong></td>
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<tr>
<td><strong>No explicit design</strong></td>
</tr>
<tr>
<td>• Curriculum as specification but ignore</td>
</tr>
<tr>
<td>• Do not update official-curriculum</td>
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<tr>
<td>• Drifting</td>
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<tr>
<td>• Little changes</td>
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<tr>
<td><strong>Normal</strong></td>
</tr>
<tr>
<td>• Test out change</td>
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<tr>
<td>• Needs monitoring</td>
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The following chapter sets out the findings that emerged from the data.
Chapter 5  FINDINGS

The goal is to turn data into information, and information into insight

Carly Fiorina, former executive, President, and Chair of Hewlett-Packard Co.

As discussed in the preceding Chapter, participants in both phases of data collection explained and described their concept of curriculum. They were also asked to describe what they did when they designed, developed, and implemented their curriculum. When answering they described and explained what they did when they taught a new course, i.e. one that has not been taught at their institution before; what they did when they inherited a course that has been taught by somebody before them; and what they did when they taught the same course over a period of years. Phase One participants used only words, while Phase Two participants created visual models of their concepts of curriculum, which they then used to help describe and explain what they did. Visual models typically included elements of the curriculum development and design process. Phase Two participants used both their conceptual models and words to explain the process with which they engaged.

The findings presented in this chapter emerged from my analysis of the data collected in both phases. Although the findings provide answers to the questions underpinning this research they are not presented according to which question they provide an answer. Instead, they are grouped around the two core themes that emerged from the data analysis: (1) curricular concepts, and (2) participant behaviour with regard to curriculum development and use. Answers for each of the research questions asked are presented in Chapter 7 – Conclusions and Implications and emerged from an analysis of the findings presented here. Chapter 6 provides an analysis, discussion and synthesis of these findings.
This approach to presentation of the findings was chosen because the data was not analysed with the goal of finding answers to the specific research questions asked. Data analysis was holistic and when analysis was complete and I had the set of findings presented here, the findings were grouped around the two core themes. At this point, I was not sure that I necessarily had complete answers to all my questions. Findings are presented as they emerged from the analysis.

Data from Phase One is the view of a single individual and is identified using the labels A, B, C and so on. While Phase Two data are usually the comments of an individual, the individual who made the comment is not identified. The comment may have arisen from the discussion rather than reflecting that individual’s initial thoughts. Phase Two data is identified by focus group session, using the labels FGA, FGB, FGC, where FGA represents Focus Group A, and so on. Where conversational exchange is shown, each individual’s comment is prefixed by an identifier such as participant 1, participant 2, or facilitator. Except where indicated, all excerpts are direct quotes and have not been edited for readability.

In this thesis, the term ‘program’ refers to a complete, integrated course or program of study leading to the award of a degree qualification. A program is constructed from many courses. The term ‘course’ refers to a single unit of study, sometimes also called a unit, subject, or module. Students take a number of courses each semester.

To start, I let the participants tell their story of curriculum, which provides a summary of the findings. Sections 5.2 and 5.2.8 present the findings that emerged. As noted above, findings are presented according to which of the two emergent core themes they relate. Section 5.2 presents the findings related to the concepts of curriculum held by participants, while Section 5.2.8 presents the findings related to participant behaviour and their use of the official-curriculum.

5.1 Curriculum – In the words of participants

The following selection of participant statements summarises the findings of this research; these are the words of participants and, except where indicated, have not been edited. Headings have been inserted to emphasise the themes and to clarify the flow of the story; they are not quotes from the data. Comments on opposite sides of the page have been used.
to indicate the conversational element of data collection. This is the academics’ story, their account: curriculum in the words of the participants.

**What they think it is**

Curriculum is just content

The content and how that feeds into the learning outcomes

It’s the structure we use to communicate the contents. It is the learning structure

What’s in the curriculum is, what’s the shape, what are the building blocks

I guess the sequence of content which students, which we teach students and expect students to learn and understand

The sort of sequence of lectures and all the topics and all the exercises and the flow of the assignments

You come up with the degree program and then that becomes the individual degree courses

The aims, the objectives and the goals infer the learning outcomes … And then there’s certain constraints

Constraints play a fairly significant role

If you can’t achieve the goals there’s not much point in fantasising about it

It impacts on the nature and extent of what you could do

There is a process around the formation of curriculum and that has the aims and the objectives and it also has the evaluation and then the teaching activities and so on

It’s a design with constraints and it has goals as in any human oriented system

That’s just like requirements. The first step, we get the requirements. Then the second step, is we need to come up with the program and then for each program we need courses.
How they use the official-curriculum

I know what the course is called and I will print on the course my understanding of what that topic is

Much of what you do is constrained by the actual topic. So if you tell me I’m going to teach third-year algorithms. I pretty much know already what’s going to be in there

I guess the other thing that sort of informs curriculum is like your experience in curriculum, like what you did at university when you went to university

So you come up with a curriculum and then you think, well what were we intending to do anyway? So maybe goals aren’t a big driver anyway ... and then let’s have a think. Well what do we want to do? Oh yep, that sounds about right

Often I’ve taken one thing out ... They would accumulate over time so if you change one thing in the course each year, or one entry, then the course will change over time

I make sure [my course] is professionally and academically valid, whatever it is, but it’s not my problem if that doesn’t logically fit into a program, that’s somebody else’s problem.

The espoused curriculum is what we have written down in our documents for accreditation and curriculum-in-use is what the teachers teach because they like teaching that thing rather than what was written down.

The following section presents a summary of the various themes, codes, and categories that emerged from the data analysis.
5.2 Curriculum – concepts

Participants described curriculum as both a process and a designed object. Phase Two participants described curriculum as a designed object more clearly than did Phase One participants. The curriculum, as a designed object, was the output from the curriculum design process and related to both a degree program and to its constituent courses. These curricula exist in a form of hierarchy. Participants identified three principal curricular elements:

- content,
- desired skills and learning that students should be able to exhibit at the end of the course or program, and
- goals or purpose of the curriculum.

Early in their descriptions participants were not clear whether curriculum contained a fourth element, that of structure.

As Phase Two participants discussed their concepts, they determined curriculum was a problem of design involving a process that produced an object designed to meet a clearly defined purpose and set of goals within the constraints and influences that were imposed upon it. During this discussion, participants determined that structure was not an element of the curriculum itself, but an aspect of its implementation.

Participants in both phases were clear that the concept of curriculum belonged to both programs\(^8\) and courses\(^9\), suggesting that they existed in some form of hierarchy.

When describing their concepts of curriculum, the process surrounding the design and development of curriculum was one of design. Not only did they use the language of design to describe the process but also participants clearly described the implementation of the curriculum, even suggesting, “if you take the same curriculum you can implement it with different methods” (FGC)\(^10\). Implementation led to the creation of curricular variants, most

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\(^8\) Program refers to a complete, integrated course or program of study leading to the award of a degree qualification. A program is constructed from many courses.

\(^9\) Course refers to a single unit of study, sometimes also called a unit, subject, or module. Students take a number of courses each semester.

\(^10\) FGA, FGB, FGC, FGD, and FGE, where FGA identifies focus group A and so on, identify focus groups involved in Phase Two data collection. Individual participants in focus groups are not identified. A, B, C, D, E, and F identify individual participants in Phase One data collection.
notably the “curriculum-in-use” (FGC, FGE). These variants differed more or less from the official-curriculum.

The following sub-sections present detailed findings related to participants’ concepts of curriculum.

5.2.1 Confusion of understanding and terminology

Participants did not possess a common understanding of the elements from which a curriculum is composed. This confusion of understanding was most obvious in focus group sessions. At times there was bewilderment when participants discovered that while using the same term they were discussing closely related, but different concepts.

Of the five focus groups, only Focus Group B attempted to clarify just what it was that they were modelling, asking prior to creating their model: “It’s our concept of a curriculum? It’s not a process? It is the actual object – the curriculum, the concept? … [Because] a process to develop curriculum and the concept are, I think, different things”. Nonetheless, part way through this focus group session one participant said, “I was thinking about a degree program when we were doing this” to which another replied “Oh right. See I was thinking about a course”. In another group, there was uncertainty when the facilitator asked, “so when you say you’re designing a curriculum what are you talking about? A program or a course?” to which a participant replied “[the curriculum] of a program, and a group of subjects, and some majors. All of that could be mixed up together” and another interjected with “Oh! I was assuming a course. I’ve just realised that it doesn’t have to be a course”. Specific findings describing the relationship curriculum has with programs and courses are covered in Sub-Section 5.2.4 below.

Participants were also unclear about exactly which elements comprise a curriculum. For example, there was debate about whether pedagogy, that is the teaching methods adopted, were an element of curriculum or whether it was an aspect of the implementation of that curriculum. Findings related to curricular elements are discussed in Sub-Section 5.2.3 below, while Sub-Section 5.2.6 contains findings related to the implementation of a curriculum.
Adding to the confusion caused by a lack of a common understanding, focus group participants were also at times confused by the different terminology used. Findings related to this aspect are woven throughout this chapter.

Although there was a confusion of understanding and terminology obvious, participants were clear that curriculum was both a process and an object.

5.2.2 Both a process and an object

Participants were not asked specifically whether they perceived curriculum to be an object or a process or even both. During focus group sessions in particular, participants were clear they considered the notion of curriculum to encompass both a process and the creation of an object. Participants' clearly described a "process around which we decide what's in the curriculum" (FGA), and noted that this process includes another decision-making process to determine the "lower granularity of how you ... organise the curriculum" (FGA). Although only one focus group clearly described the official-curriculum as a "designed object" (FGC), all participants' descriptions and models identified the official-curriculum as a purposeful object that was the output of a process. Furthermore, participants not only articulated the idea that curriculum encapsulated both the process and the output of that process but that both were necessary. They were described as closely interrelated "because you can't really understand that [the official-curriculum] in absence of that [the process]. You can't represent it [the official-curriculum] without that [the process]" (FGA).

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FGB  [Participant 1] It's not a process it is the actual object – the curriculum, the concept ... [A few minutes later]

[Participant 2] There is a process around the formation of the curriculum

FGC  This is a static thing that we've designed ... it is a designed object

FGD  You just keep on doing this slow refining process in terms of the program

5.2.3 Elements of curriculum

As to describe their concept of curriculum, Phase One participants talked mainly about content as well as notions of desired outcomes or objectives. Of the six Phase One participants, four expressed sentiments indicating that for them "curriculum as a whole relates more to the program than to particular courses" (F)\(^1\). Notwithstanding this, all

\(^1\) A, B, C, D, E, and F identify individual participants in Phase One data collection

Findings
participants expressed the view that a program curriculum included “the courses and the curriculum in each of the courses, all the courses in a program” (A). It was also noted that once you have the curriculum for a program it could be “divide[d] … up into individual courses and you’d have a curriculum for individual courses as well so you’d have an idea of what content you’d want students to understand and learn through a particular course” (F). Phase One participants included structure in their definition of curriculum. The curriculum was described as “the structure of the program and content” (A) that laid out “the sequence of content” (F) and “the sequence of courses” (D). Only two participants discussed the concept of how it is taught. For one, curriculum was “more about content and objectives than the methods used to get there” (C) while for the other, “it can also incorporate some aspects of the way it is taught because … you might be trying to change their behaviour” (B).

Phase Two participants created a visual model of their concepts, which was then explained and used through the ensuing discussion. When explaining and describing their models, curriculum development was described as a “design problem” (FGC). Considering curriculum as an issue of design required description of a clear process and required determining the goals and purpose of the curriculum, considering the influences and constraints that would affect its design, and then designing a solution – the official curriculum – which would be used to guide the implementation. Implementation was also affected by constraints. With the exception of a single participant, all Phase Two participants were clear that one of the curricular elements was that of purpose. One participant, however, felt that purpose was simply an aspect of the design process because “as long as that curriculum meets the initial aims and goals then that curriculum exists on its own” (FGB). This participant, when acknowledging the importance to the design of goals, suggested, “if you’re talking about the curriculum being a written document there could be a preamble that summarises the aims, but I don’t think that’s part of the curriculum”.

When describing their model, Phase Two participants placed a heavier emphasis on the process of curriculum design and development than did Phase One participants. This emphasis emerged from the discussion between participants as they compared the processes in which they engaged. Phase Two participants were clear that the output of that process – the official curriculum – was an object they had designed.
Initially participants included structure as one of the elements within their definition of curriculum. As discussion continued, however, structure was identified as a constraint on the design and implementation of a curriculum rather than an integral element of it.

Structure provided the “organising principles for the logistics ... the framework” (FGA) within which participants implemented their curriculum. It could also be seen as providing a “rough map of how that’s going to fit together” (FGB).

Three key curricular elements were identified by all participants. The following subsections identify these elements.

5.2.3.1 Element 1: Content

Content was the most frequently mentioned curricular notion. It was mentioned by every participant and included in all conceptual models. Frequently it was the first aspect of curriculum mentioned. Generally, participants used the term content when talking about the program, while more usually the term topic was used when referring to the content of a course.

| B     | It means the things that you want a student to learn. So content |
| D     | All the topics in the whole program that you're trying to ... that try and deliver all of the content that you want someone to learn in that particular program |
| FGA   | The actual content that we teach: content, subject matter and topics |
| FGD   | A fairly short, constrained, formal document that describes the content of the course. |
| FGE   | I’m working out my topics and how it’s going to be delivered. |

5.2.3.2 Element 2: Outcomes

The second curricular notion all participants included in their discussion or models of curriculum was that of required knowledge and skills. Depending whether they were talking about a program or a course, participants sometimes used different terms. As the following graphs show, participants used different terms to describe what appeared to be the same thing – the knowledge and skills that students should be able to demonstrate after completing an individual course or graduating from a degree program. Furthermore, the same individual was likely to use multiple terms when describing the same notion, especially when discussing the program curriculum.

Participants used a greater variety of terms when describing the desired student outcomes from a program than they did when discussing the desired outcomes from an individual
course. The data provided by participants that related to their pedagogical education and experience may have enabled conclusions to be drawn about the number of terms and which particular terms were used. As this was outside the scope of this thesis, I did not attempt to uncover any correlations.

As there was a difference between participants’ description of outcomes according to whether they were talking about a program or a course, these findings are presented in two Sub-Sections. I start with findings related to program outcomes and then present those related to course outcomes.

**Program**

Figure 5.1 plots the number of terms used by each individual participant or focus group session when discussing or describing desired student outcomes from program curricula.

Participant D did not mention outcomes at all when discussing curriculum as it related to a degree program. For this participant curriculum was “the collection of courses and learning activities that um contribute a degree program ... Um, well yeah, the collection of courses that goes to a degree program ... So when I think of the word curriculum I think of the sequence of courses” (D).

![Figure 5.1 - Number of different terms used describe program outcomes](image)

**Figure 5.2** below plots actual terms used by individuals and focus group participants. While 12 separate terms were used, the two most commonly used were learning outcomes and outcomes. Both student outcomes and graduate outcomes were used by two different focus groups.
Course

Figure 5.3 plots the number of terms used by individual participants and focus groups when discussing and describing individual course outcomes. As can be seen there was much greater consistency of usage when discussing courses, with only participant B using more than a single term.

Findings
discussing and describing individual course outcomes, with learning outcomes being by far the most commonly used.

![Figure 5.4 – Terms used to describe course outcomes](image)

### 5.2.3.3 Element 3: Purpose

The third curriculum element to emerge was the strategic purpose of a curriculum. Participants referred to purpose (FGA), goals (FGA, FGB, FGC, FGD), aims (FGA, FGB, FGC, FGE), and at times curriculum intent (FGB). This concept emerged most strongly from focus group participants and was a result of their discussion related to curriculum as a designed object.

FGA All this stuff here is about purpose and why we’re doing it  
FGB There is some material at the beginning that describes the aims

### 5.2.4 Curriculum applies to both programs and courses

Although there was at times confusion in focus group discussions when one participant was talking about a course and another a program, it was clear that participants considered the notion of curriculum applied to a program as well as to the individual courses contained within that program.

F Initially when someone says curriculum I’d think of all the courses in a program, but you’d then divide that up into individual courses and you’d have a curriculum for individual courses as well  
FGB [Participant 1] I was thinking about a degree program when we were doing this  
[Participant 2] Oh right. See I was thinking about a course. But ... if, from now on, you said we’re only going talk about like programs like yep no problems ... it wouldn’t change a thing
5.2.4.1 Hierarchy of curricula

Participants suggested that the curricula for a program and its constituent courses would be much the same thing, but that they existed at different levels, in some form of hierarchy. When undertaking curriculum design, the outcomes of a program “filter down” (FGC) to the courses because the process of designing a curriculum is “a top down process” (FGB).

They’d almost be the same thing, but at a different level

You come up with the degree program and then that becomes the individual degree courses ... and these just get repeated ... the objectives and goals at the course level down here ... It's a program and a course ... I guess that's hierarchical

A program, and a group of subjects, and some majors, all of that could be mixed up together ... the whole interleaved ... in some form of hierarchy.

Participants suggested that because of the “top-down” (C, FGA, FGC, FGD) structure of a curriculum with the different levels representing increasing granulation, that is, program, majors, courses, lesson and so on, the curricula existed in a form of “hierarchy” (FGA, FGB, FGC) such that “they’re almost the same thing, but at different levels” (FGC). Figure 5.5 illustrates this concept. At the top, the official-curriculum for a program is “an overarching thing ... that says this stuff adds up to a program” (FGA). When developing a curriculum for a program “you come up with the degree program and then that becomes the individual degree courses” (FGB). A curriculum can represent “a program and a group of subjects, and some majors” (FGC). One focus group even went so far as to suggest that it should be possible “to cut courses cookie cutter style” (FGB) from the program curriculum.

![Figure 5.5 – Hierarchy of curricula](image)
5.2.5 Curriculum as a Design Problem

While only Focus Group C explicitly identified a curriculum as a “designed object”, all participants used the language of design to describe their concepts. Furthermore, they all frequently drew a distinction between the curriculum as an artefact that was then implemented as they developed teaching and learning material and actually taught their courses.

Focus Group C provided a very clear description of curriculum as a problem of design. They explained that graduate or student outcomes are the guiding principles, the goals that the curriculum designer sets out to achieve. The aims, learning outcomes and structure constituted the ‘thing’ that was designed to achieve the specified goals, and the content, the subject matter, topics, modules of content were some of the material the designer had to work with to design the ‘thing’. They also explained that the mode of teaching, teaching methods, learning activities, and assessment were the means of implementing the ‘thing’. Available resources and cost were determinants or constraints on both the design and the implementation. In addition, like all design problems, the designer would start with the goals and then, factoring in the constraints such as human resources and costs, the designer would proceed to design a solution that would be used to guide the implementation.

All focus groups discussed the need for the curriculum to meet the specified purpose (FGA), the intent (FGB, FGE), goals (FGA, FGC, FGD, FGE), and/or aims (FGA, FGB, FGC, FGE). Participants more generally considered that the design and implementation of the curriculum had to take account of constraints (A, C, D, FGA, FGB, FGC, FGD, FGE) especially human (A, D, FGA, FGB, FGC, FGD, FGE) and financial resources (FGA, FGC, FGE).

C We collectively form a view of what the degree program is … without articulating the interfaces at that time. We don’t apply to that kind of design, the sorts of design principles we do to software modules … but equally we don’t come back and say here’s what the outcomes are. Is this right against the expected input states to a subsequent course or against the whole degree program

FGA I think it’s like designing software, you’ve got to work out who the customer is, what they’re trying to achieve and what resources you’ve got

FGE It’s a bit like us having a requirement statement and what we implement has to meet those requirements … I’m just thinking about, you know, like when you do a project. In terms of the requirements that go in how you build things.
5.2.6 The curriculum development process

Participants in both phases described curriculum development in terms of a design process, which led them to consider the importance of purpose and goals, the impact of constraints on both the design and implementation, and the need to verify that the implemented solution meets the original purpose and goals. Focus Group C went as far as describing the curriculum itself as a “designed object”. In acknowledging the impact of constraints on both a curriculum’s design and the implementation of that design, participants identified curricular variants, or what can be seen as layers of curriculum (see Sub-Section 5.2.7 below).

5.2.6.1 Curriculum as specification

The curriculum was likened to a requirements document used when designing and developing software or an engineered solution (C, FGD, FGE). Curriculum goals were likened to project requirements, again evoking the world of projects and design that the participants inhabit. A curriculum was also referred to as a specification and there was clear distinction between the specification (the “espoused curriculum” FGC), the design of a solution and the actual implementation of that design (the “curriculum-in-use” FGC, FGE).

C The objectives might be the same, but ... how material is put together, how activities are put together, how they are presented, how they are represented in different tasks and so on ... That’s the operational teaching and learning bit.

FGA You have a whole bunch of assessment items, which are implemented using these mechanisms ... don’t think about delivery at the moment, this [pointing to their model of the official-curriculum] is the big picture right, this is about our belief.

FGC If you take the same curriculum you can implement it with different methods

At times, participants were quite explicit in likening curriculum design and development to engineering or software design and development. For example, saying that the official-curriculum is “a guideline, a specification of sorts, a framework” (FGC), and that it “indicate[s] the level of the knowledge and what kind of knowledge. That’s just like requirements. The first step, we get the requirements ... you have to design something under constraints” (FGD). Participants also identified the need to clearly state and understand the goals and purpose of the curriculum and the constraints the curriculum will operate under because these determined both the desired outcomes and the ability to
achieve those outcomes. Outcomes help the curriculum meet the desired goals and purpose because "you get to the goals via the outcomes" (FGB); they are "the things we cover in order to meet those aims. We cover these things within the framework set out in the structure" (FGA).

5.2.6.2 Curriculum Implementation

Initially participants included structure within their definition of curriculum. As discussion continued within focus groups, however, structure was identified as a constraint on the design and implementation of a curriculum rather than an integral element of it. In one focus group, in response to the facilitator asking whether structure was an integral element of curriculum, it was described as "a constraint that is so strong you almost don’t think outside that box" (FGC). A statement with which all other participants in that focus group strongly agreed. No other participants so clearly identified structure as a significant constraint; they just accepted it as something within which they had to work. In fact, participants were so accepting of the imposed structure, they used it as a guide for their design saying that when designing and implementing their courses they generally used "the structure around the semester and ... where things go in terms of weeks" (FGD) to help them design their courses. It was also suggested that the "bare bones structure" (D) of a course was something that could be passed from one instantiation to another and even from one institution to another.

5.2.6.3 Purpose and goals used for design and evaluation

Participants indicated that the curriculum should be designed to meet a clear purpose and goals and that both the design and the implementation of that design were impacted by a set of constraints or influences. Clearly articulating a set of goals for the curriculum also facilitated the evaluation of its effectiveness in meeting those goals.

**Design**

The purpose and goals that drive or determine content and learning outcomes were included as an integral element of curriculum. Within Focus Group B, there was discussion about whether purpose and goals were actually elements of a curriculum or instead were constraints. One participant noted “there’s some material at the beginning that describes the aims and so on [pointing to grouped tags aims, objectives, goals, underlying philosophy] and we wouldn’t have a curriculum that didn’t have some statement about these”. In reply, it was suggested,
if the curriculum is something tangible that comes out at the end ... you throw away the goals ... As long as that curriculum meets the initial aims and goals then that curriculum exists on its own ... I think the analogy would be constructing a building you have an architect who designs it, but at the end of the day it all exists after being built. It doesn't matter so much how you got there. (FGB)

The exchange was settled with a compromise by the dissenting participant: “well I guess if you’re talking about the curriculum being a written document there could be a preamble that summarises the aims”. Regardless of whether goals and purpose were an element of curriculum or a constraint on its design, all participants in that focus group agreed it was important to have clearly articulated purpose and goals when designing a curriculum.

A This stuff is essentially about purpose. There's always things related to purpose, objective, goals. From the perspective of... from different perspectives – student’s perspective, quality, dollars can probably come in there actually.

FGB The aims, the objectives and the goals infer the learning outcomes

**Evaluation**

In addition to driving the design of the curriculum, the stated purpose, goals, and objectives of a curriculum were used in evaluating how well the implemented curriculum had met the stated purpose, goals, and objectives.

E I try to make sure my outcomes are reflected in the evaluation, assessment, of the course.

FGA The students are assessed whether they’ve achieved those objectives, the student objectives and the courses are also ... whether they have achieved those and then the courses are evaluated, whether it's all in general achieving the purposes of doing this course

FGD My way of thinking probably is more like software engineering refinement. Like start with requirement, next is the goal, the very general goal, like we have a set of things then we refine this to courses ... you just need to define a set of skills or knowledge in terms of the goal ... at the course level, it’s easy to design the unit test equivalent of say tutorials, exam questions, and assignment questions and so on, and I also include some fusion questions that’s combining a bunch of those unit tests, to ask them to do something

The ability of the official-curriculum to deliver the required outcomes is evaluated externally, generally through accreditation and benchmarking exercises. The curriculum-in-use is evaluated internally when individuals responsible for its delivery evaluate their courses.
Participants noted that evaluation involves two different aspects. This is best explained by the snippet from discussion in Focus Group B:

With assessment, there [are] ... two slightly different concepts that are bundled into one. One is determining ... whether you’ve met the course outcomes and the other is in just ranking the students ... They're two different things. They're related, but ... one is for the benefit of ... the teacher and the institution, whereas the other is purely for sending students out into the world so that they can get good jobs (FGB).

5.2.6.4 Constraints and influences

Participants identified a number of influences and constraints that affect the desired and actual outcomes and goals, help determine the design, as well as the implementation of that design. These are shown in Figure 5.6 below.

![Figure 5.6 - Constraints identified by participants](image)

The purpose and objectives of a curriculum also acted as constraints upon its implementation because the required competencies and capabilities "have an overall effect on what we can do down here [pointing to learning outcomes and learning objectives within their model]" (FGB).
Findings

C I always find that contact or the classes, the tightest constraint ... the class contact and what goes on in those classes is very constraining. There’s only 13 weeks, there’s only 7 weeks of lecture type classes and 6 weeks of laboratory type classes

FGC [During discussion about the typical 12 or 13-week semester] it’s a constraint that is so strong you almost don’t think outside that box. You don’t think I’d like to have 20 weeks on this, is it the right size. You think what is the coherent unit, coherent set of knowledge which fits in a 13-week chunk

FGD The skills depend on constraints. Because some constraints... for example, if you don’t have staff who have expertise in some area you won’t be able to offer this course

Structure

One of the most significant constraints identified was that imposed by an institution in terms of the structure into which participants had to fit their curriculum. This imposed structure included the semester length and breaking a program into courses of equal size and weight. This is best explained by the following excerpt:

We are all forced these days into this common framework called courses and years and pre-requisites. We don't have this very flexible, we get you for two thirds of the year ... [students] get three lectures on Latin, five on that and 10 on that ... [with] very variable sizes of things ... [We] have gone to things which are in tradable chunks so that we can say you can take a course in computer science and a course in information systems and a course in engineering and we know where they fit in the year ... It’s a constraint that is so strong you almost don’t think outside that box. You don’t think I’d like to have 20 weeks on this. That is the right size [General agreement from other participants]. You think what is the coherent unit, coherent set of knowledge which fits in a 13 week chunk. And that's unfortunate, but we've been doing it for so long we've almost been straitjacketed and it's more than just a constraint. It's a box [quiet laughter and general agreement from other participants] (FGC).

Constraints on a curriculum may not remain constant over time. For example, “if you don’t have staff who have expertise in some area you won’t be able to offer this course” (FGD). Another constraint that changes over time was that “technology is changing rapidly” (E).
Participants excluded structure, organisation, and teaching practice from their notion of the official curriculum. Instead, they argued these were aspects of the “operationalisation” (FGC) of the official-curriculum: they were constraints upon the design and implementation of the curriculum-in-use. Thus you could “take the same curriculum [and] you can implement it with different methods” (FGC). This meant that the same official-curriculum could be implemented as face-to-face synchronous, on-line asynchronous, on-line synchronous, large group or small group etc., and that the learning activities that might be used to achieve the outcomes are only limited by the content, the desired outcomes, and the constraints that relate to things such as student population, financial limitations, personal ability etc. When discussing this concept, a participant suggested that if a course was taught “in two intensive blocks … the activities would be of even more intensity and would not be splittable in the same ways … [as] face-to-face activities” (C). Participants suggested that these learning and assessment activities were “methods … which are the means you do it” (FGA) and which would be different depending on the implementation.

Participants identified two kinds of structure: one imposed by an organisation and the other that exists within a program or course and relates to sequence of content and/or learning activities. The structure imposed by an organisation was generally spoken about in terms of a constraint, while the second was seen more as a logical constraint, one that was imposed by the subject matter itself. This led to sequences of courses; sequences of topics within a course as well as a sequencing of activities within a course. The structure related to sequencing of topics and activities in a course was something that could be passed from one instantiation of a course to the next. For example, one participant said about inheriting an existing course “[I] used the same structure that already existed but wrote new assessments to fit that structure” (B) while for another “the structure stayed pretty similar and the teaching methods just kind of evolved as materials were developed to support the teaching activities” (D).

**Curricular outcomes**

Curriculum outcomes were also identified as important constraints. The implemented curriculum needed to be able to achieve the specified outcomes so there need to be learning activities that facilitate their development, and assessment that determines whether students have actually reached the desired level. Curriculum outcomes arise from a variety of sources. Especially at program level, curricular outcomes are frequently
imposed by external bodies, including accrediting bodies, the institution, and more broadly society itself. As shown in Figure 5.5, the outcomes exist in a form of hierarchy.

