

1-1-1998

The experience of flow and learning by designing interactive multimedia software

Leonie Ramondt
Edith Cowan University

Follow this and additional works at: <https://ro.ecu.edu.au/theses>



Part of the [Education Commons](#)

Recommended Citation

Ramondt, L. (1998). *The experience of flow and learning by designing interactive multimedia software*. Edith Cowan University. Retrieved from <https://ro.ecu.edu.au/theses/1007>

This Thesis is posted at Research Online.
<https://ro.ecu.edu.au/theses/1007>

Edith Cowan University

Copyright Warning

You may print or download ONE copy of this document for the purpose of your own research or study.

The University does not authorize you to copy, communicate or otherwise make available electronically to any other person any copyright material contained on this site.

You are reminded of the following:

- Copyright owners are entitled to take legal action against persons who infringe their copyright.
- A reproduction of material that is protected by copyright may be a copyright infringement. Where the reproduction of such material is done without attribution of authorship, with false attribution of authorship or the authorship is treated in a derogatory manner, this may be a breach of the author's moral rights contained in Part IX of the Copyright Act 1968 (Cth).
- Courts have the power to impose a wide range of civil and criminal sanctions for infringement of copyright, infringement of moral rights and other offences under the Copyright Act 1968 (Cth). Higher penalties may apply, and higher damages may be awarded, for offences and infringements involving the conversion of material into digital or electronic form.

USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

**EDITH COWAN UNIVERSITY
LIBRARY**

The Experience of Flow
and
Learning by Designing
Interactive Multimedia Software

By

Leonie Ramondt
BA (Media), Graduate Certificate CBID

A Thesis Submitted in
Fulfilment of the Requirements for the
Award of Masters in Education
at the Faculty of Education,
Edith Cowan University,
Perth, Western Australia.

Date of submission: March, 1998

Abstract

As computer technology is increasingly adopted in education, some students continue to have little context for its use. This is particularly true of tertiary drama education students, of whom many still remain computer illiterate.

Constructivist pedagogy proposes that a learner constructs knowledge through active participation in their learning. An approach that is gaining currency which applies this principle, is learning by designing. This approach was adopted for this study, with the premise that the process of designing multimedia software for their peers would not only motivate these students to use computers but could also lead to a deepening of their understanding of the subject matter. Questions that arise in response to this hypothesis include: what do students learn from designing multimedia software; and what motivates their engagement in this task?

These questions were addressed by a project which spanned a two week period at a university. Five university drama education students participated in designing multimedia software which aimed to elucidate the process of devising plays for their peers.

The data this activity generated provided the foundation for five case studies which document the students' engagement and learning processes. The findings indicate that the learning by design approach proved an effective learning approach. Also, the use of flow theory as a theoretical framework was helpful in developing an understanding of each person's individual process of engagement. The thesis comments on this theoretical framework and suggests a number of hypotheses for further testing by education professionals.

Declaration

I certify that this thesis does not, to the best of my knowledge and belief:

- (i) incorporate without acknowledgment any material previously submitted for a degree or diploma in any institution of higher education;
- (ii) contain any material previously published or written by another person except where due reference is made in the text; or
- (iii) contain any defamatory material.

1st August 2007

Acknowledgments

I would like to thank all the students who contributed to the design project and especially those who participated in the six days design workshop. Without their generous participation, after a hectic and challenging semester, this thesis would not have been possible.

I would also like to thank my supervisor, Dr Tony Fetherston, for his availability, support, patience and detailed feedback. His demands for rigour have provided me with a worthy challenge.

I would also like to thank the staff of the school of Multimedia and Learning Technologies at Edith Cowan University for their kind support in providing access to the facilities and equipment that made this study possible. Apple Computers also kindly provided the use of an 8100 Power PC through an Apple University Consortium grant. This machine was used to compile and produce the main body of the project.

Finally, I would also like to thank my network of friends for their support and encouragement, especially the members of Pinakarri community, who've remained patient with my absences and have accepted my sometimes unequal contribution to the work of building our "intentional community" housing co-operative.

List of Tables

Table	Title	Page
Table 1	The Experience Sampling Form.	56
Table 2	The additional three questions appended to the ESF.	58
Table 3	The research questions, data collection method and data collection points.	60
Table 4	Data collection times.	61
Table 5	The daily activities performed by each of the participants.	78
Table 6	John's daily ratings for challenge, skill and flow.	90
Table 7	Kimberley's daily ratings for challenge, skill and flow.	101
Table 8	Nathan's daily ratings for challenge, skill and flow.	113
Table 9	Sonya's daily ratings for challenge, skill and flow.	126
Table 10	Valerie's daily ratings for challenge, skill and flow.	134
Table 11	A comparison of each participant's mean for challenge, skill and flow.	138
Table 12	Ratings comparison for the content discussion and video viewing/ logging sessions.	139
Table 13	A comparison of Nathan's and John's ESF results for the activities they both participated in.	140
Table 14	A comparison of Kimberley and Sonya's content writing ratings.	141

List of Figures

Figure	Title	Page
Figure 1	Three memory systems in processing input.	9
Figure 2	Why the complexity of consciousness increases as a result of the flow experience.	29
Figure 3	A model for the analysis of experience.	31
Figure 4	How constructivism informs learning-by-designing and thereby provides the context for stimulating flow to enhance learning.	43
Figure 5	Components of Data analysis: Interactive model.	62
Figure 6	John's first day opening menu flowchart	85
Figure 7	John and Nathan's Play branch design	88

Table of Contents

Abstract.....	i
Declaration.....	ii
Acknowledgments.....	iii
List of Tables.....	iv
List of Figures.....	v
Table of Contents.....	vi
CHAPTER ONE	1
Introduction to the Study.....	1
Background.....	1
Purpose of the Study.....	4
Research Questions.....	4
Organisation of the Thesis	5
CHAPTER TWO.....	6
Review of the Literature.....	6
Introduction	6
Overview of Learning Theory.....	6
The Origins of Objectivism.....	6
The behaviourists.	7
Implications for learning and teaching.....	8
Conclusions.....	8
The cognitivists.	8
Implications for learning.....	11
Critique of objectivist and cognitivist approaches.	12
Constructivism.....	12
The humanists.....	13
Critique of humanist approaches.	13
Implications for the study.	14
The constructivists.....	15
Critique of constructivist approaches.....	17
Implications for the study.	18
Learning by Designing.....	19
Implications for the study.	21
Tools for the Mind.....	22
Implications for the study.	23
Situated Cognition.....	23
Implications for the study.	24