![Hierarchy of curricular outcomes](image)

When referring to outcomes at levels 0 and 1, which apply predominantly to program curricula, as well as calling these both “outcomes” and “objectives” participants referred to them as “graduate outcomes”, “graduate skills”, and “generic skills”. Level 2 outcomes – program curriculum outcomes – were referred to as “learning outcomes”, “student outcomes”, “learning objectives” and “student objectives”. Program outcomes “filter down into things in the courses” because the program curriculum is “an overarching thing ... that says this stuff adds up to a program”. To put this another way, outcomes at levels 3 and 4 when taken together holistically need to help achieve the outcomes at levels 0 – 2. Participants also identified the “tension” that exists between the outcomes required by accreditation and those that individual academics want to include.

Depending on the structure used to implement a program it might be broken up into a number of majors and courses, each of which would have their own set of outcomes that reflect the outcomes at levels 0 – 2. Participants referred to these as “first year outcomes”, “learning outcomes”, “course outcomes”, as well as sometimes “outcomes”, “student skills”, and “generic skills”.

Personal interest and ability of academics were often reflected in course outcomes especially in the curriculum-in-use. As constraints, outcomes should be guiding the selection of appropriate textbook and associated learning activities.

**Human and financial resources**

Participants identified both human and financial resources as important constraints upon the development and implementation of the official-curriculum. Available financial resources frequently dictated how much time and effort was put into the
operationalisation of a curriculum. At times either financial or human constraints might cause the adoption of less appropriate activities within a course, such as group work, simply to save money. In terms of human resources, it was suggested that the development of the official-curriculum needed to take account of the people available to teach it: their interests and ability as well as their availability to actually teach the course. Changing staff make-up of an institution was also identified as likely to have an impact upon the implemented curriculum.

**Students**
Students themselves, in terms of the number of them in a course, their backgrounds, and language abilities were also identified as an influence or a constraint upon the curriculum. For example, “the diversity of students means I need to understand what skills and experience they have so that I can work out how I can get the students to achieve the outcomes I want” (E). Another participant said, “I’ve really felt under pressure in the last few years. Especially when I started having big classes I really had to consider what was possible” (FGC). While another indicated that the “student type, students’ interests” (FGC) also had an impact upon the operationalisation of the official-curriculum saying about a course they had not taught for a couple of years:

> the single thing that's changed ... [is] 98% of the class is [now] Chinese. I'm having to teach it differently ... I've had to change ... the teaching style. It had to have a ... very careful explanation of concepts ... [I] have a section that actually says key concepts ... so that we're quite clear they know what the words mean before I go on any further. (FGC)

**Other constraints**
At the program level, constraints tended to be described as influences. Influences included industry – what processes and technology they use, and what outcomes they seek – as well as those imposed by institutions and accrediting bodies. Influences were often related to content and the implementation of the program, i.e. what courses were needed. Influences could also be political. The “vested interests ... [or] power groups” (FGC) of academics involved in design and development “form curriculum towards their own personal ends” (FGC). Because of these vested interests it was important that “if you want to bring in a new degree then you need the support of the school ... [otherwise] you’ll design the degree
and the rest of the school says no you have to have this particular course” (FGD). Another influence on curriculum design and development was the tension between science and industry. This could be seen as the “dichotomy in engineering ... between the sort of professional emphasis engineers versus the highly mathematical, research emphasis engineers” (FGA). It appeared that this tension between academics with a science or research focus and those with a more industrial or professional focus was common across engineering, software engineering, information systems, and computer science.

Participants acknowledged that at times it could be hard to tell exactly what the influence was, suggesting that inclusion of particular content was influenced both by “vested interests but there is also costs” (FGC). Costs could be important when someone had to learn “to teach new subjects, [because] it's going to cost more of their time” (FGA). However, when an academic says, “I wouldn't know how to teach that. We don't know how to teach courses in "X". Is that vested interests or is that resources? We don’t have time to go and hire someone” (FGC).

5.2.6.5 Structure

Structure was a concept mentioned by all participants when discussing or modelling their concepts of curriculum. It related to both programs and courses. When creating their model, focus group participants initially included it as an element of curriculum. However, as discussion progressed in focus group sessions, participants no longer saw it as an element of a curriculum, instead defining it clearly as an element of the operationalisation of the official-curriculum.

At program level, structure provided the 'container' for a collection of courses, or content and included the notion of majors and sequencing of courses. Structure was also seen as something external that could be imposed upon a program or course, such as the teaching periods of an institution and was one of the constraints that the design process had to work with. Structure also enabled communication about the contents and outcomes of a program or course and the sequencing of courses and topics and activities within a course.

A It's the structure of the program, how all the courses, ... you know, the breakdown of all the courses, the levels at which those courses are taught

FGB You can’t digest all of that detail and understand how the whole thing fits together ... it comes down to this top-down structure ... a rough map of how that's going to fit together and then you drill down into the individual courses
Especially when discussing individual courses, structure was something concrete that could be passed from one implementation to the next, even from one institution to another and related to the implementation of the curriculum. For example, when one participant “borrowed a friend’s course” (D) from another university “the structure stayed pretty similar and the teaching methods just kind of evolved as materials were developed to support the teaching activities … but actually the assignment and the exams and the mid-term all stayed. You know those kinds of really bare-bones structure stayed the same throughout” (D).

B I used the same structure that already existed but wrote new assessments to fit that structure … Don’t think I really changed the structure too much

C The repetition of activities week by week certainly defines a structure within a course

Sequence

For some participants, structure also implied sequence of content, activities, learning, and the courses themselves. It defined the flow of content and courses, as well as learning activities, lectures, assignments and so on within a course.

D I think of the sequence of courses .... the sort of sequence of lectures and all the topics and all the exercises and the flow of the assignments and things like that

F I guess the sequence of content ... this is the sequence ... this is how it is put together ... this is what we expect them to know at the end

FGD The framework for learning for students: so you know, you try and put together a puzzle of things where you can think they can, over the semester, progressively build up the knowledge towards the final exam ... I guess you have, in terms of presenting information, you've got sort of a sequence ... in terms of assignments and labs

5.2.6.6 Curriculum alignment

Although participants generally had limited knowledge of formal educational and curriculum design approaches most appeared to readily accept the concepts behind constructive alignment (Biggs, 1996). For example, immediately following my very brief explanation during one focus group session, when referring to the model they were constructing one participant commented: “the way I would be thinking about this, what you were just explaining about constructive alignment, is that all of this has to be in balance. It all of this has to present a consistent picture, you know, there shouldn’t be any discontinuities anywhere” (FGA). In another group following a similar explanation, agreed,
“intuitively you understand ... you know what you are trying to achieve and you’ve got the methods to achieve that” (FGC).

5.2.7 Layers of curriculum

Participants distinguished between the official or written curriculum, which one group called the “espoused curriculum” (FGC) and the “curriculum-in-use” (FGC, FGE). All participants acknowledged the likelihood that what was written down was different from what was taught. A number of participants indicated that without a process in place to which all academics adhered, the official-curriculum did not “really relate to how it gets taught often” (FGD). Participants acknowledged that individual “lecturer’s interest” (FGC), “personal taste or interest” (FGD), “politics” (FGA) (internal to the School and/or organisation, as well as external), and even the lecturer’s or the students' “boredom” (B, FGA, FGC) lead to changes to the curriculum-in-use which may not be reflected in the official-curriculum.

FGC Well there’s what’s called the espoused curriculum ... the received curriculum ... what the students learn ... The espoused curriculum is what we have written down in our documents for accreditation and curriculum-in-use is what the teachers teach because they like teaching that thing rather than what was written down ... there is sometimes several variants of this ... So you might have the one you put into accreditation three years ago and you might have the one that has gone on to [the official website] today by accident, so there’s a third one the accidental curriculum.

FGE [Participant] We like to think ours [the official-curricula] are really accurate, but that’s not the case with other units that we have no control over. There’s sometimes been no resemblance...

[Facilitator] To what’s published and what’s actually delivered?

[Participant] Correct.

5.2.8 Curriculum review

Participants identified two distinct feedback loops within the curriculum development process. One related to individual, informal review of courses, and the other was related to more formal reviews generally occasioned by an external event.

Individual academics reflected on and informally reviewed their course curriculum-in-use at the start or end of teaching a course especially when “you perceived that students want a change” (FGD), or on “hearing different ideas from other people, teaching ideas and thinking how could I incorporate that into my course” (B). The outcomes of these reviews...
seemed to involve “adding stuff or removing stuff as you think what works, what didn’t work” (F). “Every now and then” (FGC) course curricula are reviewed by someone other than the academic responsible for the course. Generally, these more formal reviews were driven by issues such as “student numbers and complaints” (C), because “the course got really bad [student evaluation] scores” (FGA), or when “you want a course to be given to someone new as the way of reviving it, and trimming off the deadwood and refocussing it” (FGC).

These more formal reviews involved a group of people and were concerned with “determining … whether you’ve met the … outcomes … for the benefit of, I guess, the teacher and the institution” (FGD). Formal reviews were prompted by “a shock from outside … when there’s something new … or there’s something else that is missing, or you realise that the students haven’t got the pre-requisites” (FGB) or “leading up to accreditation” (FGA) as “every accreditation period is a review” (FGC).

Review occasioned by accreditation was seen as being useful, not least because “it is a forcing function on curriculum to at least, at least some standards have to be kept. If accreditation comes back and says ‘this database course isn’t covering what database courses should be covering’, well, we have to do something about that” (FGC).

While most participants acknowledged that processes existed for regular review of curricula and that the intent exists to review program curricula regularly, there was mixed acceptance of how well those processes worked. Instead, participants suggested attempts to review program curricula usually ended up in “endless debate about a particular course, how can it get good [student evaluation] scores … [or] should we combine these courses” (FGA) as well as “arguing about things that aren’t all that relevant … [rather than] about things that are important” (FGB). Except in the lead up to an accreditation visit, participants noted there was “not a lot of communication among academics about curriculum” (FGA). There was cynicism expressed about internal processes when a participant noted that meetings were held prior to accreditation visits so that “we could tell the accreditation people, ‘yeah, well we’ve had all these meetings’” (FGD) because after the visit it stops until the next visit is due.
5.3 Curriculum – development and use

Participants in both phases were asked to explain and describe what they do when they are given a course to teach that has not previously been taught at their institution; what they do when they inherit a course that was taught by someone else previously; and what they do when they teach the same course over a period of years.

The data collected from the focus group sessions was more detailed than that collected during Phase One. Phase Two participants used their conceptual models of curriculum to provide more detail and understanding. All participants explained how and from where they sourced content, ideas, and course material for their courses. They also explained how they arrived at the structure, and sequencing of activities.

5.3.1 Focus attention on courses

Discussion of curriculum tended to focus on courses with the majority of examples provided relating to participants’ courses. A simple analysis of the transcripts of the interviews and focus groups, based on the most frequently used 25 words related to curriculum, indicates that the most commonly used word was “course” (including courses), which was used 797 times while “program” (including programs) was used only 283 times. This is shown pictorially in Figure, which presents a word cloud based on this analysis.

Figure 5.8 - Top 25 words based on frequency of usage
5.3.2 Using the curriculum to implement a course

When describing their approach to implementing a course, either a brand new one or one they had inherited, only one participant indicated they considered the official program curriculum and only three participants said that they would turn to the official-curriculum for the course for any guidance.

5.3.2.1 Inheriting a course

When inheriting a course, participants focused first on sourcing content and course material with no apparent consideration of the relationships between the content, the purpose of the course and the stated learning outcomes. Most frequently, content and course material was sourced from textbooks or their own ideas of what should be included in a course with a particular name. Many indicated that they did not “have any real desire to use the materials” (FGB) created and used by their predecessor. Sometimes though, they may use it to help re-develop the course by “just look[ing] at all the materials, all the written stuff … and … build[ing] a framework that looked similar in terms of the sequence of assignments and exams and all the kinds of bureaucratic constraints of the course” (D).

Use of the official-curriculum

Only one participant suggested they would look at the official-curriculum for the program of which the course was a part. With the exception of that one participant, it appeared the role a course played within the overall program was not considered.

When inheriting a course, two participants said they would start with the official-curriculum for the course. One would “review the formal [official course curriculum] statement of what is expected in terms of learning outcomes” (F), while the other would “get the [official course curriculum] entry” where it “declares a certain set of knowledge and skills that people need to learn” and “try and map them to different parts of the course over certain weeks” (FGD). A third participant would begin by seeing “how the course has been taught and whether it lines up with that data, that description [in the official course curriculum]” (A).

All other participants indicated that rather than looking to the official-curriculum to provide guidance, they sometimes used the “schedule” (C) to help determine appropriate content and learning activities for their course. The might use the “sequence of lectures
and all the topics and all the exercises and the flow of assignments and things like that” (D). More frequently, however, they relied on their own knowledge and experience.

FGD  I started my course from scratch so I didn’t use previous materials. So basically, I just focused on my knowledge.

FGE  I inherited that, but I changed it entirely ... What’s in it, you know, when I’m given Business Intelligence, then it’s up to me to think about well, what would I include in Business Intelligence

**Sourcing content**

Determination of appropriate content for inclusion within courses was principally based on individual experience, other sources such as textbooks and other institutions, and lastly existing course materials.

**Experience**

The data indicates that participants rely heavily on their experience when determining what appropriate content is, developing course material, and setting outcomes for courses for which they have responsibility.

A  I worked on the basis of what I thought that particular type of course should be teaching

FGB  I know what the course is called and I will print on the course my understanding of what that topic is

FGC  It’s experience ... Your own teaching philosophy

FGD  Things that sort of informs curriculum is like your experience in curriculum, like what you did at university when you went to university

FGE  So it was more guided by what I taught before, my experience and textbook. I was very much guided by a text book and my background

**Other sources**

Frequently participants indicated they included material and ideas from their own research interests, from textbooks, other institutions, and sometimes the body of knowledge or model curricula produced by the IEEE and ACM\(^1\).

D  I looked on-line as well for other good courses in the area to look for things to include in the contents

F  The research interests of the various people we got together to teach it

FGC  You might go to a comparator institution and see if they’ve offered a course in the same area and see what they do

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\(^{12}\) For an explanation of IEEE and ACM see Glossary of terms.

*Findings*
Existing course material

While a few participants indicated they liked to review existing course material when they inherited a course, predominantly participants indicated they did not make use of the material itself, rather they used it simply to get a feel for what had been done in the course previously.

B At the beginning of semester I looked through what was the assessment and the lecture notes and everything ... but wrote new assessments

FGB My first step is to get a bunch of textbooks. I’ve asked for access to the materials ... to simply see where it’s pitched. I don’t have any real desire to use the materials

FGD I started my course from scratch so I didn’t use previous materials

5.3.2.2 Teaching multiple iterations of the same course

It appeared that over time, as participants taught subsequent iterations of the same course, they made even less use of the official course curriculum and no use of the official program curriculum.

Participants said they would make changes to both the content and the learning outcomes of their courses generally without reference to the official course curriculum and even at times without reference to their colleagues. One participant said that when changing learning objectives "I might go and talk to the lecturer [of the pre-requisite course] to say what’s a good entry test, a diagnostic test" (C) but there was no mention of updating the outcomes on the official course curriculum, nor of reference to the official program curriculum. Another acknowledged, “often I’ve taken one thing out. But not a big enough change that you need to get a whole committee together ... they would accumulate over time, so if you change one thing in the course each year, or one entry, then the course will change over time” (F). Yet another acknowledged that this sort of behaviour leads to the situation where “what often happens is you get overlap because people, because something’s new and then everyone decides to start teaching that and then you find everyone’s teaching the same thing” (FGC).

There was acknowledgement that ignoring the official-curriculum could lead to problems. Participants made comments such as “I’m thinking, I guess, ideally the goals should be the main drivers, but I don’t think they always are ... Maybe that produces not as good curriculum and not as good teaching, because you’re driven often more by constraints than by your ultimate goal [chuckles]” (FGD).
Another participant was quite blatant about ignoring the official-curriculum saying, "I guess, sometimes the goals also change a little bit ... Do you worry that your course might be different from the [official-curriculum]? ... I wouldn't care. As long as the students are happy I know they're still learning something, then who would care about this?" (FGD).

When teaching a course over a number of years, at times participants changed aspects of their courses because they got "bored of the way it was taught and wanting to do something that would give me more interest" (B) or to deal with the "lecturer's personal preferences" (FGC).

5.3.2.3 A completely new course

When they were given a new course to design and develop, participants were most likely to "start by picking a textbook" (FGD), would research "examples in other universities" (C), and likely would also look at the model curriculum produced by the ACM and the IEEE. They also all relied on their personal experience, drawn from when they had taken a similar course "in my undergraduate, and also from my research background" (FGD).

Participants' approaches to sourcing content and learning activities for a completely new course were very similar to what they did when they inherited a course. However, in this instance, by its absence in the discussion, it appears they made even less use of the official-curriculum, with only one participant indicating they considered the official curriculum. Predominantly they looked to textbooks, other institutions, and their own experience to provide guidance on appropriate content and learning activities, though they might also look at the curricula produced by professional bodies such as the ACM and the IEEE.

A  The first thing is the [official-curriculum]. You've got to work from the assumption that is correct, that what's been put in there is right and then from that design a course that will deliver on those

F  You'd probably look at other universities teaching other similar sorts of courses and see what content they have. You'd have a look at text books and see what content is in those and that would help shape what you'd want to ... what curriculum you'd want to stick in that course, what you'd want to teach in that course.

FGD  [Participant 1] I guess you'd put some things in that you're interested in (laughs) ...Yes, yes, I think that's really important.

[Participant 2] I would start by choosing a textbook. I always look if other institutions have covered similar subjects, looking at what textbooks they use, looking at new text books that come out and they're reviewed
5.3.3 Curriculum design and development

Participants did not identify any formal approaches to curriculum design and development. Instead, they appeared to use intuitively design principles to which they were likely introduced during their own studies. While program design was a collaborative activity due to its size, complexity, and the political nature of what should be included, course design and development was largely a solitary activity.

5.3.3.1 Intuitive use of design principles at times

While participants expressed almost no knowledge of constructive alignment (Biggs, 1996) or of formal approaches to curriculum design, it appears their knowledge of design meant at times they intuitively applied those principles. For example, one participant noted, “I don’t really use any principles I know about, but I do look for... I look at all these things [outcomes, goals, assessment] and they’re integrated in the design and it has to then fit within all the other units for the students to achieve what they need to achieve ... you realise that maybe the student should have certain outcomes and so you make sure the assessments cover that” (FGE). Another noted, “you know what you’re trying to achieve and you’ve got the methods to try to achieve that” (FGB).

5.3.3.2 A solitary activity

In response to the question “when you’re working on your course, do you work alone predominantly or do you talk to people about your ideas and changes”, participants acknowledged they most often worked alone.

B I did it by myself ... the reason I had done it by myself was because it wasn’t...
Because it was a final, end of the line subject I guess that there was nobody who depended on it, so there was nobody who really cared to discuss it

FGA I think in computer science particularly, that academics just don’t talk to each other about course content

FGC I think it’s really an extreme example of this siloing and it’s not just that I own this course. I don’t want to talk to someone else about running it

FGD Pretty much by myself I’d say. Although, I guess often you have other key players who you want to inform and make sure that they don’t get too upset [laughter]

5.3.4 Curriculum drift

During their explanation and discussion of what they do when responsible for a course, participants identified that over time small changes to a curriculum would lead to much
larger overall change that would mean that the curriculum would “drift” (A, FGA, FGB, FGC, FGE). Participants in Focus Group A provided the most comprehensive description of this phenomenon, as follows:

[Participant 1] Well that happens a lot ... and it’s amazing, ... the degradation of the integrity of our degrees ... there’s all these forces degrading, changing, evolving, not necessarily getting bad or good within themselves, but they’re drifting away from that picture of everything being in balance [pointing to the model with hand and arm movements suggesting it is a holistic view]

[Participant 2] And they’re all being done individually.

[Participant 1] Yes. That’s why it happens. So the integrity of the degree, which is actually defined by this [pointing to the model of the official-curriculum] disappears, because everything’s drifting off and I think that’s a natural thing. If you’re given a course, especially some people will say, ‘OK, I’ve been given this course to teach, I’ve never taught before’. ‘I’m not going to be teaching much in the future’, ‘it’s the last time it’s run’ or whatever it happens to be. You fiddle around with it to make it comfortable for yourself and maybe hopefully improve your [student evaluation] results, maybe fiddle around with the assessment a little bit, if you can get away with it and you don’t think about this [pointing to the model of the official-curriculum] at all ... You know what happens in reality? If this is integrity, you’ve got the program, I don’t know if it’s the right word, but you know, coherence or whatever, you know, satisfaction of this, over time it dwindles then someone exclaims, ‘redesign the curriculum!’. I think the other thing that happens ... is that we, I suspect unconsciously, we rely on accreditations... to maintain the integrity of this and to say look, cool we've done that, but the ACS is cool, Engineers Australia say it’s cool.

Participants suggested that drift happens primarily because of lack of individual academic interest, the tension between research and teaching, and relative lack of use of the official-
Engineering the Curriculum: Towards an Adaptive Curriculum

Findings

curriculum for the program "because there’s a description of what the course achieves and
it’s somebody else’s problem to work out whether that fits into the program” (FGA).

A

No-one was looking at the program ... there’s almost an assumption ... that
that’s all been thought through

FGB

We do this to identify drift towards topics that people like ... but periodically we
get a shock from outside. You know ... when some new thing that you sort of
have to do. If you don’t do it, you look funny or there’s something else that is
missing. There’s some places where it’s obvious ... and you realise that the
students haven’t got the pre-requisites, then clearly there’s been a disconnect
somewhere in the program development.

FGC

[Participant 1] It drifts in little areas a bit ...
[Participant 2] Actually it doesn’t take much because, for example, one person
was teaching something and he hadn’t been there when we had our last
accreditation and he’d missed a quite sort of important piece of information
about where his course fitted in the program. And then he just started moving it
somewhere else ... We should have more quality controls.

FGE

[Participant 1] I think there’s too much of a tendency to have individuality in a
lot of these units, I mean, this is where we go astray a bit, because each unit has
the drift, drifts depending on the lecturer’s individual...
[Participant 2] And we’re highly dependent upon the competence of that
person.
[Participant 1] But it can go too much out of whack.
[Participant 2] That’s right.
[Participant 1] So you have to balance between what’s required and people
going off and doing their own thing.

Drift was also seen as a normal occurrence as well as something that was necessary to test
out curriculum change. It needed to be controlled and monitored but this was seen as
difficult because individual academics “resent intrusion” (FGE).

FGC

[Facilitator] Do you think it matters that there is this drift?
[Participant 1] Yes
[Participant 2] In a way, it drives the changes to the espoused curriculum. That
is, the drift is one of the natural ways in which you both explore and also
perturb the curriculum, and say that’s a good way to go rather than bringing it
back. You say let’s change the description and that description change will then
filter to the neighbouring course or the overall objectives. And say either we’re
keeping up to a good quality that we want kept, or that yes that means we can
put things in here which weren’t there before, or drop things out, or need to go
elsewhere, or we didn’t need anyway. So in effect, it’s a way of evolving the
whole program.
[Participant 3] Well, it matters if it is not monitored [agreement from all other
participants]. If it’s monitored and you can see where it’s going and what it’s
doing and the gaps are being filled in in different ways, yeah, but if it’s not being
monitored then it’s an issue [general agreement]
Through an analysis of the findings presented here, the following chapter, Chapter 6 – Discussion, expands these findings to put forward possible interpretations and a deeper understanding of what participants’ conception of curriculum may mean, and suggests possible explanations of why they behave as they do.
Chapter 6  DISCUSSION

When solving problems, dig at the roots instead of just hacking at the leaves.

Anthony J. D’Angelo

In this chapter, I present an analysis, discussion, and synthesis of the findings which emerged from the data analysis and which were presented in the preceding chapter. The analysis presented here not only provides a deeper understanding of participant conceptions of curriculum and their behaviour when designing and developing their curricula, it also provides the basis for the answers to the research questions underpinning this research project. As with the preceding chapter, my presentation of the analysis, discussion, and synthesis of the findings is organised according to the themes that emerged from the data analysis itself. Answers to the research questions are presented and discussed in the following chapter, Chapter 7.

This chapter consists of four Sections. Section 6.1, analyses and discusses participants’ descriptions and explanations of their concepts of curriculum. Conceptually, participants were clear that curriculum was a design problem involving both a process and an output – the official-curriculum – and that the official-curriculum was a designed object. In this section, I also present a synthesis of participant views that led to the development of a meta-model of the official-curriculum and its operationalisation. Section, 6.2 presents a synthesis of participants’ concepts of curriculum as a process of design and their behaviour when designing, developing, implementing, and evaluating their curricula. From this synthesis, a model of curriculum as design emerged. Section 6.2 is broken into two sub-sections. Sub-Section 6.2.1 provides an analysis of the findings related to the design and development of the official-curriculum at both program and course level. In describing curriculum as a design problem, participants emphasised the need to determine the purpose or goal the curriculum design aims to achieve, as well as the important role
constraints play in the process that surrounds both the development and implementation of the official-curriculum. Sub-Section 6.2.2 presents an analysis of participants’ explanations and descriptions of what they actually do when engaging with official-curriculum as they operationalise it through the design and development of the curriculum-in-use and learning material for their courses.

An analysis of the difference between participants’ conceptual view of curriculum and the design process and what they do in practice is presented in Section 6.3. Reflection on how participants perceive curriculum and what they actually do gives rise to an apparent paradox: conceptually participants described the official-curriculum as a specification or a guideline and described a process of design surrounding it, however, when developing the curriculum-in-use for their courses they made little if any use of it. Instead, they let their personal experience guide them. Consequently, they lose sight of the big picture and focus almost entirely upon their individual courses rather than the place and role their course occupies within the larger degree program.

The final Section of this chapter, Section 6.4, offers an analysis of the findings arising from the confusion that occurred because participants did not possess a common understanding of the concepts of curriculum, nor a generally accepted language with which to discuss those concepts.

In this chapter, I have not identified the source of the snippets quoted from the data. Many of the snippets are sourced from focus group sessions and are excerpts of conversations involving multiple participants while at other times they are a single participant’s view. To identify excerpts of conversations and an individual participant’s thoughts in the same manner did not seem appropriate. However, to present those snippets representing conversational exchange in a format that made that exchange clear did not add value to the analysis and discussion, instead it interrupted the flow. Therefore, where I have included quotation marks without formally attributing the words to a source, and unless otherwise indicated, these are the unedited words of participants.
6.1 Curriculum as a design problem

This is your guiding thing. If you’re doing a program, you’ve got a design problem. This is the eventual goal. This is the design thing to achieve the goal and this is some of the material you’ve got to work with (FGC).

Although only one focus group described the official-curriculum as “a design with constraints … [that] has goals as in any human oriented system”, all participants clearly described and modelled their concept of curriculum in terms of a design problem. Given that participants all teach within the domains of engineering, software engineering, computer science, and information systems, it could be argued they simply used these terms as part of their everyday language. It is, nevertheless, more than the frequent use of certain words associated with design; it is the juxtaposition of these words with the concepts of design that I argue make it apparent that participants were describing curriculum as a design problem.

In recognising curriculum as a problem of design, participants noted it involved a design process, which led to the design of an object – the official-curriculum. They also identified the need to recognise early in the process the influences and constraints upon that design; that outcomes were determined by the goals or purpose one set out to achieve; that content was a product of the curricular purpose and desired outcomes; and that how well the desired goals had been achieved needed to be evaluated. They also clearly separated the specification of the curriculum from its design and implementation noting that the official-curriculum could be likened to a set of requirements, a specification, or guideline. Furthermore, they argued even though a curriculum may exist in written form, that before a course or a program has been taught “it’s not mapped out … it’s not been made operational”. Separation of specification and implementation is an important aspect of an engineering design process. Participants also talked about the “operationalisation” (C, FGC) or “implementation” (C, FGA, FGB, FGC, FGD, FGE) of the curriculum leading to the development of the curriculum-in-use. (For more detail on these concepts and for a definition of curriculum-in-use, see Sub-Sections 2.1.4 and 2.1.6 above respectively.)

A number of educational researchers have also identified curriculum as a problem of design (Diamond, 2008; Romiszowski, 1981; Waks, 1995). While they have not identified curriculum as a problem of design, others have identified the role of influences and
constraints as well as including process within their descriptions of curriculum design and development (Lattuca & Stark, 2009; Print, 1993; Tyler, 1949; Zais, 1976).

Identifying curriculum as a design problem has advantages. As noted in Chapter 3, Sub-Section 3.1.1 above, design is a process and begins with the identification of the problem that the design is attempting to resolve and includes enumeration of the limitations and constraints under which the design needs to operate. Participants remarked that the intended outcomes of a curriculum should reflect the stated purpose of the curriculum. They also observed that when determining the desired outcomes constraints played an important role because if “you can’t achieve the goals it’s not much point in fantasising about it”. Another advantage of understanding curriculum as a design problem is the separation of the design from the implementation of that design. This leads to the view that participants expressed that the official-curriculum is a set of requirements that guide the implementation of the curriculum.

As the literature suggested was likely (Ambrose & Norman, 2006; Felder & Brent, 2004; Stark et al., 1997; Van Der Vleuten et al., 2000), participants appeared to have little if any knowledge of research relating to or knowledge of research-based approaches to curriculum design. They did not reference any curriculum design approaches and although the term “map” or “mapped” was used on occasion, this was never related to “curriculum mapping” (Great Schools Partnership, 2013; Willett, 2008), which I therefore infer was a non-specific usage of the word. Most participants indicated they were unaware of constructive alignment (Biggs, 1996) and some were unaware of Bloom's taxonomy (Krathwohl, 2002).

Despite participants having limited if any knowledge of constructive alignment, they readily accepted the concepts underpinning it. I suggest this ready acceptance is because these same concepts underpin software and engineering design. As explained in Section 3.1, especially in Figure 3.1 above (included in pull-out figures), software and engineering design begins with identifying and understanding the overall goal the product needs to meet and then identifying a set of requirements that will enable that goal to be met. Requirements are used to guide an appropriate design and implementation. Finally, requirements are used to evaluate how well the implemented product meets its original goals. Conceptually, intended outcomes perform a similar role to requirements: they identify what the design needs to do to meet the purpose and after implementation,
outcomes can be used to evaluate how well the implemented curriculum meets the stated purpose. While this finding is uncorroborated by the literature, it is nonetheless an important finding from which others might learn.

The following sub-section presents a meta-level model of the official-curriculum and its operationalisation that emerged from a synthesis of the findings related to curriculum as both an object and a process.

6.1.1 Curriculum is both an object and a process

As part of describing curriculum as a design problem, participants' description of what might be termed curriculum at the meta-level, or *curriculum-in-the-abstract* (for more detail, see Sub-Section 2.1.6 above), clearly included both an object – the official-curriculum – and a process that surrounded the production of that object. Importantly, the object and the process are mutually interdependent: that is, one cannot exist without the other.

As explained in Sub-Section 4.3.3.2 above, I synthesised participants' meta-level descriptions of curriculum into the model shown in Figure 6.1. I have used the term meta-level to signify that both participants' descriptions and this model represent an abstract notion of a curriculum rather than a specific instance relating to the curriculum for a particular program or course. (Section 2.1.6 above provides detailed definitions of these aspects of curriculum.)

The model in Figure 6.1 below (included in the pull-out figures) illustrates how the various conceptual elements of a curriculum relate to each other in terms of both the process and the output of that process – the official-curriculum. Labelled boxes represent the concepts; the lines between boxes indicate relationships between them; and the arrows indicate the direction of influence between concepts. The model incorporates the two aspects of curriculum: the concepts and their relationships that make up the official-curriculum and the concepts related to the operationalisation of the official-curriculum that gives rise to the *curriculum-in-use*. The boxes surrounding groups of elements and associated colours are used to group the elements and their relationships logically at each layer of curriculum (see Sub-Section 6.2.2.3 below for details relating to curricular layers).
At the meta-level, the official-curriculum (the centre box, shown in black) is an inter-related collection of three elements (described in Sub-Section 5.2.3 above) all of which must exist in the official curriculum. These elements capture the concepts of curriculum intent, that is a curriculum’s strategic goals and purpose; a high-level description of the content to be covered and the related desired learning outcomes and map to the artefact – the official curriculum – that has been designed. "Operationalisation" of the official-curriculum involves two aspects: the design and development of the curriculum-in-use (shown in blue) that is guided by the official-curriculum, and the delivery of the curriculum-in-use (represented by the green box), as described in Sub-Section 5.2.6 above. Shown in purple are those aspects of the larger system of which the curriculum is a sub-system that interact with and affect the curricular system (also described in Sub-Section 5.2.6 above).
The elements of the design and development of the curriculum-in-use (shown in blue) capture the concepts of deciding on the sequence of content and activities; designing and developing the actual learning and teaching material including assessment of student achievement of the desired learning outcomes. The official-curriculum is used to help determine what is appropriate for each of these elements. Decisions about what is an appropriate inclusion for each of these elements are influenced and constrained by various external constraints (shown in purple), including the teaching and learning structure – semesters, weeks per semester etc. – that is imposed by the institution. The output of this stage is the curriculum-in-use. The curriculum-in-use is delivered by the teacher in the classroom – represented by the green box.

I suggest participants’ descriptions of curriculum and the process that surrounds it as modelled above in Figure 6.1 could be used to describe an academic plan (Lattuca & Stark, 2009) in greater detail than that provided by Lattuca and Stark. Academic plans have at their core the notion of process surrounding the creation of the curriculum. Lattuca and Stark (2009) also note the importance of constraints suggesting that academic plans exist in a sociocultural context that influences the educational environment in which the academic plan exists. In my study participants referred to the official-curriculum as “a guideline, a specification of sorts”, which does not completely accord with Lattuca and Stark’s (2009) claim that an academic plan “incorporates a total blueprint for action, including purposes, activities, and way of measuring success” (p. 4). I suggest that in the model shown in Figure 6.1 the combination of the official-curriculum and the curriculum-in-use meets Lattuca and Stark’s claim of being a “total blueprint for action”.

All participants agreed that a curriculum set out to meet a set of pre-defined purposes, aims and goals, and importantly, that “the aims, the objectives and the goals infer the learning outcomes”.

According to participants, curriculum intent, that is, its strategic purpose and the rationale behind its choice, is a critical element of the official-curriculum because, according to participants, “the aims, the objectives, and the goals infer the learning outcomes”. Despite giving little attention to the aims and goals expressed in the official curriculum when actually designing and developing their curricula, participants understood the importance of including the goals and purpose as an element in the meta-level description of curriculum. They suggested that the intent of a curriculum – as expressed in a statement of
its goals and purpose – could be seen as recording “corporate knowledge” and suggested unless this information was an integral element of the curriculum, it “gets lost in the mist of time” as that knowledge was lost with changes in academic staff. In this connection, participants asserted that if the rationale is not included as well as the purpose, “one person can just say I dropped that [ethics] because I don’t think it’s central to my course and suddenly you realise you’ve lost it from the program” because “as an academic at a low level, [you] don’t know the strategy. You don’t know the big picture”. In addition, recording the purpose and rationale was important because it was difficult to infer the aims of a curriculum, especially when the “original design process may be incredibly crappy” so that even “someone who has a good understanding of the requirements of the course may not be able to infer what the original goals were”.

Many of the authors cited in Sub-Section 2.1.1 above, do not include the notion of curricular purpose within their definition of curriculum. Of those who do include it within their definition, Print (1993) and Stenhouse (1975) refer to aims, Lattuca and Stark (2009) refer to curricular purpose, and Wiles (2008) refers to goals and values. Additionally, with the exception of Kelly (2009), none of those authors cited in Sub-Section 2.1.1 above, suggest the need to include the rationale for the choice of purpose and goals of the curriculum. Kelly (2009), like participants, argues that if a curriculum is to be of real use it must include an explanation and justification of the purpose. As participants noted, if the purpose and the rationale behind the choice of purpose are not included as an integral element of the curriculum, then it is likely that curricular integrity will be lost rapidly. Consequently, I argue that any definition of curriculum must include the purpose and associated rationale.

Outcomes were also mentioned by all participants and all agreed they were an integral element of a meta-level description of the official-curriculum. Outcomes encapsulate the required knowledge and skills students are expected to possess on graduation from a degree program or on satisfactory completion of a course. Although participants used a variety of terms when describing outcomes (see Sub-Section 5.2.3.2 above), there was a sense that outcomes had a slightly different meaning at program-level than at course level. It was suggested that the outcomes of a program were “objectives”, which were “what you want them to learn” while the outcomes from a course were literally “outcomes”: they were “what they actually learn”.
The final and most frequently mentioned element participants included in their meta-level description of curriculum was content. In fact, for some participants a curriculum appeared to be little more than a definition of the content to be covered. At times, even where participants had defined curriculum as more than just content, the terms curriculum and content were used interchangeably. For example, "there’s too much emphasis on curriculum in a way, like there should be some basics but ... we get too hung up on some specific curriculum ... on specific topics ... content".

Using the terms curriculum and content interchangeably suggests that while participants included the concepts of curriculum purpose and desired outcomes in their models, most participants’ understanding of curriculum was in terms of a “formal document that describes the content of the course”. Furthermore, it implies that while they suggested that both the desired learning outcomes and the curriculum purpose determine appropriate content for inclusion, they do not look to these to help them make decisions about when designing and developing the curriculum-in-use for their courses.

Without a clearly stated purpose, it is very difficult for a curriculum to be aligned, coherent, and cohesive, to possess integrity (see Sub-Sections 2.2.2 and 3.2.2.1) because the outcomes and the content together enable the program or course to meet that purpose. Without a clearly stated purpose “you’re not sure where you’re going, [and so] you’re liable to end up some place else – and not even know it” (Mager & Peatt, 1962, p. vii). In addition, the curricular purpose guides the evaluation of whether a curriculum is delivering what was intended. Although uncorroborated by the literature, I argue this is an important finding if we are to develop quality curricula.

Conceptually, the curriculum for a course is the same as the curriculum for a program. A program is comprised of a number of courses which need to work together to deliver the program outcomes. A course is comprised of a number of components such as lessons or modules which also need to work together in the same way to help deliver the course outcomes. In other words, the role the curriculum plays for a program is the same role it plays in relation to a course. It can be argued therefore, that the meta-level description of the official-curriculum modelled in Figure 6.1 above (included in pull-out figures) can represent a complete program of study, groups of courses, single courses or units of study, or even individual lessons. Participants explained this notion saying, “it’s a top down process. You come up with the degree program and then that becomes the individual
degree courses”. The teasing out of the overall strategic purpose, outcomes, and content into the smaller elements means those core elements of a curriculum “just get repeated” at the lower levels.

Lattuca and Stark (2009) also claim that their curriculum plan is “applicable to all levels of curriculum ... for a single course, for aggregations of courses ... for broader organisational groupings of majors (such as schools or colleges), and for a college or university as [a] whole” (p. 5). I suggest this is an important concept in relation to developing and maintaining program integrity and so improving learning outcomes. It also supports the argument that curriculum is multi-dimensional (see Sub-Section 3.2.2.1 above).

Participants described curriculum as a design problem involving a process from which a designed object – the official-curriculum – was the output. Having analysed and synthesised the findings in relation to the designed object, I now turn my attention to an analysis and synthesis of the findings in relation to curriculum as a process.

6.2 Curriculum as process

There is a process around the formation of curriculum and that has the aims and the objectives and it also has the evaluation and then the teaching activities and so on (FGB).

The model of curriculum as a process of design described in the next few pages and shown in Figure 6.2 below (included in pull-out figures), reflects participants’ descriptions and explanations of their concepts of curriculum as well as what they actually do. What they do when actually designing and developing their curricula is discussed in Sub-Sections 6.2.1 and 6.2.2 below.

Participants’ description of the process surrounding the design and development of curriculum had the hallmarks of an engineering design process. Descriptions and models produced exemplified the iterative process typical of engineering design (French, 1998; Pahl et al., 2007) (see Section 3.1 above). They began with inception where the purpose, outcomes, and content were decided upon; there was clear separation of the design and implementation of the curriculum; and there was evaluation of the curriculum to ensure that it was delivering its intended goals along with iteration forwards and backwards.
between these stages. The description, conversation, and model creation moved backwards and forwards between the various stages as participants moved from determining the elements of a curriculum towards the planning, design and implementation of a curriculum. Given the focus participants had upon individual courses, as discussed in Sub-Section 6.2.2.1 below, their descriptions largely reflect the process for design and development of the curriculum of a course rather than a program.

Figure 6.2 – Model of the curriculum process as described by participants

(See Pull-Out Figure 6.2)
Figure 6.2 above (included in pull-out figures) provides a visual model of the curriculum design process described by participants. The model reflects participants’ descriptions of their concepts of curriculum and descriptions of what they actually do when working with their courses mapped on to an engineering design process. Reading the model from top to bottom suggests a linear flow. It is anything but that: it is highly iterative and recursive. As described, it was not a recipe to be followed blindly.

Arrows indicate the direction of flows within the overall process. Boxes indicate steps within the process and identify key activities related to each step. Within each box the activities may be, and frequently were, carried out iteratively. The two large, blue boxes grouping steps, represent the two major stages of curriculum design and development: the design and development of the official-curriculum and the operationalisation of the official-curriculum leading to the design and development of the curriculum-in-use, its delivery, and evaluation.

While the process is iterative and recursive, it is important to realise that there is an element of linearity within the model. For example, Step 4 – Evaluate the design and implementation, cannot be carried out prior to its creation and implementation. Equally Step 3 – Create and implement a design ideally should not be commenced prior to at least some work on Steps 1 and 2. I have labelled the flows to assist in explaining the process. The alphabetical order of the letters on the flows does not imply that movement through the process follows these flows in any particular order; they simply represent the order of presentation.

To facilitate understanding of the process described, snippets of Figure 6.2 are included with the text where appropriate. Flows referred to in the text are coloured on the snippet to help identification and improve understandability. The complete visual model, Figure 6.2, is included in the pull-out figures at the end of the thesis.

When designing and developing a new curriculum, participants said that the process began with the identification of the strategic goals that one wished to achieve and the constraints under which the curriculum would operate, Step 1 – Define the problem. Within Step 1, the process is iterative and recursive as the goals that can be achieved are limited by the constraints. Participants suggested that as constraints were identified they might cause changes to the strategic goals of the curriculum or to its intended outcomes.
Almost at the same time as participants were determining the purpose and constraints, they were determining the desired outcomes and the content to be covered – Step 2 – Requirements specification. Participants stressed it was important to have considered both the strategic direction of the curriculum and the constraints right at the start because the goals “infer the learning outcomes” and the constraints limit what you can actually achieve. The process surrounding these two steps was highly iterative and recursive. As shown in Figure 6.3, the movement regularly followed flows A (pink) from Step 1 – Define the problem to Step 2 – Requirements specification and E (brown) backwards and forwards between the two steps as constraints that limited possible outcomes and / or required content were identified, which in turn might constrain what could reasonably be set as the strategic goal. Steps 1 and 2 combined lead to the creation of the official-curriculum.

![Figure 6.3 – Designing & developing the official-curriculum](image)

Depending upon the individual’s knowledge and experience, especially related to individual courses, participants suggested they might also engage in Step 1/2 – Background research. This step might happen immediately following Step 1 and movement, as shown in Figure 6.3 would follow flow B (red) from Step 1 – Define the problem to Step 1/2 – Background research. Depending on the purpose of the research and / or what is uncovered, movement may follow flow D (green) to Step 2 – Requirements specification or flow F (orange) back to Step 1. In Step 2, as the academic decided upon the desired outcomes and associated content for the curriculum, it was suggested they might...
feel the need to understand what is done in similar curricula at other, “comparator institutions”. In this instance, movement would follow flow C (blue) back to Step 1/2 from where it might follow flow F (orange) back to Step 1 or flow D (green) on to Step 2.

Discussion suggested that once an academic had a reasonable understanding in their own mind of what they were trying to achieve they would then begin the process of designing and developing the teaching and learning material for use with their course. In other words, at this point they began to operationalise the official-curriculum by designing and developing the curriculum-in-use.

As shown on Figure 6.4, operationalisation involved moving from Step 2 – Requirements specification via flow G (red) to Step 3 – Create and implement a design. Step 3 involved the iterative process of design and development of the curriculum-in-use. This step includes the determination of the structure of the course including sequencing of topics and teaching and learning activities, and the development of the various teaching and learning and assessment material to be used. It concludes with the implementation (i.e. teaching, using the developed material) of the curriculum-in-use. While designing, developing and even implementing their curriculum, academics indicated they might need to carry out some background research, in this case the process would move back to Step 1/2 – Background research via flow I (orange) before moving forward again following flow J (pink) back to Step 3. Only one participant suggested that as they carried out Step 3 that
they might move back to Step 2 following flow H (green) because “you’d have to figure out whether to change the [official-curriculum] or to change the course ... I’d be keen on ensuring that the two lined up” before moving back to Step 3 via flow G (red).

Participants did not identify the point or points in the process at which they might capture and document their design. Apart from a single participant who mentioned that the official-curriculum was the only place where curriculum decisions were captured and ratified, there was no mention of how and when the official-curriculum was documented.

As shown in Figure 6.5, after a course has been delivered, or even while that is happening, participants suggested that sometimes courses would be evaluated, so the process would move from Step 3 to Step 4 – Evaluate the design and implementation via flow K (red). At Step 4, the curriculum is evaluated to determine whether students are achieving the desired learning outcomes, whether the implementation is addressing the strategic goals and desired outcomes adequately, and whether organisational indicators, such as student evaluation scores, are being met or even perhaps whether students were happy with the course. At any point during this step, movement may loop back to Step 3 – Create and implement a design via flow L (blue) or to Step 1/2 - Background research via flow N.
(orange) before moving forward again, via flow J (green). It was suggested that as well as changing teaching and learning material, they might need to make changes to the outcomes “because you do all this, but you just can’t get it to work, so you go well, there’s something wrong with these learning outcomes. So you’ve got to change the learning outcomes”. In most instances, participants indicated they would loop back to Step 3 via flow L (blue) and make changes to the curriculum-in-use. For the few who saw the need to keep the official-curriculum and the curriculum-in-use aligned, this would necessitate following flow M (pink) back to Step 2 – Requirements specification.

Figure 6.6 – Review of implemented curriculum-in-use

As shown in Figure 6.6, after collecting evaluation data, usually in response to an external review, the process moves, via flow O (red), to the final step in the process, Step 5 – Analyse and understand results of evaluation. This step involved analysing the results of the evaluation and, in an attempt to improve the outcomes, determine to which point in the process it needed to loop back. Only two participants indicated they were concerned that the official-curriculum and the curriculum-in-use matched, saying, for example, “I’d be keen on ensuring that the two [the official-curriculum and the curriculum-in-use] lined...
up”. This suggested they would loop back to Step 2 – *Requirements specification*, via flow R (pink) or perhaps via flow S (orange) back to Step 1 – *Define the problem*. Through the total absence of reference to the official-curriculum, the other 20 participants implied they would simply make changes to their courses, i.e. loop back to Step 3, via flow Q (green), without reference to the official-curriculum for their course and certainly without reference to the official-curriculum for the program. This may signify a larger problem with curriculum design and development, as half of the participants had formal education in pedagogy.

As a curriculum can be seen to have a life cycle – the curriculum is created, it is in-use and may be modified to meet changing needs, and finally it will be retired – the process described above may vary slightly depending at what life cycle stage the official-curriculum and / or the curriculum-in-use is. For example, if an academic is developing a curriculum for a new program or course then the “purpose, objective, goals ... from different perspectives” need to be identified at the start. Participants pointed out, however, there is a different process from the one we’ve just described where someone comes in and inherits a new course ... I think there’s a satisficing process that occurs for something like curriculum redevelopment that doesn't occur so much when doing curriculum design when you have the brand-new sort of ideas that you have to implement.

When inheriting a course, one participant suggested that you would “look at the [official-curriculum] ... make sure that that was there for a start ... then see how the course has been taught and see whether it lines up with that data, with that description”.

Conceiving of curriculum as a design problem meant that not only did participants describe a process of design surrounding the development and implementation of a curriculum; they also focused on the importance of deciding on curricular purpose, the influences and constraints on its design and implementation and separating the design of the curriculum from its implementation. The following sub-section offers an analysis of the findings relating to these three aspects.
6.2.1 Designing and developing the official curriculum

There was only limited discussion about the design and development of the curriculum for whole degree programs. Design and development of program curricula more closely followed participants’ meta-level descriptions. The process described was more formal than that described for courses. Largely a collaborative activity, it involved various committees and groups of academics meeting to discuss the program, its content and desired outcomes. It also included review occasioned by external events such as accreditation visits.

Although the process described for developing program curricula more closely resembles a traditional design process, it was noted that the official-curriculum for a program does not provide a “well integrated view of learning outcomes threaded through the degree program”. Instead academics “collectively form a view of what the degree program is ... in terms of subjects and streams of subjects, without articulating the interfaces at that time ... [and] we don’t come back and say here’s what the outcomes are. Is this right against the expected input states to a subsequent course or against the whole degree program?”.

When discussing the design of the official-curriculum for either a program or a course, participants were clear about the need to first determine the strategic purpose or goal that one was setting out to achieve. According to participants, the purpose or goals should guide the design, development, and implementation of the curriculum.

6.2.1.1 The importance of determining the purpose

According to participants “in the design of the curriculum you’d normally start out with goals”, and “then there’s certain constraints and aims and objectives and you work your way down. It’s a top down process”. The process of identifying goals and constraints was iterative with the identification of constraints possibly leading to the need to modify the intent, that is, the goals and purpose because “if you can’t achieve the goals it’s not much point in fantasising about it”.

Engineering and software design processes both underline the importance of understanding the problem you are setting out to resolve and the environment in which the proposed solution must operate before attempting to design or develop a solution (French, 1998; Pahl et al., 2007). As part of this process engineering and software designers determine the goals or purpose they are setting out to achieve as well as
developing a good understanding of the constraints under which both they as designers and developers work and the constraints on the potential solution itself. In the same way, it is important that academics also understand the strategic goals of the curriculum they are designing and developing as well as any constraints that may affect that design, development and implementation. Having a clear and well understood goal or purpose for a curriculum has also been shown to be an important factor in overall successful curriculum development (Diamond, 2008).

A number of curriculum theorists have identified the importance of understanding the context and the influences that are at work. Lattuca and Stark (2009) include the element “purposes” in their academic plan because this requires academics to make decisions about the “knowledge, skills and attitudes to be learned” (p. 4). Phase 2 of Print’s (1993, p. 84) process model also identifies the need to determine appropriate aims and goals. He is not clear, however, about the relationship between appropriate aims and goals and the determination of appropriate objectives and content.

Despite identifying the importance of the curriculum design process commencing with the determination of the strategic purpose of the curriculum, there was no discussion related to the source of curriculum goals, especially program level goals. I suggest this lack of discussion may have arisen for two principal reasons. Firstly, participants generally were unused to involvement in the initial design of a program curriculum. If involvement with program level curriculum comes after the initial design, then it is probable the goals are set out in some form already so academics are not required to consider this aspect. Secondly, as participants were unfamiliar with research-based approaches to curriculum design, it seems unlikely they have considered sources of and approach to determining appropriate goals. When thinking about curriculum at course level, I suggest it is likely they rely largely on their own experience, and what may be included in selected textbooks, just as they do when making decisions about appropriate content and learning outcomes.

Because participants saw curriculum as a design problem, it was natural for them to think of things that might constrain both their design and the implementation of that design.

### 6.2.1.2 The role of constraints

Constraints identified related to things such as the student population and background, financial limitations, academic’s own ability, accrediting body requirements and so on.
Early identification and recognition of constraints and influences were acknowledged as vital to the success of designing a curriculum because “it’s no good planning all this stuff if we can’t do it”. Although participants clearly noted the importance of recording the rationale behind and the strategic purpose itself, constraints were seen as a more important determinant of the outcomes of a curriculum than the goals one was aiming to achieve “because you’re driven often more by constraints than by your ultimate goal”.

When discussing the relationship between the goals of a program and the constraints that affected its design, the “common framework called courses and years and pre-requisites … [and] tradable chunks” that was “forced” onto program planning was acknowledged as perhaps the most significant constraint imposed on the design of a program. When students “are going to go away after only three or four years and you go away after only 13 weeks” it constrained what could be achieved, especially within a single course. There was no discussion, however, of how this constraint might affect the design and development of sequences of courses.

A number of curriculum theorists also comment on the importance of understanding the context of and the influences and constraints on a curriculum (Kelly, 2009; Lattuca & Stark, 2009; Print, 1993; Tyler, 1949). Lattuca and Stark (2009) argue embedding academic plans in sociocultural context “emphasises the influences of sociocultural and historical factors” (p. 6) upon curriculum design. In this connection, they note however, “internal and external influences vary in salience and strength depending on the course, program, or institution” (p. 6). Print (1993) includes within his notion of “presage” (p. 26), the need to recognise the forces brought to bear on curriculum decision-making tasks and includes consideration of the background and experience of the individuals involved as well as organisational requirements. (Biggs, 1993) in his 3P model – presage, process, product – of curriculum development identifies the importance of beginning with understanding the student factors, that is their prior knowledge and ability, and teaching context, that is the objectives, assessment, climate/ethos, teaching and institutional procedures, prior to commencing the process of curriculum design.

The importance and role of curricular purpose and constraints appeared to differ between the design and development of a program curriculum and a course curriculum.
6.2.1.3 The difference between the design and development of Program and Course official curricula

As might be expected, participants from different institutions, and even different areas within a single institution, identified different processes surrounding the development of a new curriculum for a program. It was apparent, however, that design and development of a new official-curriculum for a program was a collaborative activity centred around “specific meetings called to discuss the ... [new degree] and in those meetings there was quite a lot of discussion about what should be in the program”. Acknowledging the importance, complexity, and size of designing and developing a new program, participants noted it was not something that happened quickly and that there were likely to be “quite a number of meetings, probably over a number of years all up ... There had to be discussion. You can't just cobble some stuff together”.

Participants also suggested that the design and development of a program curriculum is a large undertaking in which only a sub-set of academics participate and that unlike course curricula, the program is not ‘owned’ by an individual academic. The program is something upon which an organisation's reputation rests: instead of belonging to an individual, it belongs to the institution. Generally, the official-curriculum for a program is accredited and so is scrutinised, not the individual course curricula. Additionally, participants suggested that the “vested interests” of different groups ensure that more than one person is involved in program curricula design and development.

Print (1993) notes when discussing the development of program curricula that “there is no doubt that the selection of subject content is a highly political activity, in that curriculum developers argue, negotiate, debate and caucus each other in an attempt to control the content included in the curriculum” (p. 145). Stark et al. (1997) also acknowledge, “curriculum planning can become political, involving compromise among faculty self-interests” (p. 101). While Lattuca and Stark (2009) do not remark on the potentially political nature of the activity surrounding the selection of content for a program they observe that “the primary internal influences ... are instructors’ beliefs ... and content expertise” (p. 129). More frequently, however, discussions about selection of appropriate content within the literature do not acknowledge the political nature of program design and development, instead they assume the ideal situation, that curricular purpose and desired outcomes influence the selection of appropriate content (Diamond, 2008; Romiszowski, 1981; Toohey, 1999).
It is likely therefore, as participants suggested, that the composition and nature of the academics involved with the design and development of a program will influence what is determined to be appropriate content and outcomes, and that because of those “vested interests”, the content of a program may become “twisted”.

The process participants described when discussing what they actually do when designing and developing their course curricula did not so closely resemble their meta-level descriptions of curriculum design and development as shown in Figure 6.2 (included in pull-out figures) and described on pages 164 – 170 above.

The following sub-section presents an analysis of the findings relating to participant behaviour when operationalising the official-curriculum.

6.2.2 Operationalising the official curriculum

As described above, part of the process surrounding the design and development of curriculum is taking the curriculum represented by the official-curriculum and “operationalising” it. As shown in Figure 6.2 above (included in pull-out figures), the overall curricular design and development process described can be broken into two parts: the design and development of the official-curriculum and the operationalisation of the official-curriculum. According to participants, when a program or course has not been taught at an institution, the curriculum only exists in the form of the official-curriculum as it has not yet been “mapped out ... it’s not been made operational”. Operationalisation involves the creation of the curriculum-in-use, its implementation, or delivery as well as evaluation and modification. Generally, operationalisation takes place after the creation of the official-curriculum. However, given the different situations that lead to the development of a new curriculum it appears that operationalisation of a course may happen at the same time the official-curriculum is being developed.

Operationalisation of a curriculum involves Steps 3 – 5 shown in Figure 6.2 above (included in pull-out figures). Operationalisation of the official-curriculum for a course entails academics designing the course structure and designing and developing learning material based on the information contained in the official-curriculum, which leads to the development of the curriculum-in-use. The official-curriculum is a relatively general representation of the curriculum. According to participants, “operationalising” the curriculum takes the general representation of the curriculum in the form of the official-
curriculum and expresses it in a more detailed form in the curriculum-in-use. This step involves determining "the sort of sequence of lectures and all the topics and all the exercises and the flow of the assignments" as well as the development of teaching and learning material such as lectures, assignments, and assessments such as tests or exams.

Using the teaching and learning material they have developed, the curriculum-in-use is delivered. Within the concept of operationalisation, participants also included evaluation of how well the outcomes are being met. The curriculum-in-use is evaluated from both the students’ points of view using feedback such as student evaluation scores, as well as the point of the view of the curriculum itself, which might be evaluated using student grades and reflection. Sometimes, review might lead to "changing the approach or the method or the mode but not the espoused curriculum ... the means of assessment might change just slightly or the class contact might change slightly, but nothing else does in terms of the topics or the objectives of the learning outcomes they're not changed because I think they're right. It's just I need a better way of achieving them".

I argue that while the concepts of assessment and evaluation are closely related to the official-curriculum, they are not part of it. To include them within the definition of the official-curriculum unnecessarily constrains how the curriculum may be implemented. Such limitations would not necessarily take account of the changing constraints over time, for example with the change of academic responsibility or changes in available technology.

Development of the curriculum-in-use through the operationalisation of the official-curriculum leads to the curricular material becoming more detailed and specific. Operationalisation causes the curriculum to move along the curricular continuum from left to right as shown in Figure 2.1 on page 32, repeated here for convenience.