Knowledge as Design.....	25
Collaborative Software Design.....	25
Collaboration.....	26
Conclusion.....	26
Flow Theory	27
Background.....	27
The Pre-conditions for Flow.....	28
The Relationship Between Flow and Complexity.....	28
The Experience Sampling Form (ESF).....	29
The Systematic Assessment of Flow in Daily Experience.....	30
Strategies for Building Flow	31
Flow Concepts.....	32
The role of goals.	32
Attention as psychic energy.	32
Entropy and negentropy.	33
Microflow and anti-flow.....	34
Complexity.....	34
The autotelic experience.....	35
The autotelic personality.....	35
The autotelic family.....	37
Flow and design.....	37
The Educational Relevance of Flow Theory.....	38
Summary	38
Implications for the Study.....	40
Theoretical Framework	42
Methodology	44
Introduction	44
A Comparison of the Objectivist and Interpretivist Paradigms.....	44
Implications for the Study.....	46
Perspectives of Interpretivist Research	46
Case study.....	49
Validity.....	50
External Validity.....	50
Internal Validity.....	51
Testing rival explanations.....	52
Negative cases.....	52
Triangulation.....	52

Reliability.....	53
External Reliability.....	53
Internal Reliability.....	53
Fittingness.....	53
Bias.....	53
Conclusion.....	54
CHAPTER THREE.....	55
Data Collection.....	55
Procedures.....	55
Interviews.....	55
Observations.....	56
The Experience Sampling Form (ESF).....	56
Discussion Groups.....	59
Documentation.....	60
Open-ended Questionnaires.....	60
Data Collection Methods, Points and Times.....	60
Participants.....	61
Conclusion.....	61
CHAPTER FOUR.....	62
Data Analysis.....	62
Data Reduction.....	62
Data Display.....	64
Conclusion Drawing and Verification.....	65
Conclusion.....	65
CHAPTER FIVE.....	66
Background and Context to the Case Studies.....	66
Introduction.....	66
Background.....	66
The Workshop.....	73
Activity Summary.....	78
Conclusion.....	79
CHAPTER SIX.....	80
Results.....	80
Introduction.....	80
Case Study One - John.....	81
Background.....	81
Project Participation.....	82
Summary of Flow Experiences.....	90
Discussion.....	91

What John Gained Through Participating.....	94
Case Study Two- Kimberley	95
Background.....	95
Project Participation.....	96
Summary of Flow Experiences.....	101
Discussion.....	102
What Kimberley Gained Through Participating.....	105
Case Study Three- Nathan	106
Background.....	106
Project Participation.....	107
Summary of Flow Experiences.....	113
Discussion.....	113
What Nathan Gained Through Participating.....	117
Case Study Four- Sonya	119
Background.....	119
Project Participation.....	121
Summary of Flow Experiences.....	126
Discussion.....	126
What Sonya Gained Through Participating.....	129
Case Study Five - Valerie.....	130
Background.....	130
Project Participation.....	131
Summary of Flow Experiences.....	134
Discussion.....	135
What Valerie Gained Through Participating	136
Summary and Comparison of the Case Studies.....	137
Reasons for Participating.....	137
Project Participation.....	137
Comparison of the ESFs.....	138
Conclusion.....	142
CHAPTER SEVEN	143
Discussion of the Findings.....	143
What Students Learned From the Process of Multimedia	
Design	143
Factors that Influenced the Experience of Flow.....	147
Context.....	147
Flow and Personality	148
Implementation of “The Essential Steps to Build Flow”	149
Additional Themes Arising from the Study.....	159

The Role of the ESF and Metacognition	159
Variations in the Flow Profile.....	159
Designing and Producing as FlowActivities	160
Task Allocation and Peer Scaffolding.....	161
Project Outcomes.....	162
Groupwork, Flow and Anti-flow.....	162
Collaborative Flow.....	165
Strategies for Building Group Flow	166
Peer Scaffolding and Collaborative Flow	167
Conclusion to the Discussion.....	169
CHAPTER EIGHT.....	171
Summary of the Findings, Limitations, Hypothesis for Further Research and Conclusions to the Study	171
Introduction	171
The Findings for the First Research Question.....	171
The Findings for the Second Research Question.....	174
Limitations of the Study.....	178
Evaluator Effect.....	180
Hypotheses for Further Research	180
Conclusion to the Study	184
References.....	186
List of Appendices.....	194
Appendix A- Letter of notification.....	195
Appendix B - Letter of Consent.....	196
Appendix C - Flow Poster	197
Appendix D - Flow Interview Questions.....	198
Appendix E - Final Questionnaire.....	199
Appendix F - Day Two Activities Video	201
Appendix G - Day Two Activities Content.....	202
Appendix H - Day Three Activities Video.....	203
Appendix I - Day Three Activities Content.....	204
Appendix J - Case Study Summary Matrix.....	205

CHAPTER ONE

Introduction to the Study

This chapter provides the background and rationale for this qualitative case study, which aims to describe and explain the engagement and learning processes of five tertiary drama education students who participated in the design of a multimedia CD-ROM. The research questions are presented and the organisation of the thesis is explained.

Background

The quest around the turn of the century for the scientific validation of psychological theory has left its mark on education around the world. Where apprenticeships were once an accepted means of imparting knowledge, the institutionalisation of education has led to the teacher often being cast in the role of knowledge provider. Knowledge within the scientific paradigm which prevailed at the time, was seen as *objective* and was delivered via lectures, tutorials and evaluated through tests. This approach which became known as objectivist, (Marra & Jonassen, 1993, Reeves, 1993) emphasised the acquisition of external knowledge and prevailed until the 1960s. During the 1960s a wave of humanism swept through western educational systems and classrooms began to incorporate approaches like discovery learning and problem solving (Bruner, 1971). As these approaches began to evolve, they became formalised in theories about deeper levels of learning (Biggs & Moore, 1993; Marton & Saljo, 1976), and learning motivated through the intrinsic interest of the student. Deep learning was found to promote the construction of meaning by the learner, and was viewed to occur through the linking of new knowledge via organisational networks or schemata (Biggs & Moore, 1993), to the learner's existing understanding and knowledge base. This provided a more coherent explanation for how learning may be generalised and utilised in new and novel situations than the objectivists were able to provide.

Access to information has grown exponentially around the world with the advent of the World Wide Web during the 1990s. No longer is it useful to simply remember information, because it can be accessed at the push of a button. The requirement in today's workforce is to be able to sift that information, to use discernment and higher level skills such as

analysis, complex problem solving, and collaboration (Bork, 1991; Nowakowski, 1994). In the words of Kember (1990)

The student who can stand aside from the subject matter and take his [sic] own view of it, marshal the relevant data, understand his material, draw logical inferences, be aware of his own limitations and, above all, be sceptical of previous solutions and then thread his own way to an independent conclusion, that is the excellence required (p. 43).

Another increasingly baseline requirement in the workforce, is mastery of current computer technology. This requires the ability to perform an increasing plethora of technologically oriented tasks.