![Curricular Continuum](image)

**Figure 6.7 – Curricular Continuum, based on Zais (1976, p. 12)**

Once an official-curriculum for a program has been operationalised, it appeared it was not really considered again except during the accreditation process.

There was little discussion about change to program curricula. Instead, discussion related principally to changes to course curricula. This may be because participants simply did not
consider it, but is likely also because significant change to program curricula happen infrequently (Stark et al., 1997).

Participants suggested that when changes were put forward for official endorsement and inclusion in the official-curriculum for a course, at times it seemed “there’s almost an assumption by … that that's [curricular integrity] all been thought through” which “leads to the problem, and that is, does [the official-curriculum] reflect the program”. Furthermore, participants suggested it was not an individual academic’s role to be concerned about the program curriculum. The official-curriculum for a course includes “a description of what the course achieves … [so] it’s somebody else’s problem to work out whether that fits into the program”.

Although participants’ descriptions indicated that they conceive of curriculum in terms of design, when they are responsible for a course the behaviour they described does not reflect this view. Given participants likened the official-curriculum to a set of requirements, a specification, or guideline it could be expected they would use the official-curriculum to guide their course design and development. In reality, it appeared that little use was made of the official-curriculum: instead, participants relied largely upon their personal experience relating to what and how they were taught at university, their knowledge of the subject area, what is taught at other institutions, and textbooks. “I know what the course is called and I will print on the course my understanding of what that topic is” because of their knowledge of “the content of computing and the way things relate to each other technically”. It appeared that changes made to their courses were often not reflected back into the official-curriculum. It was also suggested by participants that the course curriculum-in-use might often be different from the published, official-curriculum. I suggest that ignoring the program curriculum happens because participants work more closely with courses than programs. It appeared that not all participants were members of, or had participated in relevant curriculum development committees. Consequently, they were unaware of discussions that might or might not happen in those committees.

6.2.2.1 Focus on courses

In 1997 Stark et al. conducted a study of 59 academics at two United States universities in which they asked participants about “their assumptions and the influences upon them as they work with colleagues in planning program curriculum”. They reported, “faculty had
difficulty in conceptualising their academic program as a whole ... [and] frequently returned to their own course planning and discussed how a course for which they were responsible seemed to fit into the program”. Findings from my study corroborate this finding.

Participants had a limited view of where their course belonged within the overall program and were not especially concerned whether it fitted or not, seeing that as someone else’s responsibility. Having no concern about nor understanding of where their course fits within the overall program implies participants lacked knowledge of research relating to curriculum design and learning theory (Stark et al., 1997; Van Der Vleuten et al., 2000).

As Stark et al. (1997) also reported, when describing or modelling their concepts of curriculum, even when asked about the program curriculum, participants frequently discussed these in terms of individual and/or particular courses. My study corroborates Stark et al.'s findings. That many participants focussed their attention at course level can be explained, at least in part, by the fact that many had “only really worked at the course level. I've looked at programs, but ...”, while, perhaps because of organisational roles, only a few had the “experience to work with the whole. I work with whole bodies of knowledge, and degree programs”.

Another reason for the heavier focus on course curricula may be that individuals are held responsible for course outcomes, as measured through student evaluation of learning and teaching surveys and which may affect promotional prospects. One focus group suggested that “performance drivers” produced this behaviour because academics’ teaching performance was measured by these scores. They suggested academics principally reviewed course curricula either after teaching an iteration of the course, or prior to commencing the teaching of a new iteration of it in an effort to improve or maintain good student evaluation scores rather than for pedagogical reasons.

A further reason for focus at course level may relate to norms of professional autonomy. Academics take ownership of the courses for which they have responsibility. Frequently they are “very individualistic ... and if you were to go and suggest to some of these people that it’s not really a good idea ... you might think of something else new ... that would be interference with their course and they’d be so upset. So you don’t do it”.

Discussion
Stark et al. (1997) suggest that where “faculty autonomy is viewed as essential, faculty may be reluctant to engage in planning if it is likely to stimulate disagreement that can be avoided by not planning” (p. 119) because “personality clashes, or conversely, the effort to avoid them, can bring all communication about program matters to a halt” (p. 119). It appears participants’ experiences accord with this. Participants discussed the possibility of developing a tool to help visualise and manage the curriculum, noting “instead of arguing about things that aren’t all that relevant, it could direct you to argue about things that are important. Because some things we have to argue about”.

It can be argued also that focussing attention at the course level is a consequence of taking a reductionist view of the program curriculum. Such a view may lead to the design and development of an excellent course, but one that does not perform its role within the overall program.

I argue that without a clear understanding of the strategic purpose and desired outcomes of a program and without knowledge of the role an individual course plays in delivering that purpose and outcomes, it is less likely that academics will design, develop, and implement a quality curriculum that exhibits and maintains integrity. I also argue this is a factor in the notion of curriculum drift discussed in the following chapter, in Sub-Section 7.2.1 below.

When discussing their actual curriculum design and development, participants indicated that personal experience played a significant role in their decision-making. This was especially obvious when they discussed from where they sourced appropriate content for inclusion in their courses.

6.2.2.2 Sourcing appropriate content
Course design was mostly “based on your experience. It’s not based on … I don’t know, going out and finding the IEEE or ACM curriculum” although that “would be reflected there as well. But if it’s a third-year algorithm course, if you ask almost anybody, almost any computer scientist, they’ll give much the same answer”. Rather than checking what is included in the official-curriculum participants suggested, for example, “when I’m given Business Intelligence, then it’s up to me to think about well what would I include in Business Intelligence”.
Participants were seemingly unaware of where a new academic would source information about what were appropriate content and the level of outcomes for a course when they said, for example,

in the first year you learn processes, in the second part of first year you learn debits and credits as a mirror of those processes. But then, in second year you would learn things like consolidation, which is debits and credits on a much larger scale. And then in third-year … you learn … implications of things like that

This statement and others like it implied that all academics had sufficient knowledge and experience and that all university degrees are structured in the same fashion with the same desired outcomes for similarly named courses. I suggest it is likely that a new academic may not have sufficient knowledge to make appropriate decisions on course content and outcomes unless guided by a well-designed official-curriculum and that not all university degree programs and similarly named courses have the same desired outcomes.

Participants rarely mentioned referring to the official-curriculum for their courses to provide guidance when determining appropriate content, learning activities or learning outcomes. Instead, they were largely guided by ideas and material from similar courses they had taught elsewhere, what they had learned during their own university studies and how they had been taught, as well as their knowledge of the field, and what they thought that type of course, usually based upon its name, should be teaching. They also relied upon textbooks, model curricula, and courses at other institutions to provide guidance to their decision making. Participants suggested also that decisions, especially on content were influenced by individuals' research interests because what academics think students should know is "not from their research ... it's what I do research on".

Participants suggested that academics rely on their own experience and ideas when operationalising a curriculum because "my impression is that, well, academics think they are experts in everything, they're very clever people and they know how to do stuff". For many academics their knowledge of teaching appears to relate to how and what they were taught as they have not undertaken formal studies in teaching and learning. Felder and Brent (2004) make note of this also as an explanation for why academics rely on their experiences as a student to shape their approach to teaching.
A paradox known as the Dunning-Kruger effect (Kruger & Dunning, 1999, 2009) provides further explanation for why academics rely on their own ideas and experience rather than the official-curriculum when making decisions. When a person does not have much knowledge about a topic, they are less likely to be aware of the scope of their ignorance. In addition, those with less knowledge in a particular subject area are likely to be more confident about their knowledge than those who have a greater depth of knowledge, simply because the person with the greater depth of knowledge is aware of how much they do not know. “People tend to hold overly favorable views of their abilities in many social and intellectual domains … Not only do these people reach erroneous conclusions and make unfortunate choices, but their incompetence robs them of the metacognitive ability to realize it” (Kruger & Dunning, 2009, p. 30).

Given only one third of my participants had any formal education in pedagogy especially that related to curriculum design, the Dunning-Kruger effect can be used to explain why academics rely on their own knowledge rather than the official-curriculum. The effect suggests why, when inheriting an operationalised course, an academic was likely to “sort of … [think] of the aims and objectives because I know [what] that subject in my opinion is meant to be”. It also explains participants’ behaviour when they suggested they “just chucked out everything that was there because I knew that what was there was not appropriate so I didn’t pay any attention to it”. As participants identified, such behaviour was likely to lead to situations where “what was actually taught was perhaps not what was agreed upon, because the lecturer did then take it upon themselves to teach what they wanted to”.

Toohey (1999) and others suggest that when designing and developing learning material for a new course that it is appropriate for academics to rely upon personal experience, textbooks, colleagues and model curricula. I argue that this approach leads academics to focus on content to be covered rather than the strategic goals of the course and the desired outcomes. If academics use the official course curriculum as a guide to the desired outcomes it is likely instead they will focus on what is needed to ensure that the desired learning has been achieved (Wiggins & McTighe, 2005) rather than simply what content they believe needs to be covered.

I argue that relying on one's own experience rather than using the official-curriculum to provide guidance on desired outcomes and associated content gives rise to a phenomenon
I have called curriculum drift. This phenomenon is discussed in detail in Sub-Section 7.2.1 below in the following chapter.

The process of operationalisation of a curriculum leads to the development of “several variants” of the official-curriculum. These variants can be described as different layers of curriculum.

6.2.2.3 Development of curricular layers

These variants of the official-curriculum, or curricular layers as I have termed them, include the official-curriculum and the curriculum-in-use, among others such as the “received curriculum – what the students learn” and the “one that has gone onto [the official institutional website] today by accident … the accidental curriculum”. The literature has identified many other layers, some of which include: the hidden curriculum – unplanned student learning frequently from what is left out or not assessed; the delivered-curriculum – what the teacher actually teaches rather than what was planned to be taught; the assessed curriculum – what is actually assessed; and the attained curriculum – what student assessment certifies students have learned (Print, 1993).

Figure 6.8 below (included in pull-out figures) provides a diagrammatic representation of the various layers. The base layer is the official-curriculum with its statement of strategic intent – of purpose and rationale – and associated intended outcomes and high-level statement of content to be covered. Academics create the next layer when they operationalise the official-curriculum and create the “curriculum-in-use” which they then deliver, leading to the “delivered-curriculum”. Participants identified that sometimes errors in organisational process can create the “accidental curriculum”. Students create another layer – the “received curriculum” or the learned curriculum. As indicated by the use of different shapes and colours to represent the different layers of curriculum, each layer is a variant of the official-curriculum: that is each layer is slightly different from the official-curriculum as well as from each of the other layers.
Print (1993) suggests that “another way of conceptualising curriculum is to view it in terms of the perceptions people have of curricula. Different people perceive a … curriculum in different ways and sometimes in multiple ways depending upon the context in which the concept is used”. He goes on to provide a list of “the most common perceptions of curriculum” which include the “intended or written curriculum … the available or supported curriculum … the implemented curriculum … the achieved curriculum … [and] the attained curriculum” (p. 4).

Print's notion of different perceptions of curriculum implies different views of the same thing. I suggest, however, that while each perceived curriculum is more or less closely related to each other, they are in fact different things: each is a variant of the official-curriculum. Thus, each layer in my model represents a slightly different version of the official-curriculum, which in turn leads to slightly different outcomes and is what causes...
the official-curriculum to lose its integrity. The concept of layers brings to mind building upon something that has gone before with associated change to what was there before. The change occasioned by the layering of curriculum relates to the notion of curriculum drift discussed Sub-Section 7.2.1 below in the following chapter.

One approach to minimising the variation between the different layers of curriculum is to subject the curriculum to review.

6.2.2.4 Review

The behaviour participants’ noted with regard to both program and course review is in accord with that reported in the literature. Stark et al. (1997) suggest program planning and review happens less frequently than course planning because academics do not see program planning as what they do and that "systematic program planning takes place only when a catalyst and leadership co-exist" (p. 112). As participants did, Lattuca and Stark (2009) suggested that programming planning was "reactive – responding to problems as they arose – rather than periodic and systematic" (p. 248).

Analysis of the findings, relating to participants’ conceptions of curriculum, and what they do, highlighted an apparent paradox. Participants conceived of curriculum as a design problem and described the official-curriculum as a “set of requirements” a “framework”, and a “guideline” which they could be expected to use to help design and review their implemented curricula. However, when it came to describing what they actually do, they did not use the official-curriculum to guide their design, development, implementation and review of the curriculum-in-use instead they ignored it which I suggest may lead to curriculum drift (see Section 8.2.2). Despite this, participants applied design concepts to their design, development, and implementation of the curriculum-in-use for their courses.

6.3 Difference between concept and reality

Participants’ meta-level description of curriculum design and development as modelled above in Figure 6.1 above (included in pull-out figures), showed only small differences between program and course level curriculum activities and could readily be mapped onto engineering or software design and development processes, as shown in Figure 6.2 above (included in pull-out figures). Descriptions of what they actually did, however, did not closely match this process. When it came to day-to-day activity, the official-curriculum did
not appear to be a "set of requirements", a "framework", "a guideline", or even "a rough map of how that [the content and outcomes] is going to fit together" instead it was essentially ignored.

The following section presents an analysis and comparison of the findings related to participants' conceptions of curriculum and their behaviour.

6.3.1 No formal pedagogical approach to design

As also noted by Stark (2000), participants in this study generally did not appear to use any formal pedagogical approach to design, instead they suggested, "we've got these design mechanisms in our head and we use them". What is unclear is whether participants possess these design mechanisms because their domain of learning involves concepts of design, or whether such mechanisms apply more broadly to the general populace.

The structure of semesters and number of teaching weeks imposed by the institution was in many cases an unconscious design mechanism. This, in connection with the natural structure imposed by the content, seemed to be the most significant method participants used to aid course design. One suggested, "I would use the structure around the semester and thinking of where things go in terms of weeks and then also in thinking about how content relates to each other and how to order it". Another would "do a partial mapping or a mental map between ... a certain set of knowledge and skills that people need to learn and I kind of try and map them to different parts of the course over certain weeks". Where there was no natural and logical structure imposed by the content, using the structure of semesters and weeks imposed by the institution facilitated developing "some sort of framework ... to give it structural soundness ... So we worked through the ... sections one a week ... Every week there was a ... series of sections that were totally unrelated to one another". It was acknowledged, however, that with "some people, their preferences will override everything and so the design just goes out the door".

6.3.2 Ignore the official curriculum

Depending on whether the individual was inheriting an existing course or whether they were teaching a brand new course for the first time, participants described a slightly different approach to use of the official curriculum.
Inheriting an already existing course

When inheriting a course, the official curriculum for both course and program were largely ignored. It appeared that most participants were concerned principally with deciding what content should be included. Participants did not refer to the official-curriculum and neither did they make much use of the curriculum-in-use to obtain guidance on what content might be appropriate for inclusion. Instead they were more likely to rely on the course name because once “I know what the course is called I will print on the course my understanding of what that topic is”.

Participants indicated that often they were uninterested in even looking at existing course material. Instead, they were likely to “just work on the basis of what I thought that particular type of course should be teaching”, relying on their “previous experience in this subject or a similar subject. Either one that I’ve taught before in the past or one that I did in the past would probably influence the way I’d reformat or reshape it”.

Occasionally a participant indicated they would look at existing course material and perhaps the official course curriculum. In which case they began with a “review [of] what was taught in the past and I’d also review the ... [official course curriculum to see] what is expected in terms of learning outcomes”. For many, however, rather than reference the official-curriculum or the curriculum-in-use, despite “not having any background here ... I was more guided by what I taught before, my experience and text book”.

One participant appeared to ignore the official-curriculum even as far as the name of the course. This participant suggested that because “it’s problematic, changing a name of something, because there’s a bureaucratic process you have to go through” when the official-curriculum did not reflect what this participant believed should be included, students were simply told “here’s the name of the unit, but forget that, this is what we’ll learn”. This behaviour suggests that this participant at least sees little of value in the official-curriculum for a course and / or a program.

The tension between teaching and research was suggested by participants as a reason they ignore the official-curriculum because they “know they have to write some research papers and sit on committees and things like this” which leads to time pressure on teaching activities. Seeing the curriculum as a description of content to be covered rather than a description of strategic goals and outcomes suggests it is sensible to look for a
textbook that presents content well or to rely on what was deemed appropriate in a course taught at another institution rather than considering exactly what is needed in this particular instance. I suggest such an approach makes even more sense to the time pressed academic. The only way to change this is to change the perceived value of the official-curriculum.

It was suggested by one participant that the official-curriculum for a program should provide some guidance for changes to courses because “when you move into a course [previously taught by someone else] you can’t just look at it in isolation. You might want to make some changes, but there ought to be some underlying philosophy that the whole program is trying to achieve and you should be buying into that and reflecting that in any changes you make”. It is interesting to note the participant’s choice and use of words. Firstly, use of the conditional tense “there ought to be” suggests to me that while this participant subscribes to this view, it is perhaps not what always happens. Following it with “you should be buying into that and reflecting that” further suggests that for this participant at least, their experience is that colleagues do not use the official program curriculum as a guide and perhaps do not have concern about how their individual course contributes to the overall goals and desired outcomes of the program.

Providing support for my interpretation of the hidden meaning in the participant’s words cited above, the majority of participants suggested that for them the “first step is to get a bunch of textbooks”. Furthermore, frequently it seemed that based on the name of the course, participants felt that they “know that subject” and so did not need to refer to the official-curriculum for the course. Many were likely not to “use previous materials. So basically I just focused on my knowledge, because introductory databases, that’s a course almost every department of computer science has to deliver”.

Despite discussion suggesting that the “top-down structure” of a program meant that the official-curriculum for a program could be seen as “a rough map of how that’s [the courses and their outcomes are] going to fit together” participants could not use it as such because of the complexity hidden within the document. “By the time you get to the stage of looking at individual course outcomes, it’s sort of too late. I mean you can’t digest all of that detail and understand how the whole thing fits together”.
Developing a new course

Teaching a course for the first time was slightly different. In many instances, participants had been “involved with saying that I think we should have a course in this area”. In this situation it appeared that the design and development of the official course curriculum and its operationalisation were done at the same time as the academic had likely “spent ... about 6 months before the course started ... acquiring text books and trying to work out ... the right way to teach this stuff, to find a niche for it”. Another participant, however, implied there was an expectation that the official-curriculum for a course exists, as “the first thing is the [official-curriculum]. You’ve got to work from the assumption that ... [the official-curriculum] is correct, that what’s been put in there is right and then from that design a course that will deliver on those”.

Inheriting an already implemented course or developing a new course frequently involved change to outcomes and content set out in the official course curriculum. Frequently it appeared when academics changed content or learning outcomes, even where local process existed to deal with change to the official-curriculum, that process was entirely reliant upon the individual, a phenomenon also noted by Stark et al. (1997).

6.3.2.1 The official-curriculum does not always reflect changes to courses

Despite recognition that in operationalising the curriculum they were changing it from the official-curriculum, frequently participants indicated they did not update the official-curriculum. For some this was because they appeared to see little of value in the official-curriculum: “I sort of though of the aims and objectives because I know [what] that subject in my opinion it is meant to be ... So I just changed it and did it” and did not “put it back into [the official-curriculum]”. For others, they were likely to have “taken one thing out ... but not a big enough change that you need to get a whole committee together” and so the official-curriculum was not updated.

These behaviours are likely to lead to a growing divergence over time between the official-curriculum and the curriculum-in-use, which was recognised as a problem.

I teach ... the end capstone project where they’re supposed to know everything, so I’m keenly interested in how people change the lower thing, but I’ve almost no influence on that. People don’t tell me that they've changed things and I don't know
about that and that is a problem for us, because one of our programs is half ours and half another discipline's.

The divergence between the official-curriculum and the curriculum-in-use may lead to gaps or overlaps developing in student knowledge and skills. What also sometimes “happens is you get overlap because ... something's new and then everyone decides to start teaching that and then you find everyone's teaching the same thing”. Despite lack of corroboration in the literature of ensuring the official-curriculum and the curriculum-in-use always align, I suggest it is an important one from which others might learn.

6.3.2.2 Official-curriculum is single use artefact

A further consequence of academics largely ignoring the official-curriculum when working with their course curricula, leads to the situation where the official-curriculum effectively becomes a single use artefact, created to meet external requirements such as accreditation or institutional need. This is likely to lead to the situation where the accredited curriculum is not the one that is actually taught. In a domain such as engineering where possession of a degree is effectively a certification that the holder has achieved the requisite level of knowledge and skills performance, such a situation has the potential to be of real concern.

Ignoring the official-curriculum also means that divergence of the curriculum-in-use from the official-curriculum is only noticed once it has become sufficiently significant that academics and industry realise that students and graduates no longer possess certain desired knowledge or skills. Participants indicated that the realisation students are no longer learning a particular skill or covering a topic tends to emerge in informal discussion. For example, an academic might say “but they don’t know about ...[x]” or the realisation that instead of all students taking a particular course “only 25 or 30 of our students [are] taking this course ... [but] really we think [all] engineers need this course”. Participants noted it can be difficult to bring about the required change when the divergence of the curriculum-in-use from the official-curriculum is identified informally and outside a formal review process because academics "resent any interference” in their courses.
6.3.2.3 Curriculum-in-use becomes bloated with content

Ignoring the official-curriculum of a course and relying instead on personal experience encourages academics to focus on content to be included rather than on outcomes and enables “vested interests” and “power groups” within an organisation to have a greater influence on what is actually taught. Participants suggested that power groups pushed to have content included, since it is “what everyone needs to know because it was what I was taught”. Participants also noted that dealing with inclusion of unnecessary content was difficult. Those arguments were “hard to win because when anyone says it’s really good to have this knowledge well of course it’s good to have this knowledge. All knowledge is good”. Power groups and individuals sometimes pushed for inclusion of certain topics because they are “biased towards” a particular topic as it relates to their research area when “in fact most of our students don’t need that level” of knowledge.

Participants acknowledged that the knowledge base within the domain of engineering and computer science was expanding rapidly meaning that existing material in a course frequently needed to be updated. When reviewing their courses academics would “probably ... add some extra stuff ... shaped by my own experience of the topic or the area”. However, participants suggested that despite adding content to a course, “you don’t necessarily have to take content away”. Instead, certain topics “more fade away rather than explicitly take them away. They lose emphasis ... So you might mention them but not go into examples or [give] assignments on them”. Sometimes academics may receive instructions from organisational bodies to add content to their course, “so occasionally it’s like departmental or school meetings where people think we need to add some stuff to this course”, usually without guidance about what to remove to make room for this additional content. Continual addition of new content to computer science curricula seems to be the norm, with little consideration given to what content needs to be removed (Walker, 2011).

6.3.2.4 Considered and reviewed only in response to external stimuli

As acknowledged in the literature (Briggs, Stark, & Rowland-Poplawski, 2003) ignoring the official-curriculum means it is only evaluated and reviewed in response to external events, such as an impending accreditation visit. When the official-curriculum for a program is monitored only in response to external events, it is possible that the curriculum-in-use will have diverged further from the official-curriculum and therefore will require more significant intervention to bring the two back into alignment.
System dynamics (Section 3.3 above) provides an explanation for the divergence between the official-curriculum and the curriculum-in-use. Feedback internal to the system, such as student evaluation, exam results, or reflection of the academic responsible for the course, will trigger modification of the curriculum-in-use. As long as that feedback continues to be received and until feedback is received showing that the curriculum-in-use is diverging from the official-curriculum, the curriculum-in-use will continue to be modified leading to sustained and growing divergence between the official-curriculum and the curriculum-in-use. This explanation is confirmed by research reported by van Kemenade, Pupius, and Hardjono (2008) who argue that “continuous” review, that is review which is frequent and occasioned by internal rather than external events, is required to achieve quality within education.

Ignoring the official-curriculum for a program not only leads to growing divergence between the official-curriculum and the curriculum-in-use, it meant participants generally did not fully appreciate the role their course played in helping to deliver the overall outcomes for the program.

6.3.3 Lose sight of the big picture

Participants noted that even though the official-curriculum for a program has outcomes, it could be difficult to understand the program's strategic intent, as the outcomes often were expressed in a way that was "too generic and therefore meaningless". It was also suggested that, rather than taking a holistic view, operationalisation of the official-curriculum for a degree frequently led to the curriculum-in-use being just a collection of courses where the “courses have more to do with weight, how difficult they are, than with delivering student outcomes ... There is no concept of what do students need to be able to do" (original emphasis). Compounding this problem was that often as an academic "you're kind of given stuff and you do stuff [but] there is no systematic explanation of here's the structure” that provided an explanation of where the course fitted within the program.

Paradoxically, although participants recognised frequently that "as an academic at a low level, [you] don't know the strategy. You don't know the big picture" they did not view the official program curriculum as something that would provide them with such an overview. Not only did most not know what the big picture was and the role their course played in the overall program, they were unconcerned by this. Discussion implied that responsibility
for ensuring the program curriculum was aligned, coherent, and cohesive and had integrity was someone else’s, not theirs as an individual responsible for a course. “I make sure [my course] is professionally and academically valid, whatever it is, but it’s not my problem if that doesn’t logically fit into a program, that’s somebody else’s problem”.

Given participants described the official-curriculum as a “guideline” or “specification of sorts”, highlighted the importance of first determining the strategic goals and outcomes, and identified curriculum as a design problem, it is odd they did not also see the importance of ensuring their individual course maintained program design. Despite acknowledging that an academic responsible for a course needed to have an “understanding of the original aims” it seemed “there is no systematic explanation … True some people have thought about in the past and if you go talk to those ‘natives’ then you might get some background”. This view lends weight to my suggestion that participants saw little overall value in the official-curriculum for a program. When dealing with the official-curriculum for a course, participants suggested that the “incumbent” would provide perceived knowledge about the strategic goals of the course. As program curricula tend to be around for five plus years and maybe many more, the chances of having those involved in its inception still around to ask are significantly diminished.

Inability to access the strategic vision, what might be seen as “corporate knowledge”, for a program and its courses has the potential to impact significantly upon the ability of academics to ensure courses, and even more importantly the program, still support an environment in which the desired strategic goals and outcomes can be met.

While there is little existing literature that addresses the notion of curriculum in higher education, what literature there is, deals predominantly with course curricula (for example, Biggs, 2002, 2009; Biggs & Tang, 2007; Stark, 2000; Toohey, 1999; Xu & Morris, 2007) or with the abstract notion of curriculum (for example, Barnett, 2012; Barnett et al., 2001). The more general literature about curriculum (for example, Kelly, 1977; Print, 1993; Stenhouse, 1975) often presents curriculum as a single entity without suggesting how the official-curriculum for a program might be broken down into its component entities such as courses while ensuring the integrity of the overall program is maintained.

I argue that this behaviour of ignoring the program curriculum, focusing at course level all the while disregarding the official-curriculum for the course, leads to what might be called curriculum ageing. I suggest curriculum ageing parallels “software ageing” (Parnas, 1994)
and, over time, leads to a loss in curricular integrity and therefore the program's ability to the required outcomes to meet its purpose.

Unless the official-curriculum for a program has been operationalised holistically, that is the curriculum-in-use for the program has been designed, implemented and maintained holistically to ensure the strategic goals and desired outcomes of the program are reflected in the courses, it is unlikely that we will have a cohesive program curriculum. Participants recognised the importance of operationalising the curriculum for a program holistically when they noted that ideally one should be able to work through a program curriculum from the bottom, starting with the courses from which the program is constructed, or from the top, starting with the strategic goals and desired outcomes, and either way it should “add up to a program” and it should be clear where program outcomes “filter down into things in the courses”. According to Diamond (2008) “the closer the relationships are among courses and [program] curriculum ... the more effective the learning experience will be for our students”. In this connection, he argues that whether one is “working on the design of a single course or of a [program] curriculum it is imperative that you keep in mind the relationship between the two” (p. 83).

Although participants conceptually understood the complexity inherent in the program curriculum, their lack of use of the official-curriculum for a program suggested that this complexity was not handled well within curricular representations.

6.3.3.1 Curriculum complexity

Participant behaviour in ignoring the official-curriculum for the program all the while acknowledging its importance implies there was no easy way to use the program curriculum and its complexity meant, “it's hard for anybody to keep that in their head”. Conceptually participants understood the curricula for the courses from which a program is constructed existed in a form of hierarchy, but once they were dealing with reality this appeared to be an aspect they lost sight of unless there were “strings of courses, for example, [artificial intelligence] AI1, AI2 and AI3 so the links are obvious”.

From participants’ descriptions of their engagement with the curricular process when designing, developing, implementing, delivering, and reviewing their courses, not only did they ignore the official-curriculum for both the program and their course, work on their courses largely tended to be solitary in nature.
6.3.3.2 Solitary activity

When responsibility for a course was shared between academics, participants indicated they would generally talk briefly with their peers about the content to be included. A few participants indicated that occasionally in this situation they might also discuss desired outcomes. When participants had sole responsibility for a course, however, they were more likely to “just do it yourself” because “academics just don’t talk to each other about course content”. Participants noted that even if they wanted to discuss their course with their peers they usually found “no one else had any time”, suggesting collaboration and discussion with others was likely to depend “on who the lecturer is, are they interested in this or not”.