The current revolution in learning approaches is highlighting the importance of the learners' involvement in the task of *constructing* their own knowledge. This pedagogy, termed Constructivism, is generally based on the understanding that reality is subjective and differs according to individual experience. Constructivism aims to assist the learner in the construction of knowledge, often through the provision of authentic contexts, opportunities for collaboration, and the use of powerful tools.

Constructivist theory posits that intrinsic learning is the best motivator to master skills. Flow theory (Csikszentmihalyi, 1975) provides a model of intrinsically motivated learning, based on matching a person's skill level with the challenge of a task so that they are optimally engaged in the process of learning. Csikszentmihalyi (1975) postulates that whilst this balance between skill and challenge is maintained, a state of absorption is engendered which allows a person to sustain focus on tasks of increasing complexity. Flow theory and constructivism were viewed as complimentary theories and were adopted as the conceptual foundation for this study.

Harel and Papert (1992) used computers as tools to assist with the construction of knowledge, as well as in facilitating familiarisation with computer technology. The approach of using computers to design products has been coined as *learning by designing* (Balestri, 1992; Jonassen, 1994).

Even although the National Curriculum (Australian Education Council, 1994a, 1994b) highly prizes the activity of design as a learning strategy, there are very few books currently available which focus on this process. Those

books that do exist, mainly focus on the areas of mathematics, science and english (Balestri, Ehrmann, & Ferguson, 1992; Harel & Papert, 1992).

Whilst traditionally mathematics and science classes have provided a natural context for using the data processing capabilities of computers, arts students have had less contexts available for their use. Word processors have become the standard method for the creation of text documents, whilst digital imaging, video and music software are increasingly powerful and user-friendly enough, to be adopted into their relevant arts curricula. One group of arts students who still have very little context in which to use computers are drama students. This group remains largely computer illiterate and are often techno-phobic. This both restricts their professional practice as a result of their lack of experience with current technology (Hannafin & Savenye, 1993), and also risks perpetuating computer illiteracy with their future students.

This study was the outcome of the collaborative relationship between a drama lecturer and myself as multimedia lecturer, at a university. The drama educator initially approached me to help him examine the relevance of the new multimedia technologies to drama education and we went on to produce two multimedia CD-ROMs in collaboration with his drama education students (Hancock & Ramondt, 1996).

This case study describes, illustrates and explains the collaborative software design approach taken, and aims to contribute to teaching practice by providing a cohesive and accessible account of the processes which aided and hindered a group of five theatre education students' engagement in the design of an Interactive Multimedia (IMM) CD-ROM. The focus of the CD-ROM was to illustrate, as well as to provide background information and extension activities, for the drama education subject of devising plays. The study reports what the student participants learned through the design process and how Flow theory (Csikszentmihalyi, 1975), by providing the theoretical foundation for the study, provided a rich model which helped the author to understand their processes of engagement.

Salomon (1994) states that the most useful contribution educational research can make is in the design of learning environments which explore the "realization of potentials" (p. 22).

The attempt to employ theories to guide the design of new learning environments, novel classroom practices, or

extracurricular settings can be seen to accomplish a crystallising role. On the one hand it integrates a variety of considerations, principles, pedagogical hunches, and hypotheses to create a new composite entity, while on the other it tries to break new ground thus creating a totally new entity." ... "the study of novel and complex designs becomes a fruitful source of new ideas and hypotheses, thereby establishing an ongoing cycle of hypothesis testing through design and hypothesis generation through observations of the resultant learning environments.

(Salomon, 1994, p. 23)

This study designed a learning environment where the essentially constructivist approach of learning by designing and flow could be implemented. The study occurred at the beginning of the end-of-semester break in 1995, over a two and a half week period. Five tertiary drama education student participants kindly gave six days of their time to participate in this study. They participated collaboratively in the design of IMM software aimed to promote meaningful learning for their peers. They also participated actively in the research process through the process of reflective dialogue.

This study is significant because it aims to contribute to the education profession an understanding of what students learn by designing, what factors influence students' flow and as well as how flow theory might best be applied to the learning by designing process. It also illustrates the implementation of computer technology within a subject area that is traditionally devoid of computer use.

Purpose of the Study

This study seeks to describe, illustrate and explain the consequences for students of their participation in a multimedia software design project in terms of their learning and engagement with the design process.

Research Questions

This study commenced with these two initial questions. Other questions that arose during the study are also examined.

1. What learning gains are made by tertiary students from participating in the process of multimedia design? and;

2. How does flow theory inform the process of engagement or “flow”, during the process of multimedia design?

the latter question translated specifically to:

- i. How does flow theory inform student’s natural process of engagement?; and
- ii. How can flow theory be used to deepen student’s experience of engagement or “flow”, during the process of multimedia design?

Organisation of the Thesis

The current chapter has introduced the context, nature and purpose of the research and outlined the study focus regarding how flow theory and constructivism can be used to understand the learning and engagement processes of students during their participation in a design project. Chapter Two will present the review of the literature dealing with learning theory, learning by designing, flow theory, and qualitative case study methodology. The conceptual framework is also presented in this chapter. Chapter Three presents the data collection procedures for the study. Chapter Four outlines the data analysis procedures. Chapter Five presents relevant background to the case studies and presents the day-by-day overview of the six day study. Chapter Six presents the five individual case studies, followed by a summary and comparison of the five cases. Chapter Seven discusses and answers the research questions, and addresses other flow related themes that arose during the study. Chapter Eight presents the conclusions, the limitations and makes suggestions for further hypothesis testing and research.

CHAPTER TWO

Review of the Literature

Introduction

This chapter reviews the development of learning theory in order to justify the choice of a constructivist approach to learning. The literature on learners as designers and situated learning is reviewed as they are the specific contexts in which these constructivist approaches were used. Next, flow theory (Csikszentmihalyi, 1975) with its key concepts of engagement and optimal psychology, is introduced, followed by an explanation of how flow theory and constructivism combined to form the theoretical framework for the study. The chapter concludes with an examination of qualitative research methodology and an explanation is provided for the choice of the case study methodology adopted for the research design.

Overview of Learning Theory

This overview takes a historical view. It aims only to introduce some of the key theories that have influenced current educational practice and that are relevant to this study.

This review found that the theories of learning that influence contemporary education have developed this century, although it must also be acknowledged that learning theory can be traced back to Plato and Socrates.

The Origins of Objectivism

In the latter half of the nineteenth century, the physical and biological sciences were developing empirical foundations through methods involving measuring and testing observable phenomena. This approach was called logical positivism although the term objectivism was later adopted (Jonassen, Wilson, Wang, & Grabinger, 1993; Marra & Jonassen, 1993; Reeves, 1993; Rieber, 1996) to describe the resulting focus on an objective, external and measurable "Reality" which can be described in scientific dictums of "Truth". Many psychologists became convinced that the scientific study of learning should be based on observable and

measurable evidence and found that this was most easily achieved through the study of behaviour.