While just how much real engagement with peers took place was largely dependent on the individual, there was likely to be more consultation and discussion about courses occurring in the earlier years of a program, especially first year courses. Participants noted, for example, “for the first year course I teach I try and make sure I’ve discussed it with the immediate follow on courses to make sure there’s no overlap or to make sure that something I do introduce will be reinforced later on in the first year or second year course”. Another participant suggested that when inheriting a “first-year course, no matter how experienced you are, you can’t not talk to the person who went before. But if you’re taking over a third or fourth year course, then the issues are mainly technical” implying that for later year courses a solitary approach was appropriate.

Another reason participants suggested for working alone “depends on how experienced you are in teaching that material and related material. So I know when I took over a course from ... I spent a long time talking to him to see how he’d done that, but I imagine that in 10 years’ time if I took over a similar course from somebody else I probably wouldn’t be bothered talking to them”. Supporting this, another participant suggested whether you worked alone or discussed it with your peers depended whether “you [are] an expert and how comfortable you are teaching [the material]”.

Even though it would seem these are reasonable motives for academics to work alone on their courses, I suggest that they are also both a cause and an effect of academics not sharing a common language and understanding of curriculum. Without a common language and understanding of curriculum communication surrounding it becomes less straightforward and may be interpreted as a lack of knowledge. Within research
disciplines, criticism of research can be uncompromising, but is usually based upon well-argued professional judgements (Handal, 1999). Although this culture is lacking in higher education teaching and learning, I suggest it is possible that some academics are hesitant about their knowledge and worry that their peers may show them how little they know about pedagogy. Rather than show ignorance of pedagogy and curriculum, it is safer to rely on oneself. However, without conversations with “critical friends” (Bambino, 2002; Handal, 1999) a common understanding and terminology is unlikely to develop.

After the focus group sessions and interviews, participants indicated they had enjoyed the opportunity to think about and to discuss curriculum as a concept and in a non-challenging environment and felt they had gained insight through their participation. I suggest that not only would more collaborative work be likely to improve the quality of the program curriculum, it would gradually make academics more comfortable with the concepts, and would help to develop a common language and understanding. This notion accords with the idea that a “community of practice contributes considerably to what is implicitly learnt through routine practices and taken for-granted (sic) … [to] help academics learn what works to improve educational outcomes” (Knight, 2002). At times participants mentioned the benefits of attending educational conferences and seminars where they were able to learn from others’ experience. This benefit could be achieved locally by encouraging greater collaboration between colleagues and the development of groups of critical friends who take the time to discuss curriculum matters with and provide constructive feedback to each other.

It was also suggested that academics work alone because the institutions from which participants came were “so small there’s no kind of a large body of people researching or teaching the same thing. We’re kind of, because of size, we’re in little silos”. Along with the size of the institution, physical location and organisational structure were also identified as reasons academics worked alone because “when I was in the same corridor with … the five of us all teaching in related courses, we used to talk about it in the corridor”.

A further reason that participants put forward for working alone was that of academic autonomy. “Everybody … is very individualistic, … and if you were to go and suggest to some of these people that it’s not really a good idea … you might think of something else new … that would be interference with their course and they’d be so upset. So you don’t do it”. Furthermore, it was suggested, “I don’t think academics want to be told how to teach
something, especially if it’s their field of research as well as teaching”. Generally, it is only “when you take over subjects ... or you teach” someone else’s course while they’re away that “you can see what others ... you’re forced to see what others are doing”.

Knight (2001) argues this behaviour is just “self-indulgence” and an excuse for academics to pursue their own interests at the expense of others. On the other hand, Stark et al. (1997) suggest the unwillingness of academics to discuss and collaborate when the discussion relates to where the course fits within the overall program, stems from the fear that the discussion will become political with clashes between “educational and disciplinary ideologies” and where compromise of self-interest is likely to be required.

The findings suggest that both Knight’s and Stark et al.’s reasons for a lack of willingness to engage in discussion and collaboration among academics are valid and likely to occur. According to participants, discussion and collaboration was most likely to happen “if you’ve got the right friends among your academic colleagues”. Statements like this one suggest that colleagues who were considered friends were perceived as more likely to be helpful and provide constructive feedback and so engagement with them would be beneficial. This also supports my earlier observation that participants were uncertain of their pedagogical and curriculum knowledge and were concerned that less friendly peers may offer less compromising and more critical feedback. Research suggests that developing “critical friends”, that is peers whom you trust to provide honest critique and constructive feedback, is likely to help academics improve outcomes (Bambino, 2002).

Even when dealing with friendly colleagues, participants acknowledged that sometimes discussion and collaboration could be difficult because “we want to teach very differently” so they had to “somehow make some compromise”. Backing up Knight’s (2001) claim of self-indulgence, participants noted that some academics “couldn't care less, they just want to teach their little tiny corner and everybody stay out of the way”, their words implying that this was others’ and not their behaviour.

The tension between teaching and research was yet another reason participants suggested they worked on their curriculum alone. Participants argued there was “this constant push on academics to do well in research and so ... we try but most ... are too busy ... trying to focus on their research-students and their research, so the teaching, you do what you can. Some people apparently put in too much effort and then pay for that ... because we get
rewarded for research not for good teaching”. They argued that academics were time-poor and so adopted the approach that involves the least amount of time: working alone.

Not using the official-curriculum as a guide, not talking to their peers about proposed changes, relying on their personal experience, and focusing on individual courses causes academics to lose sight of the big picture. Ignoring the place of individual courses within the larger program curriculum leads to a loss of curricular integrity through weakening of curriculum alignment, coherence, and cohesion with flow-on consequences for student outcomes. I argue this behaviour gives rise to what I have termed curriculum drift, discussed in detail in Sub-Section 7.2.1 below.

### 6.4 Impact of the lack of a common understanding

Given the variety of understandings of and language used to describe curriculum within the literature, it is not surprising that participants also displayed a lack of both a common understanding and a common language to discuss and describe curriculum. As argued in Section 2.1.5 above, the lack of a common vocabulary to discuss curricular concepts is likely to hamper collaborative engagement in curriculum design and development and so may limit academics’ ability to design, develop, and implement a quality curriculum that will enhance student learning.

One of the most obvious examples of the lack of a commonly accepted vocabulary was provided by the variety of terms used to describe the desired outcomes of a curriculum (see Sub-Section 5.2.3.2 above). The outcomes of a program were labelled “outcomes”, sometimes with the additional qualifier “learning” or “graduate”. They were also called “objectives”, again sometimes with the qualifier “learning” or “graduate”. At times, they were also called “attributes” as in “graduate attributes” or “student attributes” and one focus group even identified them as “generic skills”. Some participants were explicit that there was a distinction between outcomes and objectives. Objectives are “what you want them to learn ... sort of mission statements” and outcomes are “what they actually learn”. The terms used to identify the outcomes of an individual course were somewhat more consistent. Predominantly they were “outcomes”, sometimes qualified as “learning outcomes” or “course outcomes”, and “learning objectives”. Some participants also referred to them as “student skills” and “generic skills”. The language used at times also implied relationships between elements of a curriculum. For example, the structure
imposed by a curriculum was also suggested when one focus group talked about “first year outcomes”. Terms were frequently used interchangeably by the same participant, especially when they were discussing program curricula.

Using fewer terms to identify and describe course outcomes and using them more consistently, suggests participants had greater familiarity with courses. Participants were also more comfortable talking about their courses and their outcomes rather than the program, again suggesting greater familiarity with the concept of courses having outcomes than they were with programs having outcomes. Familiarity with courses rather than program curricula was also noted by Stark et al. (1997). The literature that discusses curriculum in higher education also reflects this focus on courses (Barnett et al., 2001) and is mostly directed towards course rather than program design and development (for example, Biggs, 2003; Biggs & Tang, 1999, 2007; Faulconbridge & Dowling, 2009; Fink, 2013; Toohey, 1999).

Not only was there a lack of commonly accepted terms for naming the elements of a curriculum, participants did not appear to have a commonly accepted understanding of just what was encapsulated by the term curriculum. Furthermore, as noted in the literature (Conrad & Pratt, 1986; Lattuca & Stark, 2009) participants seemed unaware that essentially each possessed their own, personal understanding of just what was encapsulated within the concept of curriculum. They seemed to assume all possessed the same understanding as no attempt was made to clarify concepts until confusion was evident at which point surprise was usually expressed.

Despite participants defining curriculum as something more than content it appeared that for many the terms curriculum and content were synonymous. At times, participants were explicit that “curriculum is just content” and that the curriculum is a “fairly short, constrained, formal document that describes the content of the course”. Not only among participants, but even within participants’ minds there appeared to be confusion as to what the term encompassed. For example, one participant asked, “what’s the difference between course and curriculum? I mean, in some contexts, in a way they can be alternatively used”.

Given our decisions are based on what we think we know (Sinek, 2009), without a common language and a well understood definition of exactly what curriculum entails, at the very least confusion will occur. Furthermore, our perception of curriculum affects both
the decisions we make and the processes we engage in when designing, developing, implementing, and evaluating those curricula (Ornstein, 1987). If we possess different perceptions of curriculum, it is unlikely that we will develop and implement curricula that display curricular integrity. This is especially so at program level where the literature suggests that quality learning outcomes are more likely to occur when all the courses in the program are aligned, cohesive and coherent (Allen, 2004; Diamond, 2008; S. A. Cohen, 1987; Schmidt et al., 2002; Stark et al., 1997).

Additionally, as van Dijk, de Kwaadsteniet, and De Cremer (2009) argue, without a common understanding individuals are more likely to make decisions based on their own interests and personal characteristics. Curricular decision making will centre on determining the weight of a course, content to be included or what teaching method to adopt (Lattuca & Stark, 2009, p. 2) rather than deciding on a structure that will lead to improved learning outcomes for our students.

In acknowledging the importance of all those involved with curriculum design and development possessing a common understanding Print (1993) argues “there is little to be gained by continuing to elaborate dynamic models which describe what is happening when teachers and developer devise curricula. That situation is characterised by confusion and chaos” (p. 82). He suggests instead “what is needed is a clear, logical, prescriptive approach to curriculum development that will provide positive guidance for developers of curricula” (p. 82).

While I agree that we need a clear and logical approach that provides positive guidance for curriculum designers and developers, I completely disagree that it should be “prescriptive”. Curriculum is a complex adaptive system. Prescriptive implies the “imposition or enforcement of a rule or method” (OED, 1995) and a sense of control. Enforcing a rule or method also suggests there is a single approach. By their very nature, complex adaptive systems cannot be controlled and as their behaviour cannot be predicted there is always more than one approach; which approach is appropriate will depend on the situation at any given time. Stark (2000, p. 414) shares my opinion describing “instructional design” as a “creative act” arguing that, “course planning is not amenable to a single formula or prescription”.

Quality educational outcomes require that the curricula for all the courses from which a program is comprised work together to build and deliver the overall outcomes of the
program. Not only must all the elements of the curriculum work together to achieve the outcomes but the academics responsible for the design and implementation of those elements must also collaborate. However, when those responsible for designing, developing and implementing the curriculum for both programs and courses lack a common understanding of the concepts involved and a common language to discuss those concepts, minimal collaboration takes place between the academics responsible for the design and implementation of those elements – the courses. Lack of a common understanding and a lack of collaboration plays a role in the notion of curriculum drift identified by participants (see Sub-Section 5.3.4), which is discussed in more detail in Sub-Section 7.2.1.

The final Part of this thesis comprises two chapters. Chapter 7 – Conclusions and Implications, compiles the findings presented in Chapter 5 and the analysis, synthesis and discussion of those findings offered in Chapter 6 to provide answers to the research questions that underpinned this research. In the final chapter of this thesis, Chapter 8 – Limitations and Further Research, I briefly discuss the limitations of the research reported here and propose further research building upon and extending the conclusions articulated in Chapter 7.
Part III. CONCLUSIONS AND FURTHER RESEARCH

Engineering education is both intellectual and practical, both creative and ethical. This very complexity makes the education of engineers a particularly strategic site for applying the new sciences of learning, exploring the emerging technologies for investigating pedagogical practices, and in turn contributing new understanding to those very fields.

(Shulman, 2005)
Chapter 7  CONCLUSIONS AND IMPLICATIONS

Facing with new realities, our systems have to transform — as the society has transformed. They have to learn to co-change (co-evolve) with their constantly changing environments

(Banathy, 1994, p. 88)

In this chapter, I draw conclusions from the findings presented in 4.3.3.3 and the analysis and synthesis of those findings discussed in Chapter 6. Answers to each of the questions underpinning this research are provided. Section 7.1 presents answers to the first three questions, while Section 7.2 provides answers to the fourth question. The questions behind this research were:

1. How do engineering, software engineering, computer science, and information systems academics conceive of curriculum? What do they perceive to be the
   a. key elements of a curriculum,
   b. relationships between those elements, and
   c. the nature and importance of those relationships?
2. What processes do they engage with when designing, developing and implementing both course and program curricula?
   a. Do they follow a specific approach to design, development, and implementation?
   b. Does their knowledge of engineering, software engineering, computer science, or information systems design inform their approach to the design and development of their curricula?
   c. Do pedagogical concepts, such as curriculum alignment, inform their approach?
d. What aspects of curriculum design do they consider when making changes to an already implemented curriculum?

e. When designing and developing a completely new curriculum, what informs its design and what is the process with which they engage?

f. Is there a difference between program and individual course curricula?

3. What is the output of the design and development process and how is it shaped?

a. Is there a difference between program and individual course curricula?

4. What are the implications of these conceptions and practices?

Curriculum drift and the explanation of what is potentially happening to our curricula as they drift and lose their integrity was the most significant outcome of this research. The notion of drift and the behaviour that triggers it were identified by participants. The explanation of what is likely to happen to a curriculum as it drifts, and the notion of the multi-dimensional nature of curriculum and the role that plays in curriculum drift, emerged from my analysis and synthesis of the findings. Together, curriculum drift and the multi-dimensional nature of curriculum provide answers to research question 4.

In order to grasp the significance of curriculum drift and the multi-dimensional nature of curriculum, and to understand the synthesis that supports the models I use to explain these concepts and their impact upon our curricula, it is first necessary to understand the answers to the first three questions upon which this research was based.

7.1 Conclusions drawn for research questions 1 – 3

This section offers answers to the first three of the four research questions posed at the outset of this research, whose purpose was to uncover what higher education academics think curriculum is and how they use it in their daily interaction with it in all its guises. This section contains three sub-sections. Conclusions drawn from question one, which investigated participants’ perceptions of curriculum, are presented in Sub-Section 7.1.1. Those conclusions related to question two, which investigated the processes participants used when designing, developing, and implementing curriculum, are offered in Sub-Section 7.1.2. The third sub-section, 7.1.3, provides conclusions related to question three, which investigated what the output from those processes is and how it is shaped.
7.1.1 Concepts of curriculum – curriculum-in-the-abstract

In answering the first question about their conceptions of curriculum, its key elements, the relationships between those elements and the nature and importance of those relationships, participants modelled and described their conceptual understanding of curriculum. This sub-section presents the conclusions drawn from those models and descriptions.

In both the one-to-one interviews and the focus group sessions, there was a profusion of terms used to describe curriculum. Many of the terms appeared to be synonyms of each other as participants used them interchangeably. Moreover, despite having defined curriculum as more than just content, participants frequently appeared to use the terms synonymously. Within the focus groups, participants’ ability to create a model of their conceptions of curriculum was hampered by their lack of a common language with which to discuss it. Although using different terms to mean the same things regularly caused confusion, participants seemed largely unaware that this was what caused the confusion.

The lack of a common language and the lack of an agreed set of concepts caused confusion among focus group participants. Not only was there confusion between participants, even individuals themselves appeared confused at times. Nonetheless, focus group participants did not question their different understanding; they simply discussed curriculum using the terms each believed appropriate only halting to seek clarification when it became clear that although they were using the same terms they actually meant different things.

As our assumptions and what we think we know affects our behaviour (Sinek, 2009), it is likely this confusion of language and understanding may have contributed to the different approaches and activities in which participants engaged when designing, developing and implementing curriculum. The implication of which is, in part, curriculum drift which I discuss in detail in Sub-Section 7.2.1 below.

Despite their confusion over terminology and understanding, one of the key concepts identified by participants in this study was that curriculum is both a designed object and a design process. Participants were also eventually clear that curriculum belonged to both programs and courses, that the curricula existed in a hierarchy, and that there was a set of relationships between the elements of curriculum. Participants agreed that the output of
the design process was the official-curriculum, which was a designed object consisting of three core elements: purpose, desired outcomes, and content.

7.1.1.1 Curriculum as a designed object

Question 1, which sought to understand participants’ conceptions of curriculum, had three parts. Question 1(a) sought to understand what participants conceived to be the key elements of a curriculum; 1(b) sought to understand the relationships between the elements of curriculum and 1(c) sought to understand the nature and importance of those relationships. A partial answer to questions 1(b) and 1(c) is provided in this section, while the remainder of the answer is given in Sub-Section 7.1.1.3 below.

Conceptually, participants saw the official-curriculum as a designed object consisting of three key elements: curricular purpose, desired outcomes, and content. Curricular purpose was the strategic goal the curriculum aimed to achieve and included the rationale behind that purpose. Participants explained that the relationships between those elements meant that suitable outcomes were determined by curricular purpose, while appropriate content was the product of the relationship between curricular purpose and desired outcomes. Importantly participants argued that although a large body of content may be suggested by the relationship between the curricular elements purpose and desired outcomes, only content that is used to develop the desired outcomes should be included. A model of these elements and the relationships between them is shown in Figure 7.1 below (included in pull-out figures).

Significantly, participants in this research argued that the curriculum itself does not include the concepts of pedagogy including teaching methods and approach to assessment. They argued that pedagogy is an aspect of a curriculum's implementation.

Based on the curricular elements and their relationships identified by participants, using the \(\chi_T\) UML modelling language I have created a model of curriculum as shown in Figure 7.1. This model provides a very clear and workable definition of curriculum that could be used by academics to help understand what needs to be included when designing and developing a curriculum. The model represents what I have called \textit{curriculum-in-the abstract}. (For more detail on this concept, please see Sub-Section 2.1.6 above.)
Using the model of *curriculum-in-the-abstract* represented by Figure 7.1, I propose the following definition for a curriculum:

A curriculum will have a clearly articulated purpose or strategic goal including the rationale behind that purpose, which will determine one or more desired outcomes. A curriculum’s content is the product of the relationship between the articulated purpose and associated desired outcomes. Inclusion of appropriate content is determined by its relationship with one or more of the desired learning outcomes.

It is interesting that despite participants in this study having limited background and formal education in curriculum, the model of their concepts and associated definition bears a close relationship to Tyler’s (1949) concepts. Tyler argues “if an educational program is to be planned and if efforts for continued improvement are to be made, it is very necessary to have some conception of the goals that are being aimed at” (1949, p. 3). Acknowledging the important role the goals play when developing and implementing the curriculum-in-use, Tyler, like participants in this study, argues that “these educational objectives become the criteria by which material are selected, content is outlined, instructional procedures are developed and tests and examinations are prepared” (1949, p. 3).

What I have called a curriculum’s “purpose or strategic goal” is closely related to what Print (1988, 1993) refers to as “curriculum intent”. Instead of using Print’s term “curriculum intent”, however, I have intentionally chosen to use “purpose or strategic goal”. Firstly, within his concept of “curriculum intent” Print includes the objectives of the
curriculum; these are excluded from the notion of curriculum purpose here. Furthermore, participants referred to the goals or the purpose of a curriculum not its intent. Curriculum was depicted as a “designed object” and design is the “purpose ... that exists behind an action, fact, or object” (OED, 1995). Purpose can be defined as “the reason for which something is done” (OED, 1995) and aligns closely with the language of design used by participants. Finally, within the notion of purpose participants included the rationale behind that purpose, something that is missing from Print’s description of “curriculum intent”. Participants argued that to be effective over its lifetime a curriculum needs to include a justification for the purposes it aims to achieve. Kelly (2009, p. 9) too argues that if a curriculum is to be “practically effective” it must contain a justification of its purpose.

The model of curriculum-in-the-abstract depicted in Figure 7.1 above (included in pull-out figures) can apply to a curriculum at any level. Participants suggested that the elements of a curriculum apply equally to a program or a course, and that courses might be “cut cookie-cutter style” from the program curriculum. Lattuca and Stark (2009) also suggest that their “academic plan can be constructed for a single lesson, for a single course, for aggregations of courses (for example, a program or major), for broader organizational groupings of majors” (p. 5).

7.1.1.2 Curriculum as a design process – curriculum-as-process

As well as conceiving of curriculum as a designed object, and notwithstanding their confusion of understanding, when describing their concepts of curriculum participants described a design process, such as might be used with engineering or software design. The process began with identification of a need, often called ideation (Brown, 2008, 2014), which is where the general solution is developed and involves the development of a set of requirements – in this case, the official-curriculum. This was followed by the design, development, and implementation – what participants referred to as operationalisation – of that curriculum leading to the development of the curriculum-in-use. Once the curriculum has been operationalised, it might be evaluated to determine how well the requirements – the desired outcomes – were met. The process described was both recursive and iterative. The output of curriculum-as-process is what I have termed, curriculum-as-artefact. This process is modelled in Figure 7.2 below. Due to the layers of process, this model might be called the curriculum-as-process onion.
The innermost layer – the official-curriculum or *curriculum-as-artefact* – is both the output of, and is used by each of the subsequent layers. The second and subsequent layers represent *curriculum as process*, the curricular process that both produces and uses the official-curriculum. The circular arrows represent the iterative and recursive nature of the process.

![Curriculum Process Onion](image)

Figure 7.2 – The *curriculum-as-process* onion  
*(See Pull-Out Figure 7.2)*

The process begins with ideation and the determination of need, represented by the second, purple layer. This process was described in detail in Sub-Section 6.2. Steps 1, 1/2, and 2 in Figure 6.2 above (included in pull-out figures) represent this layer of the process. This layer of the process leads to the design of the official-curriculum, which is constrained by both the curriculum purpose and a variety of constraints. The third layer – green, orange, and red – represents the “operationalisation” of the official-curriculum, as described above and represented by Step 3 in Figure 6.2 above. Operationalisation involves using the official-curriculum as a guide to decision-making when designing, developing the teaching and learning, and assessment material, and implementing – teaching – the *curriculum-in-use*. The outermost layer – light blue – represents the process of curriculum evaluation where periodic reviews of the curriculum are conducted to
ascertain how well the desired outcomes of the curriculum are met. This layer is represented by Steps 4 and 5 in Figure 6.2 above.

Supporting the idea that the official-curriculum was a designed object and was the output of a design process, participants argued that its design and development was subject to a large set of constraints which, with time, would likely change both in importance and substance. They argued, “any design problem has constraints”, noting, “you don't have infinite time; you don't have infinite people to throw at it”. The teaching structure imposed by an institution was identified as one of the more significant constraints on the design of a curriculum. Mandating that courses have a single, equal value and the imposition of a fixed teaching structure related to semesters, plays a big part in determining what was included and how it was implemented. According to participants this meant, “modularity becomes both the structure and the driving thing” and impacts equally upon programs as it does upon courses. The imposed institutional structure was a constraint that is “so strong you almost don't think outside that box. You don't think I'd like to have 20 weeks on this ... You think what is the coherent unit, coherent set of knowledge which fits in a 13-week chunk”. Frequently this constraint became an aspect of the design of a curriculum, leading to the content simply being “chunked” into the number of weeks’ teaching an institution imposed.

Participants suggested that to deliver better outcomes a program curriculum should be decomposed into parts – courses, units, modules, call them what you will – of size and weighting appropriate to the importance and difficulty of the material. Instead, because of bureaucratic requirements a program was decomposed into parts that are not always of appropriate size and weighting for their importance within the overall curriculum. Nonetheless, when working with their curricula, participants rarely considered the structure imposed by the organisation because “we've been doing it for so long we've almost been straitjacketed and it's more than just a constraint”.

7.1.1.3 Relationships between program and course curricula

Questions 1(b) and 1(c) sought to understand the relationships between the elements and the nature of those relationships. As discussed above in Sub-Section 7.1.1.1 and modelled in Figure 7.1 (included in pull-out figures), participants identified three core elements of a curriculum, the relationships between those elements and the nature and importance of those relationships.
Participants also argued that their model of curriculum applied equally to both programs and courses and that the curricula for a program and its courses existed in "some form of hierarchy". Supporting their contention that the curricula for a program and its courses existed in a form of hierarchy, participants stated that, courses needed “to add up to a program” and that “a program needs to add up to a whole”. They also asserted one should be able to go through an official-curriculum for a program bottom up, starting with the courses, or top down, starting at program level, and decomposing it into its component parts, and be able to ascertain the purpose of the program.

Participants did not specifically discuss the relationships between the curricular elements across the different levels of the curricular hierarchy so it is not clear whether relationships exist and if they do exist exactly what those relationships might be. The data are insufficient to allow me to draw conclusions about the relationships that may or may not exist between the elements of the curricular hierarchy, how the levels of the hierarchy relate to one another and the nature, strength and importance of those relationships.

Using the description of a program curriculum as a “top-down structure ... a rough map of how that’s going to fit together” that enables "you drill down into the individual courses" I have modelled what I propose are possible relationships across the levels in the hierarchy to indicate how it fits together and provide the ‘map’. This is shown in Figure 7.3 below.

To indicate uniqueness, each entity within the model has been given an identifier, e.g. Major A, Minor AA, Course 1 and so on. The identifiers at each of the aggregation levels such as Minor AA and Minor AB show that those minors have been decomposed from Major A while Minor BA and Minor BB show they have been decomposed from Major B. The structure of the courses indicates that each of the minors will be decomposed into a number of courses that may participate in more than one aggregation. Courses and aggregations may be used by more than one program.
The process of operationalising the official-curriculum, that is the design and development of the curriculum-in-use and its implementation, which leads to the delivered-curriculum among others, creates a number of variants of the official-curriculum that I have called layers of the curriculum (discussed in Sub-Section 6.2.2.3 above and modelled in Figure 6.8, included in pull-out figures). Again, the specific relationships between the layers were not discussed and it was not clear exactly what these relationships were but as the different layers were described as variants of the official-curriculum, it is possible to assume that a set of relationships exist between those layers. However, the details and nature of these relationships were not explored in this thesis.

7.1.1.4 Summary of conclusions for research question one

The answers to the first research question support a simple model of curriculum, which provides a clear understanding of the three elements of a curriculum and the nature and importance of the relationships between those elements. The model enables the proposal of a simple, but workable definitional of a curriculum that might be used by academics as a heuristic to help understand what to include and as a guide to their decision-making when designing and developing a curriculum. The answers to question 1 also supported the
development of a simplified model of the curricular process that surrounds the design and
development of the official-curriculum and then the design, development and
implementation of the curriculum-in-use. Finally, the answers to question 1, in
conjunction with using a systems lens to understand curriculum, underpin my assertion of
the possibility of a set of relationships between program and course curricula and
between the various curricular layers but do not identify the nature and importance of
those relationships.

As discussed in the following sub-section, the answers to the second major research
question, which sought to understand the processes with which participants engaged
when designing, developing and implementing their curriculum, display inconsistency
between participants’ conceptual descriptions and their practice.

7.1.2 Curriculum-as-process – processes surrounding curriculum
design and development

Even though participants lacked both a common language to discuss their concepts of
curriculum and a common understanding of what elements comprised a curriculum, and
what the relationships between those elements were, they clearly described their concepts
of curriculum in terms of design.

At the conceptual or meta-level, they saw curriculum as both a design process and a
“designed object”. The official-curriculum was described as a set of requirements and
guiding framework. Notwithstanding this, in practice participants largely ignored the
official-curriculum for both the program and their course. Instead of using the official-
curriculum as a “set of requirements” to guide their decision-making when implementing
their course, they relied on personal experience, textbooks, and model curricula; neither
did they appear concerned about the role their course played in delivering the overall
program outcomes. Ignoring the official-curriculum and their almost total focus on their
individual courses caused many to lose sight of the big picture and gave rise to a
phenomenon participants called “drift” or “slippage” which is where the curriculum-in-use
“drifts” away from the official-curriculum causing a “degradation of ... integrity”. Drift is
discussed in detail in Sub-Section 7.2.1 below.

Answers to research questions 2 (a), (b) and (c) are provided in Sub-Section 7.1.2.1;
answers to question 2(d) are provided in Sub-Section 7.1.2.2; answers to question 2(e) are
provided in Sub-Section 7.1.2.3; and answers to question 2(f) are provided in Sub-Section 7.1.2.4. Sub-Section 7.1.2.5 summarises the conclusions drawn for research question 2 which sought to uncover what processes participants engaged with when designing, developing and implementing both program and course curricula.

7.1.2.1 Approach to curriculum design

In answer to question 2(a) – do academics following a specific approach to design, development and implementation of curricula – I conclude that participants in this study, like those in other studies (Barnett et al., 2001; Stark, 2000), did not knowingly follow a particular approach to curriculum design. Instead, they were most likely to use the institutionally imposed teaching structure as a mechanism to aid decomposition of content across the program and within individual courses.

The answer to question 2(b) – which sought to understand whether participants’ knowledge of design informed their approach to curriculum design – clearly displays inconsistency between concepts and practice. Conceptually participants’ approach was influenced significantly by their knowledge of design. In practice, however, they did not closely follow their conceptual process of design.

Both conceptually and in practice participants were clear that the articulated purpose of the curriculum determined the outcomes, which in turn guided the selection of content. Participants were also clear that the articulated outcomes should be used to evaluate how well the delivered-curriculum met both the outcomes and, through them, the purpose of the curriculum itself.