The behaviourists.

The behaviourists dominated educational approaches until the 1960s. As the current study utilises a contrasting epistemology and pedagogy, it is deemed appropriate to present this perspective.

What became known as behaviourist theory, had a number of proponents. Key theorists from this period include Pavlov, Watson, and Skinner.

Pavlov (1927) was a prominent Russian physiologist who specialised in the study of reflexes, especially in dogs (Biehler & Snowman, 1990). His observation of his dog's salivation led to his discovery of the principle now known as classical conditioning. He found that a secondary trigger (in the first instance, a door squeaking on opening), present at the same time as a primary stimulus (food being brought), could trigger the response related to the primary stimulus (salivation) as the two became associated through repetition. Therefore the dog began to salivate when the door squeaked.

Watson (1913) coined the term behaviourism and popularised the behaviourist movement (Hill, 1977) through the publication of his work in 1913. Watson believed that psychology's focus should only be on overt, measurable behaviour and that thoughts, emotions, intentions and instincts were unscientific and could all be traced to conditioned responses.

Skinner (1938) later extended the work of his predecessors by developing the theory of operant conditioning (Hill, 1977). The word operant describes a spontaneous behaviour that occurs whilst a person is "operating" on their environment as opposed to the elicited response of classical conditioning (Gage & Berliner, 1992).

Traditionally, behaviourists only accepted statements that could be verified empirically, as worthy of study. "Method became a preoccupation: methods for making the subjective objective, the hidden overt, the abstract concrete" (Bruner, 1986, p. 94). After the second world war, " 'Mind' remained a forbidden four letter word in mainstream psychology"... and "The methodology of 'scientific psychology' grew ever stricter and more puritan..." and more "concrete" (Bruner, 1986 p. 94). Nevertheless, the war

had spawned significant seeds of change which were to come to fruition a little more than a decade after its end.

Implications for learning and teaching.

The focus of behaviourist psychology is on the sensori-motor nature of learning where the environment is seen simply as providing sets of stimuli whilst behaviour is a response to those stimuli. Learning is seen to take place when new stimulus-response connections are set up through conditioning (Biggs & Moore, 1993).

Operant conditioning principles, most commonly in the forms of “positive reinforcement” and through “with-holding reinforcement” (Gage & Berliner, 1992), continue to provide teachers with strategies for motivating learning and managing students’ classroom behaviour.

Conclusions.

While behaviourists were well able to explain the learning of emotional responses and the acquisition of physical skills, their theories for language learning, problem solving and concept learning were less plausible. From the middle of the 1950s, it became increasingly inadequate to conceptualise the mind as a “black box” with invisible cognitive processes. As the need to teach and therefore understand higher order skills grew, cognitivist theories developed.

The cognitivists.

The extent and complexity of cognitive theory can not be adequately or comprehensively represented in a thesis such as this, but as cognitive theory lays the foundation for later constructivist thinking, an effort is made here to summarise some of the major trends and influences which led to the constructivist approach.

Cognitive psychology is dated as starting in the late 1950s “when the emphasis shifted from performance (what people did) to competence (what they *knew*)” (Bruner, 1986 p. 94). During this time it became much more widely accepted that mental processes existed. Biehler and Snowman (1990) argue that this was due to three causes. The second world war required psychologists to come up with training strategies for pilots facing complex tasks. This required them to develop higher order thinking skills such as

analysis and synthesis of information, which was well beyond the reflex and rote learning of behaviourism. Simultaneously, communication engineers had triggered a lexicon of communication concepts, and the field of computer science had begun to develop.

Mental processes became modelled on the information processing (IP) principles being applied to the design of computer hardware and software. The IP model divides learning into three stages each occurring in a separate memory system.

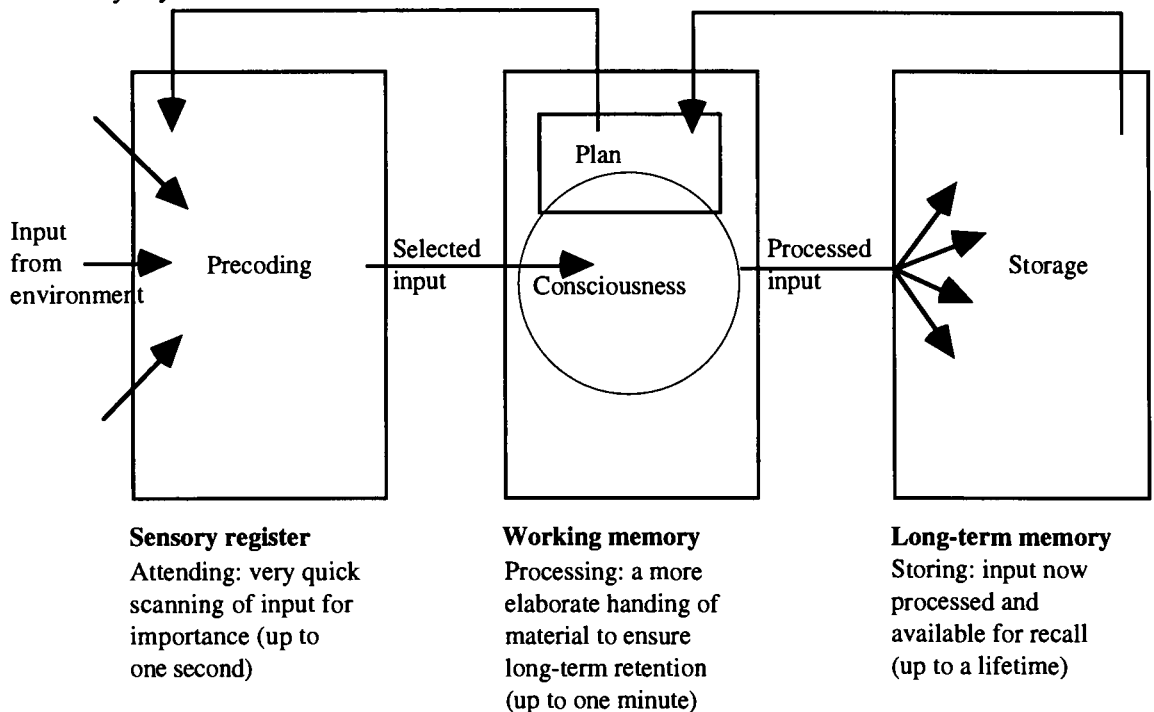


Figure 1. Three memory systems in processing input (Biggs & Moore, 1993, p. 207)

These are conceptualised as follows:

the *sensory register* filters all sensory input for relevance, allowing split second reflex action when attention and action are required. Relevant input, when it is attended to, is moved to the working memory;

the *working memory* is where conscious thinking takes place. It has been found that only one major train of thought can be processed at a time. When information is seen to be important, it requires repetition (rehearsal) or linking to existent information (coding) to be stored in *long term memory*; and

the *long-term memory* stores information available for recall by the working memory.

The IP model has proved useful when applied to sequential and logical, higher order learning. It offers a mechanistic explanation of how learning occurs and suggests cognitive strategies which can be applied readily to teaching and learning.

Cognitive theorists did not replace the S-R theories of their predecessors. Just as Skinner had built on Pavlov's theories, some theorists such as Gagné (1968) extended the behaviourists' theories. Others, such as Ausubel (1968) limited himself to a subset of the total field of learning, in his case, verbal learning (Biehler & Snowman, 1990).

Three key figures recognised as having an enduring influence on cognitivist educational theory are Gagné, Ausubel and Bruner.

Gagné (1966) designed instruction for the United States airforce during the 1950s and developed a typology of learning which included the higher order skills of problem solving, rule learning, concept learning and discrimination. Gagné also broke down these competencies to their simpler components, emphasising task analysis and objectives. Gagné's (1974) "events of instruction" remain a planning framework used by some teachers. These events are activating motivation, informing the learner of the objective, directing attention, stimulating recall of prior learning, providing learning guidance, enhancing retention, promoting the transfer of learning, eliciting and assessing performance and providing feedback.

Ausubel (1968) distinguished rote from meaningful learning and developed theory about the relationship between prior knowledge and new knowledge. He saw the need to integrate new learning with old, through a framework which he named the advance organiser. The use of the advance organiser required that preview data be written at a higher level of abstraction than the main work, with the intention of preparing students by organising the forthcoming information into appropriate schemata. Ausubel was a strong proponent of didactic instructional procedures, believing that once a learner had an adequate knowledge base they could understand a concept if it was explained simply. He therefore believed that discovery methods generally waste class time (LeFrancois, 1982).

Bruner's (1986) focus on promoting meaningful learning began with his studies of perception, which led to his theories on structure and discovery. He emphasised that understanding the structure of a topic requires an understanding of its fundamental principles, and is fundamental to problem solving and meaningful transfer of learning. Bruner argued that true learning involved "figuring out how to use what you already know in order to go beyond what you already think" (1983, p. 183 in Biehler, & Snowman, 1990, p. 427) thereby, learning "*how to learn as they learn*" (Biehler, & Snowman, 1990, p. 427).

As can be seen from these descriptions, Bruner led the progressive shift away from the objectivist perspective of one external and objective truth. This occurred as the understanding of cognition began to explain the significance of learning processes such as discovery learning, problem solving and the transference of learning.

Implications for learning.

The objectivist assumption that there is an objective truth, translated to a view of learning as basic skills and facts that could be mastered through memorisation, information reproduction and application (Marton, Dall'alba, & Beaty, 1993). Instructional processes were therefore closed and involved the transfer and assimilation of facts and skills, either through expository teaching or through individualised modules such as mastery learning (Biggs & Moore, 1993).

As can be seen from the previous summary, this emphasis shifted as the processes of cognition became better understood and numerous concepts and strategies were developed that facilitated learning. A number of these concepts are referred to during this study and are defined as follows:

metacognition- the process a person engages in when they reflect on how they learn (Biggs & Moore, 1993; McInerney & McInerney, 1994);

encoding - the cognitive linking of new material to already existing schemes of knowledge; and

concepts and concept mapping - whereby concepts are linked diagrammatically by the learner, to illustrate their interconnections and relationships (Ault, 1985; Novak & Gowin, 1984, cited in Biggs & Moore, 1993).

Critique of objectivist and cognitivist approaches.

It can be argued that approaches based on objectivist perspectives are most appropriate for specific lower order teaching/learning requirements. Objectivist approaches can be very efficient where the aim is to teach specific tasks or information, a requirement of much work place training. The hierarchical structuring can provide comfort to the novice student and teacher alike (Marra & Jonassen, 1993). It is also possible that the hierarchical approach of objectivist design is most suited for teaching a particular style of learner. Research findings have shown that surface (Biggs & Moore, 1993) or field dependent (Jih & Reeves, 1992) learners respond well to this approach. Alternately, deep (Biggs & Moore, 1993) or field independent learners (Jih & Reeves, 1992) are easily bored by this more predictable and controlled approach to learning.

However, as Merrill (1990b) notes, because this approach breaks a subject up into hierarchies, it also tends to fragment a subject into components, making it difficult for the learner to create schema's or models. The closed subset of knowledge makes it difficult to accommodate new theory and generally promotes passive learning which neglects the integration of skills, therefore making the application of knowledge in new situations (transfer) difficult. This approach also leads to a very predictable style of teaching.

Merrill (1990a) criticises the cognitivist approach of discovery learning for its wastefulness of time and states that it is unable to overcome large gaps in a learner's prerequisite knowledge and skills. He also states that it is unable to provide the novice learner with the organisation of knowledge which best builds a mental model, and that the experienced learner who only requires specific information is also not served. This has been confirmed by proponents of "guided discovery", of whom, Laurillard (1994) states that "Educators have known for some time that discovery learning is over-ambitious, even at post-graduate level students need a lot of guidance" (p. 24).

Constructivism

Constructivism is the central educational paradigm in which this study is grounded. The following section traces its development very briefly, and explores a number of the constructs that inform this study in more depth.

The humanists.

The year before Watson published his challenge to American psychology in 1913, Wertheimer published his challenge to German psychology (Hill, 1977). Wertheimer objected to the concern with analytical experimentation, stating that breaking consciousness into parts destroyed what was most meaningful about it. His emphasis on whole systems or *gestalts* led to the formation of the Berlin school and the foundations of Gestalt psychology. Instead of the behaviourist question “ ‘What has the individual learned to do?’ the gestalt therapist is likely to ask ‘How has the individual learned to perceive the situation?’ ” (Hill, 1977, p. 116). Learning is seen as the change from one *gestalt* to another. Hill argues that the most important contribution that gestalt theory has made to educational psychology is the study of insight, the signifier of a shift in *gestalt*.

In reaction to the mechanistic approach to education that developed with the advent of behaviourism, schools began to acknowledge the importance of human emotions and feelings. Humanism had a strong influence on education, where it was known as alternative or open schooling. It was most popular in the 1960s and crested in popularity during the early 1980s. It can be traced back to the progressivism of Rousseau in the 1700s, progressive schooling in United States during the 1920s to mid 1950s, and Dewey whose enduring influence began in the early 1900s.

Two of the elders of humanist psychology were Rogers and Maslow.

Rogers (1969) introduced the concept of learner-centred education, and found that an empathic environment for free expression increases self-acceptance and self-knowledge thereby leading a person to change their own behaviour.