Where their practice diverged from their conceptions was in the role of the official-curriculum. Conceptually the official-curriculum was described as a “set of requirements”, a “framework”, and a “guideline”. When describing their conceptions of what was involved in curriculum design and development, participants described an engineering design process (modelled in Figures 6.2 and 7.2 above, both included in pull-out figures). In practice, rather than using the purpose and outcomes set out in the official-curriculum, participants used what they determined to be the purpose of their course to decide the outcomes for their courses and then used those outcomes when they evaluated how well their course performed. Additionally, they were mostly unconcerned about the role their course played in delivering the outcomes of the program.
The answer to question 2(c), which sought to understand whether pedagogical concepts such as constructive alignment informed their design and development, is complicated. Despite most participants not having any real knowledge of pedagogical approaches to curriculum design, all participants appeared to use the concepts of constructive alignment. Participants explained they used the learning outcomes to guide development of learning and assessment activities suggesting also that the outcomes they wanted to achieve might influence their approach to and methods of teaching because “you’re trying to get them to engage with material ... you might be trying to change their thinking rather than ... content of what they know”.

Constructive alignment requires that “the teaching methods used and the assessment tasks, are aligned to the learning activities assumed in the intended outcomes” (Biggs, 2002). I conclude participants effectively applied the concepts of constructive alignment because those concepts accord with some of the basic tenets of design (discussed in Chapter 3 above) and participants were applying those tenets almost instinctively.

While similar, constructive alignment and the process participants described (see Figure 6.2 above, included in pull-out figures) contain a significant and very important difference. By characterising the curriculum as a design problem, participants clearly identified the notion that the purpose of the curriculum must determine the desired outcomes and argued, for example, “you just need to define a set of skills or knowledge in terms of the goal”.

Aligning the desired outcomes to the curricular purpose appears to be a significant addition to the concept of constructive alignment, which only considers alignment of teaching and learning and assessment activities with desired outcomes. Furthermore, because participants considered the official-curriculum to be a designed object and that the curricula for the courses and program existed in a form of hierarchy, they also saw the importance of ensuring that the outcomes of each course were aligned to the overall purpose of the program of which they were part. Constructive alignment only considers alignment within individual courses rather than across complete programs.

Without aligning the desired outcomes to the stated purpose of the curriculum, it is possible to design and develop a perfectly aligned curriculum that does not enable the curriculum to deliver its purpose. The notion of aligning the desired outcomes to the stated purpose is especially important when the program as a whole is considered.
Participants argued that when taken together the courses needed to “add up to a program” and that “a program needs to add up to a whole”. Ignoring the alignment of outcomes and purpose across the levels of curriculum contributed to the notion of curriculum drift, discussed in detail in Sub-Section 7.2.1 below.

Question 2(d) sought to discover what aspects of curriculum design participants’ considered when making changes to an already implemented curriculum.

7.1.2.2 Working with an already operationalised curriculum

Participants tended to ignore the curriculum design when working with an already operationalised curriculum: they did not consider the official-curriculum for the program when making changes to their courses, and were unlikely to reflect changes made to their curriculum-in-use back to the official-curriculum for a course. They suggested the official program curriculum was complex, difficult to work with and to keep in their heads, which was why it was ignored. They made no suggestions about why they ignored the official-curriculum for their course.

When taking over a course that had already been “operationalised”, that is a curriculum-in-use existed, participants were inclined to disregard existing teaching and learning material and tended not to use either the official-curriculum of the course or the program to guide their activities. Instead, they designed and developed a new curriculum-in-use based on their own knowledge and experience, even when new to that institution. Despite having no interest in using existing learning material, they suggested they might use the current structure and flow of work within the course.

As others have noted (for example Felder & Brent, 2004; Stark, 2000; Stark et al., 1997) the activity was largely solitary. Participants attributed the unwillingness of their colleagues to collaborate to a lack of time and interest on the part of those colleagues. Despite suggesting “communication should be kept as open as possible” and even though the result “may not be better”, participants often did not actively seek their colleagues’ contribution to and feedback on their changes because it was more efficient to work alone. “If you work by yourself it will save a lot of time and a lot of energy, ‘cause you can do it quicker”.

Question 2(e) sought to uncover participant behaviour related to designing and developing a course that had not been taught before at their institution, and to highlight
any differences between working with a new curriculum and an already operationalised one.

7.1.2.3 A new curriculum

To answer question 2(e), I conclude that unless a participant had been involved in the process surrounding the proposal and acceptance of the need for a new course, it appeared participants simply treated the design and development of a new course as they did the taking over of a course previously taught by someone else.

When designing and developing a new course curriculum the process described was one of operationalisation, even when the official-curriculum did not exist. In this instance, it appeared that the official-curriculum was extracted as the design and development of the curriculum-in-use was completed, though this was an aspect of the design and development of a new course that was not discussed.

The final sub-question of question 2, question 2(f), has a similar purpose to 2(e), except it sought to understand if there was a difference in process between the design and development of a program and a course curriculum.

7.1.2.4 The difference between a program and a course

The process of design and development surrounding a program was both more formal and more collaborative than that for a course, regardless of whether it was the design and development of a completely new program or the review of an existing program. Participants suggested that program design and development was too important a task to leave to an individual. They also suggested the program design and development process sometimes became political as individuals and groups attempted to ensure their subject area was not excluded and was given the importance individuals believed it warranted.

In this research, as others have noted (Felder & Brent, 2004; Stark, 2000; Stark et al., 1997), design and development of curricula for individual courses was almost totally carried out by individuals. There was little interaction between academics at this level and in many cases, it was suggested that the individual responsible for a course would see it as “interference” if a colleague made suggestions about their course. Participants also raised the notion of the tension between research and teaching. They suggested academics had little time or inclination to spend working with colleagues on their courses as promotion.
was largely based on research output, which again accords with others’ findings (Felder et al., 2000; Stark et al., 1997).

The second major research question provided an understanding of the curricular process of design, development, and implementation that engineering, software engineering, computer science and information systems academics actually undertake.

7.1.2.5 Summary of conclusions for research question two

Answers to the first three parts of research question two allow me to conclude that even though participants did not have any real knowledge of pedagogical approaches to curriculum design and so did not apply concepts such as constructive alignment to their design and development of the curriculum-in-use for their course, they did use basic design principles that are conceptually similar to those of constructive alignment. Importantly, the answer to question 2(c) has provided a significant addition to the concepts of instructional and constructive alignment. This research has shown the importance of ensuring the desired outcomes of a curriculum are aligned with its articulated purpose. Furthermore, it has shown the importance of alignment of desired outcomes and purpose between the different levels of the curriculum hierarchy.

Answers to the remaining three parts of the second research question highlighted a divergence between participants’ conceptual descriptions and their practice. In practice, they ignore the official-curriculum for both the program and the course, despite conceiving of it as a “set of requirements” that should guide its implementation. They apply the concepts of design only to the design and development of their curriculum-in-use, treating it as an atomic entity rather than as an element in a larger system – the program – that must work together with the other elements – the courses – in that system to deliver the desired outcomes of the program. Work with individual courses was largely informal and solitary, while the design and development of programs was more formal and collaborative.

The third major research question sought to understand what the output of the design and development process is and how that output is shaped. It also sought to understand any differences that might exist between program and course level curricula.
7.1.3 **Curriculum-as-artefact** – the output of the curriculum process

The output from the curriculum process is a series of artefacts. When developing a brand new program, the first artefact is the official-curriculum for that program. As the process continues and operationalisation of that official-curriculum takes place, official-curricula for the component entities of that program, such as courses, are created. At the course level, when developing a brand new course, the process produces the official-curriculum for the course and its operationalised curriculum-in-use at the same time.

The process of operationalisation produces a number of variants of the official-curriculum: the first of which is the curriculum-in-use. As the process of operationalisation continues and the curriculum-in-use is implemented, that is it is taught, other variants of the official-curriculum are created. These include the delivered-curriculum, the assessed-curriculum, the hidden-curriculum, and so on as modelled in Figure 6.8 (included in pull-out figures) and discussed in Sub-Section 6.2.2.3 above.

As the process of operationalisation takes place, the curricular layers move along the curricular continuum becoming more specific with each layer, as shown in Figure 2.1 above (repeated here for convenience as Figure 7.4). The process of operationalisation leads to the creation of artefacts relating to the implementation of the curriculum-in-use, such as teaching and learning and assessment material. (The decision-making process surrounding these artefacts and the artefacts themselves are not considered as part of this thesis.)

As modelled in Figure 7.1 above (included in pull-out figures) the official-curriculum for a program sets out the purpose including the rationale for that purpose, the desired outcomes, and high-level descriptions of content. Both desired outcomes and content are sufficiently general that they do not constrain the implementation of the curriculum. The official-curriculum for a program is decomposed into its component parts, such as courses or modules. It may also be decomposed into whatever aggregation of sub-parts a particular institution uses, such as electives, majors, minors, specialisations etc. According
to participants, the decomposition of a program is important because when all the courses for a program are taken together they need to “add up to the whole”.

Conceptually, the official-curriculum for a program can be considered as a container for all the components of that program. It should allow someone reading that official-curriculum to discover readily those components and to understand how they are used to construct the program. Inside this container are all the component parts of a program. I will refer to these as “entities”. These entities include each individual course, lesson or module (the smallest entity) as well as any aggregations of entities, such as courses, majors, minors, specialisations. At each level – single or aggregated – the official-curriculum for that entity consists of a purpose and rationale, the desired outcomes and descriptions of content. At whatever level, when taken together, the entities need to add up to the whole.

This is modelled in Figure 7.3 above (included in pull-out figures). Each level is a decomposition of the one above, and provides increasing detail as one descends the hierarchy because, according to participants, the purpose and desired outcomes of a program can be “fragment[ed] … but you can’t reduce them to pieces. What you do is distribute them. They filter down into things in the courses”. When taken together they “add up to a whole”. As one descends the curricular hierarchy, the curricular artefacts move along the curricular continuum from the general to the specific.

Despite participants being largely unaware of instructional or constructive alignment, the curriculum-in-use for an individual course is often more or less aligned due to the design concepts and mechanisms the participants employed seemingly instinctively. Conceptually, participants recognised the desired outcomes as a “guiding thing … the eventual goal” and that they needed to design their activities using the content to help them “achieve the goal”.

As discussed in Section 7.1.1.1 and shown in Figure 7.1 above (included in pull-out figures), the official-curriculum for a program and each of its constituent courses has a set of clearly articulated purposes, outcomes, and content. For a program to be aligned, when taken together the purpose and outcomes for the individual courses “add up” to those articulated for the program. While conceptually, participants saw the need for the desired outcomes of the courses to be aligned with the desired outcomes of the program, in practice this rarely seemed to happen once a program had been operationalised. Participants focused almost exclusively on their individual courses and ignored or were
largely unconcerned about the role their course played within the overall program. Rather than using the official-curriculum as a yardstick against which to gauge any changes they might make as they designed, developed, and implemented their courses, they relied upon their own knowledge and experience to determine what they believed was appropriate. If participants considered the need for alignment of course purpose and outcomes with program purpose and outcomes, they were likely to consider it was “not my problem … that’s somebody else’s problem”.

7.1.3.1 Summary of conclusions for research question three

Answers to the third of the research questions driving this project, indicate that the process of curriculum design and development produces a number of artefacts and that these artefacts become increasingly more specific as the process progresses. They also point to an apparent paradox. When describing their concepts of curriculum participants clearly saw the curricular process as one of design, which produced the official-curriculum, which in turn was used to guide the implementation of that artefact. However, when describing what they actually did, they tended to ignore the official-curriculum and develop for their courses their own sets of desired outcomes and associated purpose. Due to their almost instinctive use of design principles, the curriculum-in-use for their courses was constructively aligned. Additionally, the desired outcomes for their course were also aligned to the purpose of that course. Ignoring the official-curriculum and the role their course played in delivering overall program outcomes, meant that the official-curriculum for a program tended to move out of alignment over a relatively short period, giving rise to curriculum drift, which is described in detail in Sub-Section 7.2.1 below.

The final question underpinning this research sought to understand the implications of both participants’ concepts of curriculum and the practices they engage in when working with their curricula.

7.2 Implications

Answers to the final major research question highlight participant behaviour that has a number of potential consequences for the curricula of both programs and courses.

Despite participants clearly conceiving of curriculum as a “design problem”, describing the official-curriculum as a “set of requirements”, a “framework”, and a “guideline”, and using
the language of design to describe the process surrounding a curriculum’s design and development, in practice they frequently did not seem to follow completely the design process they had described. Instead, when working with their courses, they largely ignored the official-curriculum rather than using it to guide their decision-making. In reality, they did not view the official program curriculum as a set of requirements that needed to be fulfilled to ensure delivery of the desired outcomes. They did not see the whole: the program. Instead, they focused on the individual parts: the courses. Yet again, despite the existence of an official-curriculum for a course, they were likely to ignore that and rely instead on personal knowledge and experience. Consequently, they lost sight of the role individual courses played in helping to deliver the program. This behaviour has a number of potential consequences for the curricula of both programs and courses.

Within the domain of software and systems design it has long been acknowledged that if designers and developers are to create a solution that will deliver real, measurable value, then all involved must share a common understanding of the purpose and goals (Cohn, 2004; Dym et al., 2005; Pahl et al., 2007; Patton & Economy, 2014). As Banathy says, “it is PURPOSE – specific to the system – by which a system can be best identified. Ensuring performance required to attain the stated purpose becomes central in designing a system” (1967, p. 282, original emphasis). When individuals lack a common understanding of those purposes, decisions are influenced by individual interests and personal characteristics (van Dijk et al., 2009) because behaviour is influenced by hidden assumptions about what we think we know (Sinek, 2009).

Underpinning the implications noted in this section is the paradox that participants’ conceptual understanding of curriculum does not match their practice. Cumulatively, the impact of ignoring the official-curriculum causes the original, usually designed and reasonably well aligned, program curriculum to “drift” out of alignment and to lose coherence and cohesion. Over a relatively short period, the curriculum ages and loses integrity reducing the ability of the program to deliver its desired outcomes.

Curriculum drift and the implications of what participants said they actually do when designing, developing and implementing their curricula is discussed in the remaining Sections of this chapter. The phenomenon of curriculum drift is discussed in Sub-Section 7.2.1. This section provides an explanation of what is happening inside the curriculum as it drifts and the effect it has upon outcomes. The concluding sub-section, 7.2.2, uses the
notions of complex adaptive systems and modelling, discussed earlier in Sections 3.3 and 3.4 respectively, to explain the mechanisms of curriculum drift and to provide an understanding of why it happens. To facilitate understanding of why drift happens so rapidly and how curricular integrity is lost, a multi-dimensional model of curriculum is proposed.

7.2.1 Curriculum drift

Drift was considered a natural occurrence of a dynamic curriculum and so should be expected. According to participants, it “is one of the natural ways in which you both explore and also perturb the curriculum”. Unmonitored curriculum drift, however, is prone to affect the realisation of the articulated outcomes of a curriculum because the actual characteristics (of the curriculum-in-use) are likely to be outside an acceptable range of the desired characteristics (of the official-curriculum). Monitoring lets you “see where it's going and what it's doing. Are the gaps are being filled in in different ways, yeah. But when it's not being monitored then it's an issue”.

As the effects of the change in the characteristics of a curriculum are slow to manifest themselves, the impact of drift can be quite significant before it becomes apparent. For example, some considerable time after a compulsory course became an elective “everybody realised ... only 25 or 30 of our students [were] taking this course ... [and] really we think [all] engineers need this course”. The curriculum drift identified in this vignette relates to the official-curriculum of a program. The evidence of drift is only seen quite sometime later when, because of the change to the course structure, a large proportion of students could no longer demonstrate an aspect of the articulated desired outcomes for the program.

Many of the issues identified in this thesis under the unifying term “curriculum drift” are not new. In 1978 Abrahamson identified seven “diseases of the curriculum”, which I suggest bear a resemblance in many instances to the issues participants discussed. Moreover, I suggest that Abrahamson's statement that with the “growth of knowledge in certain fields, the replacement of faculty, [and] the vagaries of outside funding, it is both natural and healthy to expect reflected changes in the curriculum” (Abrahamson, 1978, p. 952) is just as applicable today as it was when it was made.
Furthermore, the freedom to investigate new ways of doing things and to adapt course curricula to changes within industry and society as well as within the institution is vital. Although there needs to be certainty in the ability of a curriculum to realise its goals, the curriculum must not constrain the freedom of academics or the institution to respond to change. As explained by one participant

**drift is one of the natural ways in which you both explore and also perturb the curriculum ... Rather than bringing it back you say let's change the description and that ... will then filter to the neighbouring course or the overall objectives ... We're keeping up to a good quality that we want kept or that, yes, that means we can put things in here which weren’t there before or drop things out or need to go elsewhere or we didn’t need anyway. So in effect it's a way of evolving the whole program.**

According to participants, when the official-curriculum for a new program is developed, it involves significant collaborative effort to ensure it reflects the “overall aims, objectives ... and philosophy”. As part of the design process, the official-curriculum for that program is decomposed into its component entities where even at the lowest level of decomposition the “individual courses should reflect the overall aims, objectives ... and philosophy” that was articulated for the program.

As shown in Figure 7.5 below, because of “smaller, minor changes” made each year to the curriculum-in-use for each course in a program as it is taught, over time those courses no longer completely reflect the overall aims and philosophy of the original design. Participants noted that often teachers teach what “they like teaching” rather than what was written in the official-curriculum causing it to “drift towards topics that people like”. As the curriculum drifts, it ages: it “loses coherence” leading to the “degradation of the integrity” of the program curriculum.

The progressive loss of coherence and integrity of a curriculum means the desired characteristics of the official-curriculum are no longer replicated in the curriculum-in-use. Curriculum drift can therefore be defined as the difference at any point in time between the desired and the actual characteristics of a curriculum. As shown in Figure 7.5, drift
begins slowly as the curriculum is implemented but gains momentum with each iteration of delivery, evaluation, and amendment.

Participants described the official-curriculum as an object designed to create an environment that provides students with the opportunity to achieve the desired outcomes. Once a curriculum is operationalised, however, due to the many “smaller, minor changes” the official-curriculum was seen as “degrading, changing, evolving, not necessarily getting bad or good … but … drifting away from that picture of everything being in balance”. A number of factors may affect the rate of drift. These factors include changing constraints and influences (as identified in Sub-Section 5.2.6.4 above), especially human resources, technological and structural change. For example, staff movements might cause the loss of a teaching capability leading to a cancelled course because, as participants noted, “if you don’t have staff who have expertise in some area you won’t be able to offer this course”.

Additionally, while drift may happen at any level within the curriculum hierarchy it is likely to be most noticeable at program level. A program is constructed from many individual courses and each course may experience drift. In a single course, drift may be minor, but when minor drift in each course is taken together as a whole the impact on the program is likely to be significant and greater than the sum of the changes in each course. Drift takes place in the time between official-curriculum design and/or redesign and its subsequent review.

The curriculum-in-use for an individual course is likely to be reviewed more frequently than the program curriculum, possibly as often as each time the course is delivered. This review is usually internal and is usually conducted without reference to the program curriculum. On the other hand, the program as a whole is often only reviewed in response
to accreditation visits or some other external event, perhaps every five or so years. This time lag between reviews means that the curriculum-in-use for individual courses has significant potential to have drifted a fair distance from the purpose of the official-curriculum before anyone notices. Also, reviewing the official-curriculum only in response to an external event is likely to increase the number of courses that have drifted away from their official-curriculum and therefore increase the effort required when attempting to ensure that “everything ... [is] in balance” once more.

To explain why this is I shall use Figures 3.3 – 3.5 showing images of the Mona Lisa which were used in Sub-Section 3.2.1 to explain holism versus reductionism. Figure 3.5, repeated here for convenience as Figure 7.6, shows a reductionist view of the Mona Lisa. In this image, it is not possible to understand how the round containers of slightly different colours, perhaps mugs of coffee with different proportions of milk and coffee, work together to produce the image of the Mona Lisa.

Imagine that Figure 7.6 represents a reductionist view of the official-curriculum for a program and the different coloured containers represent the courses from which the program is constructed. Figure 7.7 includes five minor changes as marked. Since we have a reductionist view – concerned about individual courses only, rather than the program as a whole – those changes are difficult to discern, because we cannot see the impact they have upon the ability of the containers to represent an image of the Mona Lisa.

Just as is shown in Figure 7.7, if reviews are carried out of individual courses without reference to the overall program, it is difficult to understand the impact that those changes may have on the outcomes of the program. Over a period of time, even more changes would be made to individual courses.
The dots of random colour in Figure 7.8 show where individual containers have had their colour changed. As was shown in Figure 7.7, when taking a reductionist view it is difficult to understand the impact of the change. If, however, we take a systems or holistic view, as shown in Figure 7.8, which is what usually happens with a program review, we are more readily able to see the impact of apparently minor changes. The longer the period between a holistic review of the program, or at least reviewing an individual course in light of the official-curriculum for that course, then the more changes that will happen before it becomes apparent that the ability of the program to deliver its desired outcomes has been diminished.

Figure 7.9 provides a graphical representation of curriculum drift in action. Over time, as the curriculum drifts the variation between its originally desired qualities and its actual qualities grows. After some time, usually in response to an impending accreditation visit, the official-curriculum for a program is subject to review and attempts are made to bring it back into balance. According to participants, following the review it is hoped that once again "all the courses ... [and] their learning outcomes ... as a whole ... represent a program" with "the individual courses ... paying attention to this [the underlying philosophy] in some sense or another". Despite curriculum reviews, however, the overall desired characteristics of a quality curriculum such as strong alignment, cohesion, and coherence continue to change causing the curriculum to lose integrity and so to age.
As discussed in Sub-Section 2.2.2 above, a quality curriculum is likely to exhibit three key characteristics: strong alignment (Biggs, 1996; S. A. Cohen, 1987; Toohey, 1999; Tyler, 1949), coherence (Schmidt et al., 2002) and cohesion (Allen, 2004). Together these characteristics give the curriculum integrity. A curriculum that lacks integrity cannot provide the environment in which students can be assured of developing the desired program outcomes (Zingg, 1987).

Systems thinking suggests unless the curriculum is considered as a whole we are unlikely to design, develop, and maintain curricular integrity. However, when reviewing a curriculum, or even writing about the theory that underpins curriculum design and development, a reductionist approach is usually taken where each aspect is considered and dealt with as if it exists in isolation from the others. Using systems thinking to help monitor curriculum change should enable it to maintain its integrity yet be sufficiently flexible and adaptable that it can stay up to date with changes in its environment.

One of the defining features of complex adaptive systems is relatively small changes to one aspect can produce large and unpredicted effects, while large changes to an aspect may have slight effects. Given the relationships between each of the three desirable characteristics of a quality curriculum – coherence, cohesion and alignment – when one is changed it affects and brings about change, often unexpected and sometimes quite significant, in the other characteristics of the curricular system.

Understanding curriculum as a complex system and identifying the relationships between these three characteristics facilitates the conception of the curriculum as a
multidimensional object rather than one with a single dimension, or even multiple, single dimensions.

7.2.2 A multi-dimensional model of curriculum

Using the concept of curriculum as multidimensional allows the creation of a model that can be used to understand and explain the rapid movement out of balance or alignment of a curriculum. The model also assists in understanding why a curriculum loses integrity as it drifts and ages as it drifts.

The following sections present a multi-dimensional model of curriculum that is then used to explain curriculum drift.

7.2.2.1 The mechanisms of curriculum drift

As identified in the preceding sections of this chapter, drift occurs principally because academics are likely to:

- rely on their own experience instead of using the official-curriculum as a guide when operationalising their curriculum or evaluating and amending an already operationalised one;
- focus on their individual course and so lose sight of the role that course plays in helping deliver the outcomes of the program; and
- work alone rather than collaboratively and so make changes to their individual course without discussing them with others.
The large cube represents the program. Each of the smaller cubes represents an individual course from which that program is comprised.
A visual representation of what happens to a curriculum for a program as it drifts is modelled in Figure 7.10 above (included in pull-out figures). The three visible faces of the cube can be considered to represent the desired attributes of coherence, cohesion, and alignment. The large cube represents the “designed object”: the official-curriculum for a program. Each of the smaller cubes represents the official-curriculum for a single course from which the program is constructed.

The first image shows all the squares on a single face with the same colour and each row perfectly aligned. This image represents a curriculum with integrity: it is aligned, cohesive, and coherent. After only a short period, perhaps within a single semester, it begins to change. Initially the change may be minimal, as indicated in the second image. At this stage, the original purpose is still relatively clear and change is minor. The movement out of alignment of the first row of coloured cubes is indicative of some of the cohesion weakening. This might be, for example, where the outcomes and perhaps the content of one course changes such that the assumed knowledge and skills for a subsequent course are no longer delivered in full. Alternatively, it might be where material already covered is included in a later course because the academic responsible for that course is unaware that it has already been covered elsewhere in the program.

As time passes and curriculum drift continues unchecked, represented by the third image and indicated by the patchwork colour of the cube faces, the facets are no longer cohesive and there is a lack of coherence in the courses and in the overall program. Furthermore, the program curriculum is beginning to move away from its original shape – to lose integrity – now not quite so obviously a “designed object” instead beginning to appear to be a number of random cubes – note the new colours representing the introduction of new material – which someone has placed together.

By the final image, the shape – the purpose and integrity – of the original program curriculum is completely lost. No longer can one tell that its origins were a cube, nor that originally each face was red, yellow, or blue. By the time it reaches this state, I hypothesise that a curriculum is unlikely to deliver all, and may even deliver none of its purpose and outcomes. Over a period, perhaps as short as five years, I suggest this may happen to our curricula with a consequent impact on the quality of the intended student outcomes it can deliver.
The large cube represents the course. Each of the smaller cubes represents an individual module or lesson from which that course is comprised.
Curriculum drift occurs within a curriculum at any level within the hierarchy. Thus the model applied to a course would look no different. Instead of the official-curriculum being a container of courses, the official-curriculum would be a container of the different modules or lessons within a single course. This model is shown in Figure 7.11 above (included in pull-out figures).

A causal loop diagram (CLD) (Kim, 1995) is one way to explain what is happening inside the curriculum as it drifts and, as shown in Figure 7.9 above (included in pull-out figures), provides an explanation of why drift continues despite reviews. As noted in Sub-Section 3.4.1.2 above, CLDs are used to help understand the dynamic and interconnected nature of a system.

**An explanation of drift – what usually happens**

Using the concepts of CLDs, Figure 7.12 below (included in pull-out figures) models participants’ descriptions of what they actually do. To make my explanations and the model more readable, I have modified the standard notation for a CLD. Normally each arrow would be labelled with a sign indicating how one variable affects another. Instead, I have annotated the flow to indicate the causal connections between the variables. For even greater simplicity, the diagram refers to the ‘desired characteristics’ of the official-curriculum or the ‘actual characteristics’ of the curriculum-in-use rather than trying to identify each of the characteristics of the curriculum and the relationships between each. As well as labelling the flows, I have also coloured them to assist with identification. In this diagram, curriculum characteristics include the concepts of curriculum purpose and outcomes as well as those of integrity, alignment, coherence, and cohesion.

Using Figure 7.12 below (included in the pull-out figures) I shall now explain what might be happening to cause curriculum drift. As discussed in Sub-Section 6.2.2 above, decision making related to operationalisation of the curriculum is heavily reliant upon academics’ own experience and other outside influences rather than the official-curriculum. Notwithstanding they are often “given stuff” and “don’t know the strategy”, instead of referring to the official-curriculum for the course participants relied heavily on experience, textbooks and model curricula when making decisions about appropriate intended learning outcomes and content to be covered in their course. Only a few participants suggested that when operationalising the official-curriculum for a course that they would “also review the ... [official course curriculum to see] what is expected in terms of learning outcomes”.

Conclusions and Implications
Representing this behaviour, the model shows three causal relationships for the curriculum-in-use: one from the official-curriculum (A – blue), one from the individual’s experience (B – pink) and the third (C – green) from individual course review. Given participants indicated that they sometimes make changes to their course without reflecting those changes back to the official-curriculum, not all of the desired characteristics of the official-curriculum are reflected in the curriculum-in-use. These three flows of characteristics give rise to the actual characteristics displayed by the curriculum-in-use.

Drift is defined as the difference, at any point in time, between the desired characteristics of the official-curriculum and the actual characteristics of the curriculum-in-use. When an individual academic reviews and evaluates their course delivery, they usually review it against the characteristics of the curriculum-in-use rather than those of the official-curriculum. Loop C is a reinforcing loop (see Section 3.3 above for an explanation of feedback loops) because each pass around the loop is likely to increase the difference between the desired and the actual characteristics, as there is limited, if any, reference to the official-curriculum. Participants indicated that when they were reviewing their courses often they were “thinking that this thing didn’t work last year” or making changes...
after “hearing different ideas from other people, teaching ideas and thinking how could I incorporate that into my course”. At times, it "was just me getting bored of the way it was taught and wanting to do something that would give me more interest".

Program reviews, on the other hand, were generally triggered by an external event (D – purple in Figure 7.12 above, included in pull-out figures) such as an impending accreditation visit, rather than something from within the curricular system itself. These reviews are based on the characteristics of the official-curriculum. It is at this point that drift is likely to be discovered. When drift is discovered attempts are generally made to compare the characteristics of the official-curriculum with those of the curriculum-in-use (E – brown in Figure 7.12 above), to evaluate the difference and to return the curriculum to balance. However, as the review is of the official-curriculum rather than the curriculum-in-use it is unlikely that the characteristics of each with align closely.