Maslow (1968) proposed that each individual is born with an essential inner nature which is shaped but not dominated by experiences and the unconscious mind. He stated that children can control much of their behaviour and should be encouraged to choose their own learning focus.

Critique of humanist approaches.

Humanistic education has suffered from a general lack of clear definition and its implementation has proven difficult to evaluate (Gage & Berliner,

1992). The variability in implementation has also made comparison between classes very difficult.

Gage & Berliner (1992) found that humanist approaches often improved co-operativeness, creativity and independence, and slightly improved students' attitudes to creativity, school, teachers, and mental ability.

Rothenberg (p. 486, cited in Gage & Berliner, 1992, p. 492) found that open schooling:

- was also very demanding for the teachers;
- did not appear to improve achievement;
- was frequently inadequately prepared;
- was not integrated into a unified approach; and
- was insufficiently monitored thereby allowing students to avoid significant curricular areas including basic skills.

It was therefore frequently seen as undesirable by parents, especially in working class areas.

Implications for the study.

The student centred approach of humanism has influenced the current study, because as facilitator in this study, my training was grounded in humanist psychology.

Some of the humanistic principles identified by Gage & Berliner, (1992) and Biehler & Snowman, (1990) which underlie the study are:

- the teacher's role as facilitator rather than knowledge provider ;
- students learn what they want and need to know;
- wanting to learn and knowing how to learn are more important than acquiring factual knowledge;
- students' own evaluation is a meaningful judgement of their work;
- and
- learning takes place best when students are feeling relaxed.

Gage and Berliner, (1992) also identified the components of humanist environments. The following applied to the study:

- flexible physical space;
- participant's choice in activity selection;
- a rich variety of learning materials;
- subject integration;

small group and individual work emphasised;
student self-direction;
open communication; and
mutual respect between staff and participants.

The constructivists.

Constructivism is a philosophy of art, science and cognition (Bruner, 1986) with the tenet that what we know of the world is in fact a product or a construction of the mind (Bruner, 1986; Marra & Jonassen, 1993; Reeves, 1993; Schwandt, 1992) which, when it appears to function in the same way as someone else's understanding, can be, "taken as shared" (Cobb, 1991 cited in von Glaserfeld, 1996, p. 4). This leads to the assumption that there is no right way for the learner to see the world and no ultimate "Truth" to convey. Instead of emphasising behaviour or skills, the goal of constructivist teaching is usually deep understanding and concept development (Fosnot, 1996b).

The two theorists in particular who have made significant contributions to this field are Piaget and Vygotsky.

Piaget (1952) gained his PhD in the natural sciences by the time he was 21, before becoming interested in psychology (Fosnot, 1996a). He based much of his conceptualisation of mental processes on his understanding of genetic epistemology. A number of his theories have become merged with, and extended by, both contemporary cognitive and constructivist psychologies (Biggs & Moore, 1993).

Piaget (1952) described how cognitive development occurs in stages "characterised by qualitatively discrete cognitive structures" (McInerney, D. & McInerney, V. 1994, p. 77), with specific abilities and restrictions and linked to specific age ranges. These stages of cognitive development have been adopted and adapted widely by modern psychologists and have considerably extended psychological understanding of cognitive development.

Piaget's later research (1977, cited in Fosnot, 1996a) focused on the process of equilibration, a concept derived from biology which describes the motivating factor in evolutionary change. He found that this process was also reflected in cognitive growth and transformation. His research showed, that when children come across new information or experiences that fit

within their current schemes of the world, they assimilate this information into their existing schemes. If however, the information does not fit, a disequilibrium is set up which motivates them build or *reconstruct* their schemes in a process he termed accommodation.

Vygotsky (1986) was a Russian scholar whose first major work was published in 1934 in Russia, although officially banned because it relied on "psychoanalysis, Gestalt psychology, and the cross-cultural analysis of consciousness" at a time when "objective science" was favoured (Kozulin in foreword to Vygotsky, 1986, p. xliii). Vygotsky's books were published posthumously in the west, the first nearly 30 years after his death at the age of 37. Vygotsky saw cognitive development as the transformation of biological capacities into higher cognitive capabilities, via social and educational processes and with the assistance of tools, language, and social structures (McInerney, D. & McInerney, V. 1994).

Vygotsky's (1986) concept of the Zone of Proximal Development (ZPD) provides a direct challenge to Piaget's (1952) assertions on stages of development, by stating that a child's developmental level is not age dependent but can in fact be "scaffolded" to a higher level. Vygotsky (1978, p. 86, cited in Bruner, 1986) defines the ZPD as, "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (p. 73). He also stated that "human learning presupposes a specific social nature and a process by which children grow into the intellectual life of those around them" (1978, p. 88, cited in Bruner, 1986, p. 73).

Vygotsky's (1986) contribution to constructivism is based on his notions of social facilitation, scaffolding and guided discovery. He places a greater emphasis on guidance than Piaget (1952). Piaget emphasised the child's self-determined exploration and discovery rather than direct teaching (Pressley et al, 1992, cited in McInerney & McInerney, 1994). McInerney, D. and McInerney, V. (1994) also note that Piaget and Vygotsky share much in common. Both Piaget and Vygotsky emphasised:

- the process of learning over the product of learning;
- the importance of the child's active participation in learning;
- the importance of grounding school learning in the daily world of the child's experience;
- the importance of peer interaction; and

the need to take account of students' individual differences.

Most contemporary constructivists view knowledge as "temporary, developmental, non-objective, internally constructed, and socially and culturally mediated" (Fosnot, 1996a, p. ix). Concepts related to deep learning such as constructing meaning, empowerment, and perceptual and personal change are constructivist conceptions and aims of learning (Biggs & Moore, 1993; Marton & Saljo, 1976). These aims are frequently facilitated by presenting opportunities for concrete, contextually relevant experience, leading to the formulation of patterns and questions, and the construction of models, strategies and concepts (Fosnot, 1996a). Information is represented from a multiplicity of perspectives, with some scaffolding, thereby providing students with contexts for learning through discovery. The social and collaborative processes of dialogue, reflection and negotiating meaning are also seen to be inherent to this approach to learning (Jonassen, 1995).

Critique of constructivist approaches.

Reference to constructivism only begins to appear in educational psychology texts in the 90's (Biggs & Moore, 1993; McInerney & McInerney, 1994). Constructivist approaches (Fosnot, 1996b) require time and reflection to develop, ideally with opportunities for peer review and dialogue.

Criticism of constructivist education can be aimed at both the variability in its implementation as well as on its approaches, which, being grounded in a different world view, present oppositional perspectives to those that until very recently, have been the dominant practice within mainstream education. Some of the common arguments against constructivist approaches follow.