Two factors affect this outcome. The earlier that drift is discovered, the less distance the curriculum-in-use will have drifted away from the official-curriculum, and so the less effort will be needed to re-align the two curricula. The second factor affecting how far a curriculum drifts is reviewing the official-curriculum without also ensuring that the curriculum-in-use is also reviewed and the two carefully brought back into alignment. This is explained in more detail on the next page.

Figure 7.13 below shows how reinforcing loop (E – brown in Figure 7.12 above, included in the pull-out figures) causes the actual characteristics of the curriculum to continue to drift away from the desired characteristics, despite reviews. As explained by one participant, drift continues despite review because academics "do their course; they put a lot of effort into it and they do it the way they want to do it. They don't want to put any extra effort and I think they resent any interferences as well". This explanation was supported by another's comment that it was not clear "how much [the process of] quality control works".
Modelling system behaviour using CLDs, helps identify the points within a system where a change may alleviate the identified problem within that system (Vermaak, 2007).

**Intervention – what needs to happen**

The CLD shown at Figure 7.12 above (included in pull-out figures) indicates that curriculum drift occurs because review of individual courses is frequently carried out using the curriculum-in-use without reference to the official-curriculum for that course. Not only is the review of the curriculum-in-use for a course, but that review is conducted in isolation from the official-curriculum for the program of which the course is part. This suggests that if we wish to moderate the magnitude of curriculum drift, then we need to intervene and change this feedback loop to a balancing loop instead of a reinforcing loop.

It may be possible to temper curriculum drift by reviewing the curriculum-in-use alongside the official-curriculum as shown in Figure 7.14 below (included in pull-out figures) by changing causal relationship C (green). As in Figure 7.12 above (included in pull-out figures), Figure 7.14 shows three causal relationships for the curriculum-in-use: one from the official-curriculum (A – blue), one from the individual’s experience (B – pink) and the third (C – green) from individual course review. The difference between the two diagrams is that now the internal review considers the desired characteristics of the official-curriculum as well as the actual characteristics of the curriculum-in-use. By considering the actual characteristics of the curriculum-in-use and the desired characteristics of the official-curriculum when carrying out an internal, individual course review, the causal relationship between the official-curriculum and the curriculum-in-use (A – blue) now enables all of the desired characteristics of the official-curriculum to be reflected in the curriculum-in-use.
Drift will still happen, but as the feedback loop is now a balancing rather than a reinforcing loop, its magnitude will be moderated and is likely to remain within appropriate tolerance levels (for more information on tolerance see Sub-Section 3.3.1 above). What appropriate tolerance levels might be with respect to curriculum drift is something for further research (see 8.2.2 below).

Figure 7.15 shows how balancing loop behaviour moderates the magnitude of curriculum drift, so keeping it within acceptable tolerance levels.

Figure 7.14 – Intervention – What needs to happen
(See Pull-Out Figure 7.14)
In the following, final chapter of this thesis I discuss the limitations of this research project and suggest further research that may provide greater understanding of the nature of curriculum drift and how we might use this knowledge to develop truly flexible curricula that exhibit the hallmarks of quality curricula.
Chapter 8  LIMITATIONS AND FURTHER RESEARCH

The engineer, and more generally the designer, is concerned with how things ought to be - how they ought to be in order to attain goals, and to function.

(Simon, 1996, pp. 4-5)

The final chapter of this thesis addresses the limitations of the research presented and proposes three areas for future research that might develop further some of the ideas already presented. The first section of this chapter considers the limitations of the research in the light of its credibility, trustworthiness, and generalisability of the findings, as well as the failure to investigate in depth the existence of potential relationships between the layers of curriculum and the levels of the curricular hierarchy. The second and final section of this chapter proposes possible future research projects that extend and further develop the research presented in this thesis.

8.1 Limitations of this research

The limitations of the research method, especially those related to grounded theory, have been discussed in detail in Section 4.2 above. A summary of limitations relating to the credibility and trustworthiness of the research is discussed in Sub-Section 8.1.1, limitations relating to generalisability are discussed in Sub-section 8.1.2, while Sub-Section 8.1.3 discusses the limitations that relate to the failure to investigate in depth the existence, nature and importance of the relationships that exist within the proposed layers of curriculum and curricular hierarchy.
8.1.1 Credibility and trustworthiness

In qualitative research, credibility can be seen as an expression of the plausibility and credibility of the claims made, while trustworthiness is the dependability of the data and is often expressed as the confidence one has in the data collection (Long & Johnson, 2000). In the research reported in this thesis, the two primary concerns with regard to the credibility and trustworthiness of both the data and the findings, relate to the research methods and sample.

8.1.1.1 Research methodology and methods used

This section provides a summary of the limitations related to Grounded Theory approaches discussed in detail in Chapter 4. It also considers the impact the research method itself may have had upon the credibility of the data collected.

As discussed in Chapter 4 above, it was decided to change the method of data collection from one-to-one structured interviews to small focus group interviews. As part of this change to the research design, participants were asked to model their conceptions of curriculum using a whiteboard, coloured markers, and a set of pre-prepared tags. Data for the tags were drawn from an analysis of the earlier one-to-one structured interviews.

**Data collection methods**

During the one-to-one interviews, it was noted that participants were not used to thinking about curriculum in the way I was asking them to do. To overcome the difficulties participants in the one-to-one interviews seemed to have thinking about curriculum as an abstract concept, I decided to ask focus group participants to create a visual model of their concepts of curriculum rather than just using words. To facilitate their initial thoughts, I provided a set of pre-prepared tags.

It is not clear what impact these pre-prepared tags had upon participants’ models. While participants were encouraged to create new tags using their own terms, they mostly used the pre-prepared tags. What is not obvious is how much participants "were driven by using all the [provided] tags" instead of using them because they accurately represented participants’ own concepts. Neither is it clear whether the language used by participants and the shape of their models was constrained and influenced by the pre-prepared tags. It is possible participants might have come up with a different set of terms had no tags been
provided. In addition, the provided terms may have had an impact upon the shape of the models participants created.

Using small focus groups to collect data may also have influenced the credibility and trustworthiness of the data and consequent findings. It is not clear what impact focus group members’ views had upon others’ views. While frequently the interaction between focus group participants is seen as beneficial because it allows participants to explore their ideas with each other (Kitzinger, 1995), it is possible where one or more of the participants had strong views, that those views may have influenced the views expressed by other members. Although I was careful to facilitate discussion and to encourage quieter members of each group to participate, there was no way that I could prevent one group member’s views influencing the view of another. Where this was obvious in the transcripts, I have acknowledged this influence and it was discussed in Chapter 6 as appropriate.

Like all research methodologies, grounded theory has both benefits and limitations. The following issues are identified in the literature and researchers are warned they need to be aware of them when designing and carrying out grounded theory research.

**Grounded theory research methodology**

According to Corbin and Strauss (1990) unless the “components of the research process are clearly laid out” it is difficult to judge the plausibility of the research findings and to “judge under what conditions the theory might fit with ‘reality’, give understanding and be useful” (p. 426). Accordingly, I have taken care to set out clearly in Chapter 4 the design used with this project. Furthermore, in both Chapters 5 and 6 I have taken care to be explicit about the relationship between the data, and my thoughts and interpretations.

Another limitation of qualitative research, where data is collected via one-to-one or focus group interviews, is the quality of the transcripts. The importance of quality, verbatim transcripts is generally acknowledged (Poland, 1995). However, transcripts do not necessarily capture the non-verbal communication, such as tone of voice, laughter, silences or conversely excitement, stance, and the interactions between participants in focus groups, all of which may affect the credibility and trustworthiness of the findings reported (Huberman & Miles, 2002; MacLean, Meyer, & Estable, 2004; Poland, 1995).
To counter this potential limitation on the trustworthiness and credibility of the research reported here, when transcribing interviews, I attempted to note all aspects, not just the words used by participants. For example, I attempted to record faithfully all the ums, ahs, pauses, laughter, and broken sentences within the transcripts. Transcripts were verified multiple times in an effort to ensure they accurately recorded what was actually said, rather than what I thought was said, or my attempt to turn the words said into grammatically correct language. Focus groups, but not one-to-one interviews, were video-recorded as well as audio-recorded. Video records were used both as a method of transcript verification and as a validation of the intent of what was being said, and to confirm what participants were referring to when they were using their models to help them describe something. Nonetheless, transcripts themselves, no matter how accurate, are read many times and each time they are open to reinterpretation (Denzin, 1995; Poland, 1995).

Additionally, as noted by Charmaz (2014), grounded theory “offers an interpretive portrayal of the studied world, not an exact picture of it ... Research participants’ implicit meanings, experiential views—and researchers’ finished grounded theories—are constructions of reality” (p. 17, original emphasis). As the interpretation of participants’ meaning in qualitative data is largely based on the researcher, there is significant potential for researcher bias based on the researcher’s individual worldview. Not only is there potential for researcher bias, however, there is also potential for participant bias as the results rely upon the opinions of the participants. At times participants may report what they believe the researcher wants to hear, or perhaps they do not want to show their ignorance and instead want to show what they believe is good practice. Above all, participants report their perceptions of what happens (Coleman & O’Connor, 2008).

In recognition of these potential limitations of grounded theory with regard to credibility and trustworthiness of the findings, where it was not automatically provided, I asked participants to provide examples in connection with their assertions. Throughout the discussion of the findings, I triangulated them with the literature. Additionally, I sought confirmation of the transcripts from participants.

Another recognised limitation of findings from qualitative research and grounded theory in particular, is the ability to generalise the findings. It should be noted, however, “the focus of qualitative research is to form unique impressions and understanding of events
rather than to generalize findings” (Kolb, 2012, p. 85). To enhance the generalisability of the findings various approaches, especially those related to participant selection, were used. Nonetheless, this study does have some significant limitations with regard to the generalisation of findings, which are discussed in the following paragraphs.

8.1.2 Ability to generalise the results

Although sampling was “purposeful” (Huberman & Miles, 2002), in that participants were selected for their ability to help understand the phenomena being investigated rather than to achieve a statistical representativeness, as indicated in Appendix E participants coincidentally provided a reasonable coverage of attributes such as gender, experience, background and professional domain. As well as selecting participants for purposeful reasons, the target group of participants was selected from three local universities for their convenience. It was considered that notwithstanding potential bias, academics drawn from these three universities were sufficiently representative of the broader academic body involved with the teaching of engineering, software engineering, information systems and computer science in higher education in Australia.

Participants all self-selected after receiving an email inviting them to participate. Self-selection may have led to some participant bias as all were interested in teaching and curriculum development in particular. Furthermore, self-selection may have caused the language used and the concepts described not to be truly representative of the academic population participants were representing.

Another limitation related to sampling is the data were collected from Australian universities only. Moreover, participants were only selected from sections of those universities offering accredited degree programs in engineering, software engineering, information systems and computer science. Participants were all teaching within these programs as well as in many cases conducting research in their specific field of interest. The small number of participants also limits the credibility and generalisability of the findings.
8.1.3 Existence, nature and importance of relationships in the proposed curricular layers and hierarchy

When discussing their concepts of curriculum, participants suggested that the curricula for a program and its constituent courses existed in a hierarchy and that the operationalisation of the official-curriculum resulted in the creation of a number of variants of that curriculum which I termed layers of curriculum. The existence of relationships, including their nature and importance, between and across the levels in the curricular hierarchy and between the layers of curriculum were not investigated.

This research project provides a number of opportunities for further research. In the final section of this chapter, I describe several potential opportunities to explore further the findings themselves and to look at new areas of research suggested by those findings.

8.2 Further research

Three different, though related, opportunities for further research are considered. Sub-Section 8.2.1 addresses one of the major limitations this research and proposes similar research across all disciplines within the higher education system to uncover possible disciplinary differences between academics’ concepts of curriculum and their use of curriculum. Sub-Section 8.2.2 considers opportunities for continuing the investigation of curriculum drift to understand how it might be used to improve our understanding of the curricular system. The final sub-section of this chapter, 8.2.3, reflects on the multidimensional aspect of curriculum suggested by this thesis and proposes further research to understand better this aspect of curriculum so that we may derive greater value from our curricula.

8.2.1 Disciplinary differences

One of the limitations of the research presented in this thesis is that it is restricted to the higher education domains of engineering, software engineering, information systems and computer science, and that it pertained to higher-tier Australian university, accredited curricula only. A further limitation is that it did not investigate in depth the existence, nature and importance of the relationships between the levels of the proposed curricular hierarchy and layers.
To improve the trustworthiness, credibility, and transferability of the findings of this research, the research should be extended to other Australian and international universities. This may help understand whether what has been noted is an Australian phenomenon, whether it relates only to higher tier universities, or whether it has wider applicability across the higher education sector generally.

The research should also be extended to other disciplines to understand academics’ concepts and use of the official-curriculum in those disciplines. Stark and Lattuca (2009; 1993) have noted disciplinary differences in both the intent and meaning of curriculum. Others (Postareff et al., 2007; Trigwell, Caballero Rodriguez, & Han, 2012; Trigwell, Prosser, & Waterhouse, 1999) have noted disciplinary difference with regard to approaches to teaching. An important aspect of understanding academics’ concepts of curriculum would be to investigate the existence of relationships inside a curriculum, including the nature and importance of those relationships. Extending the research to disciplines whose bodies of knowledge are not so structured and whose curricula are not professionally accredited may help understand the impact accreditation has upon curriculum design, development, and implementation.

8.2.2 Curriculum Drift

Further research on curriculum drift should look at developing and validating a drift categorisation framework that may facilitate possible interventions or responses to different categories of drift. This research would need to confirm:

- the existence, nature and importance of the relationships inside a curricular hierarchy, including the nature and importance of the relationships between the layers of curriculum;
- what is happening to the relationships inside a curriculum as it drifts potentially allowing meaningful measurement and indexation of drift, for example, is it positive or negative and what is its magnitude;
- what might be appropriate tolerance levels before it is necessary to intervene; and
- whether there are different characters and types of drift.
8.2.3 A multi-dimensional view of curriculum

The research presented in this thesis suggests that for a curriculum to be effective and to deliver quality educational outcomes, curriculum designers must not only be aware of, but must also understand the relationships between and the barriers to curriculum design and implementation. Further research leading to the development and verification of a definitional framework with an associated tool and visualisations may lead to improved educational outcomes and organisations deriving greater value from their curricula. Importantly, this future research would need to confirm the existence of the relationships that I have suggested exist between the various elements and layers of curriculum and to understand their nature and importance.

Lattuca and Stark (2009, p. 3) suggest there is a need to develop a “definitional framework” to provide a “working definition of curriculum to guide discussion” about curriculum. A visual implementation of such a definitional framework might provide even greater value. Not only would such a definitional framework provide a common understanding of curriculum, but because of the brain’s ability to “acquire more information through vision than through all of the other senses combined” (Ware, 2012, p. 2), a visual model is likely to improve overall usability of and valued derived from our curricula. I suggest a visual model will allow those working with curriculum to identify and understand the relationships between the various elements and so help understand where and what needs to be changed. Different visualisation tools could be used depending on the purpose of the visualisation (Shneiderman, 1996; Zoss, 2015).

Possible visualisations include a spider/radar chart, as in Figure 8.1, to show how learning outcomes are developed across year levels or strings of courses; a node-link diagram as in Figure 8.2, to show relationships between learning outcomes; while a heat-map, as in Figure 8.3 below, might be used to show where and how teaching and learning activities in courses are related to course outcomes and how those course outcomes help deliver program learning outcomes.
This study has suggested a number of further broad avenues of enquiry. As discussed, some are linked to confirming the findings of this research across all higher education discipline curricula and institutions. A second avenue looks to understand the notion of curriculum drift so that this knowledge may be used to help in the development of truly flexible curricula that deliver high quality outcomes, engage students and academics, and still meet the requirements of professional accreditation. The final broad avenue of research suggested considers the curriculum as a complex adaptive system. It takes up
Lattuca and Stark's (2009) call to develop a definitional and design framework that is
general enough to cross the variety of institutions, programs of study, courses, students,
and societies that comprise our greater educational system, and which facilitates
productive discussion and decision making leading to adaptable and adaptive curricula.
Part IV. REFERENCES & APPENDICES
REFERENCES


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APPENDICES
Appendix A. ETHICS APPROVAL

THIS IS A SYSTEM-GENERATED E-MAIL. PLEASE DO NOT REPLY. SEE BELOW FOR E-MAIL CONTACT DETAILS.

Dear Dr Lynette Johns-Boast,

Protocol: 2010/438
Exploring the curriculum development process

I am pleased to advise you that your Human Ethics protocol received approval by the Chair of the HREC on 26 October 2010.

For your information:

1. Under the NHMRC/AVCC National Statement on Ethical Conduct in Human Research we are required to follow up research that we have approved. Once a year (or sooner for short projects) we shall request a brief report on any ethical issues which may have arisen during your research or whether it proceeded according to the plan outlined in the above protocol.

2. Please notify the committee of any changes to your protocol in the course of your research, and when you complete or cease working on the project.

3. Please notify the Committee immediately if any unforeseen events occur that might affect continued ethical acceptability of the research work.

4. The validity of the current approval is five years' maximum from the date shown approved. For longer projects you are required to seek renewed approval from the Committee.

All the best with your research,

Kim

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Appendix B. INFORMED CONSENT

The Australian National University Human Research Ethics Committee
RESEARCH PROJECT: CONSENT FORM
For the project:
Exploring the curriculum development process

Researcher: Ms Lynette Johns-Boast

1. I ____________________________________________________________ (please print) consent to take part in the Research Project, entitled: Exploring the curriculum development process.

2. I have received an email explaining this research project.

3. I have had the nature and purpose of the research project, so far as it affects me, fully explained to my satisfaction by the research worker. My consent is freely given.

4. I understand that I will be asked to participate in a focus group interview. This will involve questions about my understanding of curriculum and the process I follow when developing curriculum.

5. I understand that the focus group interview will be video and audio recorded and that I may access and amend the transcript of the recorded interview.

6. I have been informed that while information gained during the study may be published, I will not be identified and my personal comments will not be divulged.

7. I understand that I am free to withdraw from the project at any time.

8. I understand that I should retain a copy of the email explaining the research project and a copy of this Consent form.

Signed: .................................................. Date ....../....../......

Researcher to Complete as witness

I __________________________________________ certify that I have explained the nature and procedures of the research project Exploring the curriculum development process to

............................................................. and consider that she/he understood the explanation.

Signed: .................................................. Date ....../....../......
Appendix C. INFORMATION STATEMENT – PHASE 1

Information Statement

Exploring the curriculum development process

Purpose
I am undertaking a PhD at ANU exploring curriculum development and how we might make this process less demanding while ensuring that our curricula still meet the needs of our accrediting bodies and the university. The focus is on curricula associated with professional degree programs.

It is hoped that my research will lead to new and improved curriculum development processes which will be flexible, adaptable and produce quality curricula. These processes will also provide the means to maintain curriculum coherence over time in spite of conflicting influences and pressures.

To this end I am interviewing colleagues, with the agreement of the Dean, to understand how you currently engage in curriculum development.

Interview details, ethics and confidentiality.

The interview will be recorded. Interview questions will be flexible and you will direct the flow of the conversation with the focus on your understanding of curriculum and what you do when you develop course and program curricula.

You will be provided with a summary of the interview, constructed from the recording and notes taken during interview, to check that the information from your interview is accurate. When you are satisfied with your interview, the information from all the interviews will be used to produce case-study material for use within my PhD research. This case-study material may also be written into an article or articles for publication in an education journal or conference.

All data collected during my research will be anonymised. You will not be identified in any published data. Where necessary, individuals will only be identified by their position within the College, eg “a Level B academic” or “a professional member of staff”. However, given the small sample size it may not be possible to completely de-identify all sources of data.

Your participation is voluntary and you may withdraw from this research project at any time. Should you withdraw, all data relating to your interview will be removed from the research, and the material deleted from the electronic and physical records.

If you have any concerns or complaints about how the research is conducted please contact the ANU Human Research Ethics Committee’s Secretary by phone (02) 6125 3427 or by email to human.ethics.officer@anu.edu.au

Protocol Number 2016/432
Ethics approval for this project has been received from the ANU Human Ethics Committee. You will be asked to sign a Consent Form before the interview.

Lynette Johns
PhD Candidate
College of Arts & Social Sciences, ANU
Phone: 61254526
Mobile: 0405 611659
Email: lynette.johns-boast@anu.edu.au

Dr Margaret Kiley
Chair
Centre for Higher Education, Teaching & Learning
ANU College of Arts and Social Sciences
Phone: 6125 2690
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Dr Gerry Corrigan
Principal Supervisor
Medical School
ANU College of Medicine, Biology & Environment
Phone: 6125 5022
Email: gerry.corrigan@anu.edu.au

If you have any concerns or complaints about how the research is conducted please contact the ANU Human Research Ethics Committee’s Secretary by phone (02) 6125 3427 or by email to: human.ethics.oficer@anu.edu.au
Protocol Number 2010/438
Appendix D. INFORMATION STATEMENT – PHASE 2

Information Statement

Exploring the curriculum development process

Purpose
I am undertaking a PhD at the Centre for Higher Education, Teaching and Learning (CHELT), ANU, exploring curriculum development associated with engineering, computer science and information systems degree programs. Specifically I am interested in how an individual’s understanding of ‘curriculum’ shapes both the process of design and development with which they engage and the output of that process – often called the intended or written curriculum.

To this end I am running focus group interviews, with the agreement of Professor McDonald, Acting Dean, to discuss how participants currently engage in curriculum design and development.

Focus group details, ethics and confidentiality.
Focus group sessions will last one and a half to two hours. The questions will focus on participants’ understanding of curriculum and what participants do when developing course and program curricula. There are no incorrect answers to any of the questions and everyone’s opinion is valuable and shall be respected. A certain amount of time will be allowed for each question and I will try to keep participants focused upon the topic without interrupting the general flow of the discussion too much. Participation is voluntary. You do not have to answer any question you don’t wish to. You may leave at any time. Focus group sessions will be recorded: both video and audio.

Depending upon the time of day that the focus group session is held, participants will be offered either a light lunch or wine and cheese.

Participants will be provided with a summary of the focus group interview, constructed from the recordings and notes taken during interview, to check that the information from their focus group session is accurate. When participants are satisfied with the record of their focus group interview, the information from all the sessions will be collated and analysed within my PhD research. The material may also be written into an article or articles for publication in an education journal or conference.

All data collected during my research will be anonymised. I will not identify you or your institution in any published data. Where necessary, individuals will only be identified by their position, e.g. "a Level B academic" or "a professional member of staff". However, given the small sample size it may not be possible to completely de-identify all sources of data.

Participation is entirely voluntary and participants may withdraw from this research project at any time. Should a participant withdraw, all data relating to their participation in the focus group interview shall be removed from the research, and the material deleted from the physical records.

If you have any concerns or complaints about how the research is conducted please contact the ANU Human Research Ethics Committee’s Secretary by phone (02) 6125 3427 or by email to human.ethics.office@anu.edu.au
Protocol Number 2016/438
Ethics approval for this project has been received from the ANU Human Ethics Committee (Protocol Number 2010/438). If you have any concerns or complaints about how the research is conducted please contact the ANU Human Research Ethics Committee’s Secretary by phone (02) 6125 3427 or by email to: human.ethics.officer@anu.edu.au

Participants will be asked to sign a Consent Form before the interview.

Lynette Johns
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Dr Margaret Kiley
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Email: margaret.kiley@anu.edu.au

Dr Gerry Corrigan
Principal Supervisor
Medical School
ANU College of Medicine, Biology & Environment
Phone: 6125 5022
Email: gerry.corrigan@anu.edu.au

If you have any concerns or complaints about how the research is conducted please contact the ANU Human Research Ethics Committee’s Secretary by phone (02) 6125 3427 or by email to: human.ethics.officer@anu.edu.au
Protocol Number 2010/438
Appendix E. DEMOGRAPHIC AND PERSONAL DATA PRO-FORMA QUESTIONNAIRE

Exploring the curriculum development process

Introduction

I am carrying out research into the process that surrounds the development of university level curricula for use with engineering, computer science and information systems degree programs.

Data collected during my research will be anonymised. Where necessary, individuals will only be identified by their position, e.g. a Level B academic or a professional member of staff.

The purpose of this focus group interview is to have a discussion about your experience of and your approach to the process of curriculum development. Questions are flexible and participants will direct the flow of the conversation. In conjunction with this, I would be grateful if you would be willing to provide the following information:

1. Name: ____________________________

2. Institution: ____________________________

3. Faculty / School / Group: ____________________________

4. What type of appointment do you hold?
   - Permanent
   - Full-time
   - Part-Time
   - Sessional
   - Other: ____________________________

5. What level is your appointment? For example, Level B ____________________________

6. What is your discipline / field? ____________________________

7. How long have you been involved in curriculum development at higher education level? ________ Years

8. Have you been involved in curriculum development at any other level? For example, vocational or secondary school?
   - No
   - Yes
   - For how many years? ________ Years
   - At what level? ____________________________

9. Do you hold any formal educational qualification? For example, Graduate Certificate in Higher Education or a Diploma of Education?
   - No
   - Yes
   - What is it? ____________________________

If you have any concerns or complaints about how the research is conducted please contact the ANU Human Research Ethics Committee's Secretary by phone (02) 6125 3427 or by email to:

human.ethics.office@anu.edu.au

Protocol Number 2016/439

Lynette Johns-Boast, Principal Ref 2016/438
## Appendix F. DEMOGRAPHIC & PERSONAL ATTRIBUTES OF STUDY PARTICIPANTS

Table 9.1 – Demographic & personal attributes of study participants

<table>
<thead>
<tr>
<th>Demographic Attribute</th>
<th>Number/Years</th>
<th>Qualifier / Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>8</td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Male</td>
</tr>
<tr>
<td>Professional domain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>4</td>
<td>Engineering</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Software Engineering</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Computer Science</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Information Systems</td>
</tr>
<tr>
<td>Appointment Type</td>
<td>17</td>
<td>Permanent full-time</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2-year contract, part-time</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Adjunct</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Contingent continuing full-time</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Permanent contingent, part-time</td>
</tr>
<tr>
<td>Appointment Level</td>
<td>4</td>
<td>Academic Level B</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Academic Level C</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Academic Level D</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Academic Level E</td>
</tr>
<tr>
<td>University type / tier</td>
<td>19</td>
<td>Research-intensive (Group of 8)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Local, 2nd Tier</td>
</tr>
<tr>
<td>Specific Educational Qualification (in addition to specific discipline qualification)</td>
<td>14</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Graduate Diploma in Secondary Education</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Graduate Diploma in Higher Education</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Bachelor of Arts (Adult Education)</td>
</tr>
<tr>
<td>Years involved in curriculum development in higher education</td>
<td>0.5</td>
<td>Lowest</td>
</tr>
<tr>
<td></td>
<td>30+</td>
<td>Highest</td>
</tr>
<tr>
<td></td>
<td>10.5</td>
<td>Median</td>
</tr>
<tr>
<td>Years involved in curriculum at other levels</td>
<td>0</td>
<td>Lowest – 15 participants</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>Highest</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Median</td>
</tr>
</tbody>
</table>
Appendix G. Phase One – Interview Protocol

Interview protocol
TURN ON PEN – is it recording?

Introduction and aim of study

Thank you for agreeing to be interviewed. I really do appreciate your time.

The aim of this study is to understand better the curriculum development process as it relates to the design and development of curricula associated with professional degrees.

I am carrying out research into the process that surrounds the development of engineering curricula at university level.

The data collected during my research will be anonymised. Where necessary, individuals will only be identified by their position within the College, eg “a Level B academic within the College of Engineering and Computer Science” or “a professional member of staff within the College of Engineering and Computer Science”.

The purpose of this interview is to get you to talk about your experience of the process of curriculum development within you school and the college more generally. The interview will be pretty “unstructured” although I may guide you in certain directions if your answers are not giving me all of the information that I feel I need.

Understanding of curriculum

1. What does the term (word?) “Curriculum” mean to you?

Process of curriculum design and development (individual)

2. When you take over a course that has been taught before what do you do? Why?
3. When you are asked to deliver a new course, i.e. one that has not been delivered before, what do you do? Why?

Aim here is:

- to understand if the individual see the course as atomic or an integral part of a program and how this affects what they do
- get a feel for what sort of process is followed
- is it once off when taking over a course or
- continuous throughout the time they teach a course
- what provokes change in their course for them

Process of approval of change to course / program (School / College)

4. What knowledge do you have of the College/School curriculum development process?

Aim here is:

- to understand if the individual is aware of the formal process
- what role, if any, they play in that process
Engineering the Curriculum: Towards an Adaptive Curriculum

- are curriculum discussions held outside the formal schedule and what provokes such meetings
- how the process relates to
  o changes to existing courses
  o changes to an existing program
  o a new program
  o accreditation recommendations or in response to the imminent accreditation process
- what are the usual triggers for change
- how are decisions on change of structure handled? For example,
  o changes to term length?
  o changes to method of delivery?
  o changes to assessment points so as to spread student workload?
- Are curriculum discussions regular and formal?
- Who and what drives discussion about curriculum?
- What is discussed? Is it more than content?
- How are decisions made and who makes them?
- How are conflicting and potentially conflicting interests, norms, ideas and requirements dealt with as part of the process?
- How is change of teaching staff and its impact on curriculum handled?