Dick (1995) voices concerns common to other objectivists struggling with the alternative paradigm, when he fears that constructivism leads to a loss of "instructional focus; that creativity will replace effectiveness, that having fun will replace learning something, and that we won't know the difference" (Dick 1995, p.10). Tobias (1991) in an editorial prefacing an issue of the Educational Technology journal devoted to the "split" in paradigms, also voiced the concern that constructivists pay too little attention to prior learning and that by accepting the students' preference, learning may be unwisely biased. He fears that depth is developed at the expense of breadth.

The above arguments do not present a strong case against current constructivist practice, especially as mainstream education is beginning to clarify and implement many of its principles. Fetherston (1997) has also developed a systematic approach to designing instruction that applies equally to constructivist learning as to objectivist learning design. This model addresses most of the concerns mentioned.

Implications for the study.

This study adopted the foundational constructivist notion that knowledge is constructed. The participants were therefore encouraged to collaboratively negotiate and clarify their understanding of the knowledge domain, thereby re-constructing it for the purpose of representing it to their peers via multimedia.

The small number of participants in the study, allowed for individual requirements to be recognised and matched in line with constructivist ideas. Issues of prior learning and skills mastery were partly addressed through the preliminary skill development sessions and through one-on-one scaffolding. Formal assessment was never an aim for the study. The preferences of participants were accommodated within the overall framework of the project outcomes.

The issue of enjoyment provides a major contrast with the objectivist view, as it was seen as a central motivator to sustain engagement with complexity and therefore as a potential catalyst to increase understanding and skill.

As shown, objectivist approaches emphasise an objective truth and the acquisition of facts. It has been argued that this approach has some utility for novice learners and for training applications. This approach is not appropriate for deepening students' natural engagement with learning, a factor that flow theory suggests is fundamental to learning. Nor does objectivism provide an integrated and deep understanding of a subject, or challenge learners to grapple with a task so that they understand it sufficiently to be able to generalise it to other contexts.

Some of the aspects of the cognitive approaches of guided discovery and problem solving have become integrated within the constructivist paradigm and are utilised within the current study. Because constructivism emphasises meaningful, scaffolded, student directed and deep learning,

which takes into account individual differences, is grounded in the daily world of the learner's experience, and takes place within a social environment that encourages reflective dialogue and collaboration, it was seen as the appropriate learning theory to undergird the study. The following section looks at a specific constructivist approach that informed the study design.

Learning by Designing

Learning by designing (Balestri and Ehrman, 1992) is the constructivist approach to learning which was adopted for this study. The following section explains the learning by designing approach and introduces the concepts of mind tools and situated cognition which are central to the study. This section is concluded with a brief description of knowledge as design, collaboration and collaborative software design as these concepts also had a bearing on the study.

Design for the purpose of this study was viewed as "the human endeavor of shaping objects to purposes" (Perkins, 1986, p. 1). Balestri and Ehrman (1992) expand on this definition by stating that design is aimed at producing a material product through a creative process, frequently based on trial and error experimentation and is "sustained, sequential, and recursive" (p. 2). A design is subject to analysis by particular criteria such as aesthetics, feasibility and economics.

Papert (1980) was one of the first educators to advocate students using computers as tools for knowledge construction, through the design of software. He was fired with a vision of the learning that occurred naturally when people had powerful tools. His work was based on Piaget's (1977) later constructivist work and on developments occurring in Artificial Intelligence research. His book *Mindstorms* (Papert, 1980) inspired many teachers to teach the LOGO programming language in schools as a vehicle to learning complex thinking skills. As he reports in hindsight in the foreword to the (1993b) edition of this book, most schools in 1980's did not have access to the technology that could realise his vision. Nevertheless, many ingenious teachers developed simplified processes for implementing his ideas.

Harel and Papert (1992) reported on their study of a group of fourth grade students who used the Logo programming language to design a simple

software package to teach younger students about fractions. They reported that students, in struggling to represent their understanding of the knowledge domain, became involved with the deeper structures of mathematics over the surface structures. Harel and Papert (1992) also found that through the vehicle of software design, students sustained engagement with the task. This facilitated a “gradual evolution of different kinds of knowledge” (1992, p. 69), a reflective and metacognitive understanding of their thinking processes that was shared and extended with other members of the group.

McInerney, D. and McInerney, V. (1994) state that the student participants also:

- developed an awareness of their own knowledge and that of their audience;
- learned to plan, revise and manage time;
- became more cognitively flexible as they abandoned inefficient designs for better ones; and
- developed confidence in their thinking ability

The concept of absorption and its role in learning is described in the work of Csikszentmihalyi, M. and Csikszentmihalyi, I. S. (1988b) and forms part of the focus of this study. This will be explained more fully in the section on flow theory.

The value of designing something to deepen understanding is explored by Perkins (1986). Perkins stated that the people who benefited most significantly from the design process and the resulting tools were the designers, not the people who used the product. Whilst discussing the efficacy of instructional software, Jonassen (1994) added to Perkin’s assertion “I shall argue that we should take the tools away from the instructional designers and give them to the learners, as tools for knowledge construction rather than media of conveyance and knowledge acquisition”. This statement prompted the formulation of the first research question, to investigate what it is that people learn from designing multimedia software. Jonassen (1995) is such a strong advocate of the learning by designing approach, because he argues that it provides rich ground for knowledge constructions through stimulating active, constructive, collaborative, intentional, conversational, contextualised and reflective learning.

Jonassen (1994) also explains that designing assists students to build a knowledge base, as they are required to analyse the subject domain and to develop mental models to represent it. They then have to frame their understanding within those models. This process readily leads to generative learning, learning that extends these mental models.

Rieber (1996) has also stimulated learning through engaging students in the design of software, this time through game design. His premise was that the "creative investment one takes in the design process leads directly to intellectual 'ownership' of the game's content". In the context of designing game interfaces for microworlds illustrating Newton's law of motion, he presented students with "a relevant context for adapting content for a useful purpose". Like Harel and Papert (1992) and Salomon, Perkins and Globerson (1991), he found that engagement caused the learner designers to become "mindful" in a manner that was nonautomatic, focused and guided by metacognition (Rieber, 1996). This alert focus, and anticipation for responsive understanding is also described by Csikszentmihalyi (1992) and will be explored more fully in the next section.

Balestri, Ehrmann and Ferguson (1992) make a strong case for establishing design studios in schools and colleges to motivate active learning in as many subjects as possible across the curriculum. Their book documents a number of projects which used technology to support the design process. The learning by designing approach was used to teach students composition, programming, computer assisted design (CAD), academic writing and genetics. Interestingly, although the design process is such a strong motivator for learning, and the Australian National Curriculum (Australian Education Council, 1994a, 1994b) is placing an increasing emphasis on the Design, Make and Appraise approach in their technology and arts curriculums, few other references to this approach are to be found. Equally sparse has been evidence of the implementation of this approach. Perhaps this is because cases are not documented or as Balestri et al. (1992) suggest, because of scarce resources and lack of time, unprepared faculty and difficulties with assessment.