KEEP IT GENERAL – AVOID PUTTING TERMS IN PEOPLE’S MOUTHS

Overall I want to understand:

- what people are actually doing (not what they think they should be doing, but what they are really doing)
- whether people are following are prescribed process
- is there a prescribed process? Yes, according to the literature, but it is complicated and so people don’t tend to follow
- what are the drivers behind change?
- who makes the decisions?
- how are conflicting and competing claims incorporated into curriculum?
- what drives the discussion?
- who makes the decisions?
- how are competing and sometimes conflicting interests, norms, ideas and requirements dealt with as part of the process?
- is it he with the loudest voice or biggest stick that holds sway? is more than content discussed?
- is this important?
- how are decisions on change of structure handled? For example,
  changes to term length?
  changes to method of delivery?
  changes to assessment points so as to spread student workload?
  how often is a review of the curriculum made?
  how change of teaching staff is handled?
  what problems are encountered when developing or reviewing curricula?
  what are the strengths / weaknesses of the current process?
  Are there discernible patterns?
Appendix H. PRE-PREPARED & PARTICIPANT CREATED TAGS

Table 9.2 – List of pre-prepared & participant created tags

<table>
<thead>
<tr>
<th>Pre-Prepared Tags</th>
<th>Participant created Tags</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aims</td>
<td>$</td>
</tr>
<tr>
<td>Assessment</td>
<td>Area / field of study</td>
</tr>
<tr>
<td>Attributes</td>
<td>Body of Knowledge</td>
</tr>
<tr>
<td>Capabilities</td>
<td>Course as delivered</td>
</tr>
<tr>
<td>Competencies</td>
<td>Curriculum in use</td>
</tr>
<tr>
<td>Content</td>
<td>Domain of Knowledge</td>
</tr>
<tr>
<td>Course</td>
<td>Espoused curriculum</td>
</tr>
<tr>
<td>Face-to-face</td>
<td>Evaluation</td>
</tr>
<tr>
<td>Goals</td>
<td>Industry</td>
</tr>
<tr>
<td>Graduate Attributes</td>
<td>Lecturer’s Preferences</td>
</tr>
<tr>
<td>Graduate Outcomes</td>
<td>Measurement</td>
</tr>
<tr>
<td>Intensive Block</td>
<td>Practice</td>
</tr>
<tr>
<td>Intent</td>
<td>Pre-requisites</td>
</tr>
<tr>
<td>Learning Activities</td>
<td>Prioritizing</td>
</tr>
<tr>
<td>Learning Objectives</td>
<td>Professional / accreditation body</td>
</tr>
<tr>
<td>Learning Outcomes</td>
<td>Purpose</td>
</tr>
<tr>
<td>Lectures</td>
<td>Quantity</td>
</tr>
<tr>
<td>Majors</td>
<td>Resources</td>
</tr>
<tr>
<td>Mode of Teaching</td>
<td>Students</td>
</tr>
<tr>
<td>Modules of Content</td>
<td>Student expectations</td>
</tr>
<tr>
<td>Objectives</td>
<td>Student interests</td>
</tr>
<tr>
<td>Off-line</td>
<td>Student prior knowledge</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Suitable personnel</td>
</tr>
<tr>
<td>Program</td>
<td>Teaching staff</td>
</tr>
<tr>
<td>Sequence</td>
<td>Theory</td>
</tr>
<tr>
<td>Skills</td>
<td>Underlying philosophy</td>
</tr>
<tr>
<td>Structure</td>
<td>Vested interests</td>
</tr>
</tbody>
</table>
Appendix I.  SAMPLE EMAIL INVITATION TO PARTICIPANTS

Invitation to participate in research on the design and development of higher degree curriculum

I would like to invite your participation in focus group interviews whose purpose is to investigate how an individual’s understanding of ‘curriculum’ shapes both the process of design and development with which they engage and the output of that process – often called the intended or written curriculum. The <Dean / Head of School> of <College/School name> has given his agreement for me to invite you to participate in this research project. The project has also received ethics approval from the ANU Human Ethics Committee (Protocol 2010/438).

Focus group sessions will last from one and a half to two hours and will be. Sessions will take place at the ANU Centre for Higher Education, Teaching & Learning. Depending on the timing of the sessions, participants will be offered a light lunch or wine and cheese.

To indicate your willingness to participate, please reply to this email. Once I have an idea of the number of participants, I will contact you again with potential dates and times. I am hopeful that you will find the time to participate.

I am undertaking a PhD at the Centre for Higher Education, Teaching and Learning (CHELT), ANU exploring curriculum development associated with engineering, software engineering, computer science, and information systems degree programs.

The next stage of my research is to conduct focus group interviews with groups of up to 8-10 engineering, software engineering, computer science and information systems academics from the <University and College / Faculty / School names>.

All sessions will be sound and video recorded. So that you can check the information from your focus group session is accurate, you will be provided with a transcript produced from the recordings. When participants are satisfied with the transcript accurately records what was said, the information from all sessions will be collated and will be used within my PhD research. The material may also be written into an article or articles for publication in education journals or conferences.

All data collected during my research will be anonymised. Neither individuals nor institutions will be identified. If necessary, individuals will be identified only by their position, e.g. “a Level B academic” or “a professional member of staff”. However, given the small sample size it may not be possible to completely de-identify all sources of data.

Participation is voluntary and participants may withdraw from this research project at any time. Should a participant withdraw, all data relating to their participation in the focus group interview will be removed from the research, and the material deleted from the physical records. All data collected from these sessions will be kept confidential.

If you are willing to participate, please reply to this email.

With many thanks for your time and attention.

Sample email invitation to participants
Appendix J.  SAMPLE EMAIL TO DEAN SEEKING PERMISSION TO INVITE STAFF

<INSERT DATE>

Lynette Johns-Boast, BA, Grad Dip Inf Sys
PhD Candidate
Centre for Higher Education, Teaching & Learning
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+61 2 6125 3013
Lynette.johns-boast@anu.edu.au
Canberra ACT 0200 Australia
www.anu.edu.au
CRICOS Provider No. 00120C

Dear Professor <INSERT NAME>,

As you may be aware, I am undertaking a PhD at the Centre for Higher Education, Learning and Teaching (CHaLT), ANU exploring curriculum development and its planning and implementation in technology and information systems degree programs.

This letter is to seek your permission to email academics in the <INSERT name of faculty / school as appropriate> seeking voluntary participation in a focus group interview. The purpose of the focus group interviews is to help me understand how an individual's perception of 'curriculum' shapes both the process of design and development with which they engage and the output of that process – often called the intended or written curriculum.

I plan to run focus group interviews with academics who have an interest in and responsibility for course and/or program curriculum development for engineering, software engineering, computer science and IT, and information systems courses and programs from three Australian universities.

All data collected during my research will be anonymised and individuals will not be identified in any published data. If necessary, individuals will be identified by their position, e.g. “a Level B academic” or “a professional member of staff”. However, given the small sample size it may not be possible to completely de-identify all sources of data. The university in which an academic works will not be identified.

Subject to your agreement, I propose to email staff members in <INSERT NAME OF SCHOOL / COLLEGE> seeking volunteers to participate in the focus group sessions. I am hoping that a minimum of 8-10 members of staff will volunteer. A larger number of volunteers will enable me to run more than one focus group, which would be ideal. Depending on the number of volunteers, however, it may be necessary to run a focus group with participants from more than one institution. Participants will be asked to provide their informed consent prior to taking part in the focus group interview. Participation is voluntary and participants may withdraw at any stage of the research process. Should you yourself be interested in participating in this project I would welcome that.

The focus group interviews will take about one and a half to two hours. I propose to hold them at a mutually convenient time, either at lunchtime or in the early evening immediately following work, in the meeting or seminar room at CHaLT. Depending on the time of the session, I will offer participants a light lunch or wine and cheese. Focus group interviews will be audio and video recorded.
Following an introduction to the research project, the focus group discussion will address the following topics:

1. The group’s understanding of curriculum.
2. The processes they engage in when designing, developing and implementing curricula at both the course and program level.
3. Constructive alignment and how it is applied to both course and program curricula.

I will also be asking interviewees to provide the following information:

1. Their level and type (e.g. permanent, sessional) of appointment and name of institution.
2. How long they have been involved in curriculum development.
3. Whether they have been involved in curriculum development at any other level of education, e.g. Vocational or secondary school.
4. Whether they have any formal education qualifications (e.g. Graduate Certificate in Higher Education, Diploma of Education).

I would be pleased to send you a summary of key findings, when available.

Ethics approval for this project has been received from the ANU Human Ethics Committee (Protocol 2010/438). If you have any concerns or complaints about how the research is conducted please contact the ANU Human Research Ethics Committee’s Secretary by phone (02) 6125 7945 or by email to human.ethics.office@anu.edu.au

I hope you will be agreeable to your colleagues participating voluntarily in my research project. I will contact your office within this week to follow-up and ascertain your response.

Yours sincerely,

Lynette Johns-Boast
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College of Arts and Social Sciences, ANU
Phone: 6125 4526
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Email: lynette.johns-boast@anu.edu.au

Dr Margaret Kiley
Chair
Centre for Higher Education, Teaching & Learning
ANU College of Arts and Social Sciences
Phone: 6125 2690
Email: margaret.kiley@anu.edu.au

Dr Gerry Corrigan
Principal Supervisor
Medical School
ANU College of Medicine, Biology & Environment
Phone: 6125 5022
Email: gerry.corrigan@anu.edu.au

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Sample email to Dean seeking permission to invite staff
Appendix K. PHASE TWO – QUESTIONING ROUTE

Focus group interview introduction and “questioning route”

Exploring the curriculum development process

Introduction (10 minutes)

For my PhD I am carrying out research into academics’ understanding of curriculum and how that shapes the process which surrounds the design and development of university level curricula for use with engineering, computer science and information systems degree courses and programs.

Over the next one to two hours I am going to ask you some broad questions and to carry out some modelling activities. Please share your honest opinions and thoughts. Your input is an important part of my effort to understand better what higher education engineering, software engineering, computer science and information systems academics do when designing and developing curricula. There are no incorrect answers to any of the questions and everyone’s opinion is valuable and shall be respected.

A certain amount of time will be allowed for each question and I will try to keep you focused upon the topic without interrupting the general flow of the discussion too much. Your participation is voluntary and you do not have to answer any question you do not wish to. You may leave at any time. To make sure I capture all your ideas and thoughts, today’s session will be recorded: both video and audio.

So that you can check the information from your focus group session is accurate, I will provide you with a transcript of the session. When you are satisfied with the accuracy of the transcript, the information from all the sessions will be collated and used within my PhD research. The material may also be written into an article or articles for publication in education journals or conferences. All data collected will be anonymised. Neither individuals nor institutions will be identified. If necessary to the findings being reported, individuals will only be identified by their position, e.g. “a Level 3 academic” or “a professional member of staff”. However, given the small sample size it may not be possible to completely de-identify all sources of data. I request also that you do not discuss with people who have not participated in this session the views and ideas expressed within it.

Participation is completely voluntary and you may withdraw from this research project at any time. Should you withdraw, all data relating to your participation in the focus group interview will be removed from the research, and the material deleted from the physical records. All data collected from these sessions will be kept confidential.

I would be grateful also if you would be willing to complete the proforma information about your level and type of appointment, how long you have been involved in curriculum development in higher education, whether you have been involved in curriculum development at any other level, e.g. VET (vocational) or secondary school, whether you hold any formal educational qualifications, such as a Graduate Certificate in Higher Education or perhaps a Diploma of Education and what your field of specialisation is.

Does anyone have any questions about today?
Focus group interview introduction and “questioning route”

Before we start, I’ll get you to read the information sheet, sign the consent form and complete the proforma questionnaire.

<At this point make sure that each person has the information sheet, the consent form and the proforma questionnaire. Give them time to read the information sheet and complete the consent form and questionnaire.>

<While participants are doing this, make sure that the audio and video recording devices are both working properly.>

<Collect completed forms and put in folder safely.>

Before we begin the fun part please make sure that you’ve got something to eat and drink. Please feel free to replenish your plates or glasses at any point during the session.

While people are collecting food and drink, engage in general social discussion, to help everyone relax.

Once everyone is seated and relaxed begin.

Today I want to spend time discussing curriculum design and development with you. Specifically, I want to hear what you understand by the term “curriculum”, what curriculum alignment might mean to you, the sorts of processes you engage with when designing and developing your curricula, and whether you knowingly use any principles of design to help you.

Wherever possible, can you please give examples from your experience to support your answers?

Questioning route: (estimated time required – 1 hour 30 minutes)

1. Academics’ perceptions of curriculum (15 minutes)

I want to begin with taking a look at what you perceive ‘curriculum’ to be. To do this I’m going to ask you to produce a model of an abstract notion of a curriculum. Through this exercise I’m hoping to uncover what you consider to be the key elements, what the relationships between those elements are and the nature and importance of those relationships. There is no need to go for consensus or to produce a single model. If that works, that is fine, but if you have different ideas I’d like to hear, and see them.

I have prepared a series of terms, drawn from my earlier interviews, to describe the elements of a curriculum. Please feel free to create new terms, especially if the terms I have created are not ones you would use. There are plenty of blanks available.

Taking those terms, the white board and pens, I would like you to spend about 15 minutes creating a model of an abstract notion of a curriculum.

To do this, you will need to take which-ever terms are appropriate to you, or create new ones, and place the terms on the white board and draw lines between them, around them, or whatever makes sense to you, to represent the
Focus group interview introduction and “questioning route”

relationships between them.

Please annotate your models to ensure that they capture all your assumptions.

<When it appears that participants have finished creating their model, ask them to explain it>

Does your notion of curriculum relate only to degree programs, only to courses or to both?

If a curriculum can relate to both a program and to the courses from which that degree program is constructed, what is the relationship between the two?

2. Notions of curriculum alignment (10 minutes)

We’re going to put to one side for a moment the models you have created and discuss one approach to curriculum design: that of curriculum alignment. If it helps to use your model to explain your concepts please feel free to do so.

If I were to ask you about curriculum alignment, what do you think I might mean? Can you explain what curriculum alignment means to you?

<May need to explain this. Can talk about constructive alignment.>

When in 1996 John Biggs described the notion of “constructive alignment” he was referring to aligning the teaching and learning activities with the assessment activities for a course. He also suggested that the assessment activities should be aligned with the desired outcomes.

OK, so you’ve just indicated that you use the notion of curriculum alignment when designing and developing your curriculum, what sorts of things and when do you do to apply them?

OR

Given you’ve just indicated that the notions of curriculum alignment are not something you have considered before, how might you apply them?

How and where do the notions of alignment we’ve just been discussing, fit with the model of curriculum you created?

Do you thing that the concepts of alignment can be applied to a program as well as a course?

3. What processes do academics engage in when designing, developing and implementing course curricula? (30 minutes)

Moving on from the notion of curriculum alignment I want to begin to consider the things that you actually do when you design, develop and implement a course.

What you do when you take over an existing course, one that has already been taught by somebody else?

Where do you begin? For example, do look at the existing course material?

Do you make changes? What sorts of changes might you make? From where do you get your ideas?

Do you discuss your ideas and changes with anyone else or do you tend to work on your own?
Focus group interview introduction and “questioning route”

Do you let anyone else know you made changes?

What happens when you teach the same course over a number of years?

Do you do anything differently? Or is it essentially the same as taking over an existing course?

What are the triggers that cause you to change your course design?

How do you approach the design of a totally new course? Is it different from the approach you take to one which has been taught before?

Where do you start? For example, do you begin with content, with structure, with outcomes or with something else altogether?

From where do you source ideas for appropriate content, learning activities?

How do you determine what are appropriate activities and outcomes?

Are any of these decisions already made for you? If so where are they recorded?

Do you work alone or with others?

What impact, if any, does the delivery method have on your course design?

By delivery method I mean whether your course will be delivered completely on-line, completely face-to-face, or blended which is some combination of on-line and face-to-face?

Does the requirement to teach a course in intensive mode as opposed to, say, a weekly approach to delivery affect how you design your course?

4. What processes do academics engage in when designing, developing and implementing program curricula? (10 minutes)

I’d now like you to turn your mind to the design and development of a degree program.

How do you approach the design and development of a program? What sorts of things do you do?

Is your approach to the design and development of a program different from your approach to the design and development of a course?

5. Do academics with a background in design knowingly use an approach which is informed by their own knowledge of engineering, computer science and information systems design? (10 minutes)

So far we’ve talked a lot about design. I’m now going to make an assumption that you all have had some exposure to engineering, computer science or information systems design.

Is your approach to course and / or program design, informed by your knowledge of engineering, computer information systems design?

What are the features that you use and why?

Can you think of any other features that you might use and why?

Bringing it all together (15 minutes)
Focus group interview introduction and “questioning route”

My experience when I was doing one-to-one interviews was that generalisation academics are not used to thinking about curriculum in the way I have just asked you to, despite being closely involved with it.

So having just spent the past hour or so discussing program and course design, I now want to return to the models of curriculum that you created at the start of the session to see what might have changed after our discussion.

Is there anything you would change or add to your model (that you haven’t already as we have been discussing curriculum)?

Is there anything else you would like to discuss or tell me about your approach to curriculum that I haven’t covered so far?

That brings our focus group session to a close. I would like to thank you all for your time and for your contribution to my research. I will send you a copy of the transcript as soon as I can.
Appendix L.  COMPOSITE MIND MAP – CURRICULUM CONCEPTS

Composite mind map – Curriculum concepts
Appendix M. INTERVIEW D – CURRICULUM CONCEPTS MIND MAP
Appendix N.  INTERVIEW C – EXAMPLE ANALYSIS SUMMARY

**Interviewee C**

1. *Curriculum—elements specifically identified as such when asked what their understanding of curriculum was*

   Element of curriculum specifically identified as such:

   - *Content*—“more about content and less about method”
   - *Objectives*—
   - *Structure*—enables the building of “streams and chains, and sufficient depth and breadth”
   - *Graduate outcomes*—“The ways we expect students to have learnt are a consequence of an understanding underneath and don’t get articulated, but the structure is what we articulate partly because it is the common ground we can all rest on”

   Also includes:

   - What’s in the curriculum
   - What’s the shape
   - The building blocks

   Interesting comment when asked whether you would have two curricula when teaching the same course in two different modes:

   “Close to. You might say the objectives are similar. The objectives might be the same, but the curriculum—how material is put together, how activities are put together, how they are represented, how they are represented in different tasks and so on, yes. That’s the operational teaching and learning bit.”

   Now specifically talking about a program:

   - “What we started with was defining that in terms of content. In the last couple of years defining it in terms of learning objectives over in fact the same examples and same kind content because we did have the same objectives in mind we just haven’t articulated them as well”

2. *Process and elements of curriculum which I believe belong to curriculum that emerge from the description of process*

   - only a couple of cases when I have taught a course out of somebody else’s notes/other box
   - nearly always had to rework it or do it almost from scratch or change it over time
   - haven’t had a textbook... for the material for the content, that meant writing lecture notes as notes and finding ways to present ideas rather than lots of words
   - the ACM curriculum—which is what we compared this to originally
   - make the course much more actively engaging
   - there’s a change in the content—which is yet to be resolved, a change in the particular details of what the learning is as well as more substantial changes in the way I want to teach it—change is related back to a policy decision that there will be a change to the orientation of the course which will change the learning objectives
   - here’s a learning objective, where is that going to be represented in the various classes and activities including the assignments
   - represented in the schedule and the schedule is important
I always find that contact—or the classes, the tightest constraint is the number of assignments.

Those modules of content have been fairly closely aligned with the learning outcomes. Threads, aren’t necessarily single lecture topics. They’re going to be threaded through.

I’m particularly feeling daunted at the moment because it was only this morning that I remembered what we were doing about changing the systems content.

I’ve got to teach the masters course integrated with this one as well.

Researching other examples in other universities or I would look for books first.

Hard to get a grasp of what’s done until I’ve gone through it once. And that’s because we don’t have descriptions. Really.

What can we learn in the scope of this course in this subject area?

Describe what a well-organized view of learning outcomes threaded through the degree program. It’s a problem.

The learning objective says the degree of understanding, or the kind of understanding, or the kind of, not the amount.

Longer course description which had the rationale, and so on and I added the skills component.

I am aware I don’t know very well what the outcomes of the preceding course are. I’ve got an idea of it from the students. I’m about to go and talk to the lecturer to say what’s a good entry test, a diagnostic test.

Yes, I am aware we don’t integrate very well with the previous or next course and in fact what the course which depends on this is one way of looking at the outcomes the other way is saying towards the objective.

Some discussions within the Software Engineering Group about the content and approach and the objectives.

Effect: we’ve had shared ownership of the content and the next stage of the process—curriculum design at the school level.

More of this has been thrashed out because there are interfaces because there are people outside the group who teach 1100, 1110 and so on.

Discussion is there, but it’s often done on concrete examples. But yeah, the curriculum is not looked at in any... in this sense at all at the college level.

Change has been approved in principle if you like, there’s a short paragraph description saying this is the way the course changes, this is the implementation of it.

1. Formal process, i.e. not personal process.

Suggest there is one—talks about a policy decision being made.

We collectively form a view of what the degree program is, but it tends to be in terms of subjects, and streams of subjects, without articulating the interfaces at that time. We don’t apply to that kind of design, the sorts of design principles we do to software modules.

Coherence and the constraints on the course are so determined, but equally we don’t come back and say here’s what the outcomes are, is this right against the expected input states to a subsequent course or against the whole degree program.

The only codification is the prerequisites that this course is expected for that and therefore there’s an expectation of they should be able to.

The college level is there to try to ensure: is this topic right for, is this course right for the engineering degree, yes or no.

It’s often been in terms of big constraints, block arguments and the introduction of a service course for that has been done at the college, the sub-college level the joint curriculum committee.

As far as those processes go it works reasonably well but in that changes in curriculum can now be captured as with learning objectives and the long description form of...
curriculum-did-exist-which-enabled-discussions-to-go-beyond-just-content.-They-did-allow-
people-to-talk-about-what-the-rationale-was,-or-what-the-blooms-taxonomy-levels-were-in-
some-cases,-and-what-relationship-to-the-ACM/IEEE-curriculum.¶

We do have a process. I think a fairly healthy one of document, discuss and approve. Without the approvals being the driving thing, the discussion is real if you like, it’s not formal, it’s lively.¶

4. Assumptions that he appears to be making¶
- While he didn’t identify courses or programs when asked what the term curriculum meant, he has used both concepts during his discussion of the process he undertakes.
- It seems that he applies the term curriculum loosely to either a course or a program, but tends to think of a course rather than a program.

5. Interpret/summarise what he has to say to mean that¶
- There is some linking of courses with the overall concept of program. When talking about the ACM-curriculum he is talking in terms of a program and how the curriculum is structured to meet the determined focus of “constructing larger (software) programs”.
- That learning-outcomes for courses could be related to something such as Blooms or SOLO-taxonomy.

6. What does his language say¶
- Interesting that he specifically excludes method from his description of curriculum while saying “I know some people regard it as including teaching method—what I would take it more about content and objectives than the methods used to get there. So what would I call that?—what I would call that “teaching and learning”…what’s in the curriculum, what’s the shape, what are the building blocks, how it’s taught or how it’s learnt is not so much. I mean they interrelate, but there’s so much variation in how you can teach and learn over the same curriculum—content, the same ideas, the same objectives.
- Uses a mixture of learning objectives, learning outcomes and objectives. Are these the same thing or do they mean different things in different places?
- Interesting when asked to describe his process it is all about his teaching approaches and methods rather than about changing content, outcomes and who he might discuss. Does this mean different things in different places?
- Uses the term “constraint” from the world of design—does it suggest that unconsciously (well not explicitly expressed at any rate) he sees curriculum development as a design activity?

Questions/-holes ggg
- Learning-outcomes?
- Is this structure?
- I assume this mean lecture notes?
- What does box mean? Is this a metaphor for an implemented curriculum?
- What is the difference if anything between notes and lecture notes?
- External curriculum—source of content and outcomes?
- Policy decision from where and made by whom?
- What is orientation—is it content is it outcomes or some mix of the two?
- Interesting concept—constraint from the world of design?
- What is a module of content—is it a topic as expressed by another interviewee?
- Identifies a potentially significant issue with his own process at least, if not the formal process too. What if he had forgotten all about the change?
- Description of what? Course description?
- Does rationale = curriculum intent?
- Skills= outcomes or are they something different?
[identifies a failing of the formal process]

[subjects=courses]

[Majors=]

[highlights what he perceives to be a problem with the process—i have listed as part of the formal]

[what is a topic? A course or simply a “chunk” of content? How might it relate, if it does to “module of content?”]

[what exactly does he mean by this? How does it relate to my views?]

[identification of lack of engagement]
Central circle contains all the big picture stuff, the key elements. The structure (left bubble) is somehow mapped on to that. The right bubble is the delivery.

Within this there are two processes the teacher and the student.

The tension exists trying to keep it all in balance.

The delivery bubble tends to move away from the structure and so throw it all out of balance.

Cohesive at the start but degrades over time. Accreditation helps bring back cohesion.

Process is very much the V model.
Teacher Driven by evaluation – manipulate the delivery components to improve the evaluation outcome – no real concern about the rest of the curriculum, the important bits

Visual model of the relationships that help teachers see / feel relationships between various outcomes. Help keep the model in balance

Top bubble is the “curriculum”

SF’s model of the brave new world!

What we should look at doing now we have computers – the other was before when we were bound by paper
Left bubble is the way it was done in the paper world

Purple and red is how it should be done in the computerised world – separation of concerns:

- Have someone determine learning outcomes and then assessment activities (mechanisms) – exams, orals ... - that deliver that learning outcome
- Lots of different learning activities – labs, field work etc. – which support the various assessment activities
- No concept of courses – do all these bits when-ever and how-ever and the assessments add up to a degree
- Maybe some grouping of the bits
- Put the onus on the student

Compare with Kahn academy map
Appendix P.  EXAMPLE MEMOS

May 2012

In interviews people talk quite a bit about teaching, but very little about learning or students. Why is that? Does it reflect their approach to teaching and learning or is it because I was talking about curriculum and that focuses them on teaching?

September 2012

Why is there no focus on intent? Is intent in reality same as aims? Does intent only belong to a program?

Re-read Print on this.

Do practitioners see intent and outcomes as effectively the same hence they don't explicitly state the intent?

Added some days later

Ah - a mis-understanding!

Intent = Aims + goals + outcomes, that is intent is composite not discrete.
Appendix Q. PHOTO OF FOCUS GROUP MODEL

Appendix P – Photo of Focus Group C, Curriculum Concepts Model
Appendix R. ELABORATED FOCUS GROUP MODEL

Appendix Q – Focus Group C Elaborated Model of Concepts of Curriculum
PULL OUT FIGURES
Pull-out Figure 1.1 - Thesis Structure
PULL-OUT FIGURE 2.1 – CURRICULAR CONTINUUM, BASED ON FIG. 1-1 IN ZAIS (1976), P. 12
French also wrote from an engineering perspective. He suggested, “The analysis of the problem is a small but important part of the overall process. The output is a statement of the problem, and this can have three elements:
- a statement of the design problem proper
- limitations placed up the solution,
  e.g. codes of practice, statutory requirements, customers’
  standards, date of completions
- the criterion of excellence to be worked to.”

The conceptual design phase “takes the statement of the problem and generates broad solutions to it in the form of schemes. It is the phase that makes the greatest demands on the designer, and where there is the most scope for striking improvements. It is the phase where engineering science, practical knowledge, production methods, and commercial aspects need to be brought together…”

In the third phase, “schemes are worked up in greater detail and, if there is more than one, a final choice between them is made. The end product is usually a set of general arrangement drawings. There is (or should be) a great deal of feedback from this phase to the conceptual design phase.

In the detailing phase, “a very large number of small but essential points remain to be decided.”

Image reproduced with permission
Pull-out Figure 4.1 – Diagrammatic representation of the conceptual framework adopted
Pull-out Figure 4.2 – Visual synopsis of the research design
Pull-out Figure 6.1 – Meta level model of the official-curriculum and its operationalisation
Pull-out Figure 6.2 – Model of the curriculum process as described by participants
Pull-out Figure 6.8 – The Layers of Curriculum
Pull-out Figure 7.1 – Curriculum-in-the-Abstract

Diagram showing the relationships between Purpose, Desired Outcomes, Rationale, Description, and Content.
Pull-out Figure 7.2 – The curriculum-as-process onion
Pull-out Figure 7.3 – Decomposition of a program curriculum showing the relationships between the different levels of the curriculum hierarchy
Pull-out Figure 7.9 – Graphical representation of Curriculum Drift for a program
### Pull-out Figure 7.10 – A visual representation of uncontrolled Curriculum Drift for a Program

The large cube represents the program. Each of the smaller cubes represents an individual course from which that program is comprised.
In the bottom half of the diagram, which is an expansion of a single, smaller cube from the top half of the diagram, the large cube represents the course. Each of the smaller cubes represents an individual module or lesson from which that course is comprised.
Pull-out Figure 7.12 – Causal Loop Diagram (CLD) for Curriculum Drift
Figure 7.14 – Intervention – What needs to happen