Implications for the study.

The learning by designing approach it is argued, challenges learners to extend their mental models of a subject domain and thereby to engage in generative learning, because it requires them to grapple with the task of

analysing a subject so that they can represent it as effectively as possible for the use of others. It is also argued that the investment in the process of design leads to intellectual ownership of the content.

The learning by designing approach was therefore deemed the appropriate vehicle to study the learning that occurred when a small group of tertiary drama education designed a piece of multi-media software for their peers.

Tools for the Mind

Vygotsky (1986) explored the notion of psychological tools “as instruments for the construction of higher functions” (Kozulin in foreword to Vygotsky, 1986, p. xxvi), through the individual’s mastery of expressions of behaviour and cognition, such as gesture and language. Vygotsky’s research studied the use of external objects such as signs, to assist in the processes of attention, recall, and decision making.

Brown, Collins & Duguid (1989) applied the concept of cognitive tools to conceptual knowledge, as tools which need to be used within specific cultural contexts. This concept will be discussed further in the section on situated learning.

Jonassen (1994) uses the term “cognitive tools” to signify the use of technology to extends learners’ understanding through facilitating their ability to represent what they know. This is achieved through providing the user with scaffolding to support, guide and extend their thinking. “Cognitive tools actively engage learners in creation of knowledge that reflects their comprehension and conception of the information rather than focusing on the presentation of objective knowledge. They are learner controlled, not teacher or technology-driven” (Jonassen, 1994).

Salomon, Perkins, and Globerson (1991) also explored the use of technology to facilitate cognition. They compared the passive effects of technology on the learner when it is the source of information, versus the intellectual partnership that is generated as an effect *with* technology which results when the learner mindfully engages in a task that uses the computer as a cognitive tool.

The advent of more user-friendly computers with high level interactive multimedia capabilities, has the potential to make technology accessible to

an unprecedented degree. This technology can provide learners with the powerful tools that Papert (1993a; Jonassen, 1994; Jonassen, Campbell, & Davidson, 1994) have spoken of, to facilitate and authenticate their designs.

Implications for the study.

Tools for the mind (Jonassen, 1994) is a term used to describe external objects which assist cognition by motivating and assisting complex representation and calculation, and thereby extending conceptualisation.

In this study, multimedia computers and software provided the participants with tools to represent, explore and extend their understanding and creative ideas. The use of these tools afforded the opportunity to study to what degree the ability to present their ideas in a professional looking manner and to extend their skills with this technology would motivate the participants to learn.

Situated Cognition

The concept of situated cognition has been widely discussed and adopted (Bransford, Sherwood, Hasselbring, Kinzer, & Williams, 1990; CTGV, 1993; Delclos & Hartman, 1993; Reeves, 1992; Rowland, Fixl, & Yung, 1992; Shore, Erickson, Garik, & Hickman, 1992), after being described and named by Brown, Collins & Duguid (1989) who argued in line with constructivism, that "many methods of didactic education assume a separation between knowing and doing". Brown et al found that learning can not be separated from its context, the latter being an integral part of what is learned. They coined the term situated cognition stating that "situations might be said to co-produce knowledge through activity. Learning and cognition, it is now possible to argue, are fundamentally situated".

In line with the constructivists, Brown, Collins & Duguid (1989) view conceptual knowledge as constantly evolving, influenced by situations and circumstances that "recast it in a new, more densely textured form". They framed conceptual knowledge as sharing a number of significant features with tools stating that "they can only be fully understood through use, and using them entails both changing the user's view of the world and adopting the belief system of the culture in which they are used". They also argued that "people who use tools actively rather than just acquire them, by contrast, build an increasingly rich implicit understanding of the world in which they use the tools and of the tools themselves". This process occurs

most readily through enculturation, where the student, like an apprentice enters a community of practice through “authentic activity” and witnesses the use of the conceptual tools in use to “reflect the cumulative wisdom of the culture in which they are used and the insights and experience of individuals. Their meaning is not invariant but a product of negotiation within the community”. They state that students in classrooms are often asked to engage in “hybrid activities” that are not endorsed by the cultures to which they are attributed and that this “limits students’ access to the important structuring and supporting cues that arise from the context”. Activities become transformed into classroom tasks within the culture of the school. They also describe the successful implementation of cognitive apprenticeships in a classroom with the example of a teacher who developed a mathematical culture of practice (Brown, Collins, & Duguid, 1989). Through dialogue and negotiation, the students’ understanding of mathematical knowledge was extended to include intuitive shortcuts and concrete knowledge based on application and hypothesis testing. This led to their own discovery of the underlying formulas and principles. Brown et al explain that “cognitive apprenticeship methods try to enculturate students into authentic practices through activity and social interaction in a way similar to that evident -- and evidently successful -- in craft apprenticeship”.

Brown, Collins & Duguid (1989) also state that collaborative activities promote: collective problem solving; understanding of the different roles that are required in cognitive work; the drawing out and confrontation of misconceptions and ineffective strategies; and the development of collaborative works skills in preparation for the workplace.

Although published critique of situated cognition has been difficult to locate, some of the problems also identified with discovery learning can be applied. Situated cognition requires time and does not readily fit into the established, compartmentalised curriculum. It almost by definition occurs beyond the classroom walls, unless teacher/student roles are the focus, although the dialogue process of cognitive apprenticeships can be incorporated more readily into the classroom.

Implications for the study.

The process of designing software situated the participants in the authentic task of multimedia software design. Each participant was invited to choose their “craft apprenticeship” role from the interface design, content

design and various production roles. They were also provided with some scaffolding by professionals, through preparatory training as well as during the actual project, so that they had the foundation of skills to meet the requirements of that role.

This use of situated practice provided the opportunity to study to what degree and depth, the participants would engage in dialogue and negotiation in the process of clarifying their understanding of the underlying principles within their chosen disciplines.

Knowledge as Design

Perkins (1986) challenged the common notion of Knowledge as information, “data devoid of a purpose” (p. 3), seeing knowledge instead as “a structure adapted to a purpose” (p. 2). This stimulated him to identify a unit of knowledge as a “design”. He postulates that knowledge as design is more than a provocative metaphor, but that knowledge in fact provides a structure that allows phenomena to be conceptually taken apart to be understood much more fully, and put back together again.

Perkins (1986) provides a heuristic to stimulate the scrutiny of objects, concepts and events.

These questions are:

1. What is its purpose(s) ?;
2. What is its structure? (or what does it consist of);
3. What are some models (or examples); and
4. What is the argument? (for and against)

During the design process this heuristic was used to generate design ideas for the various components of the project.

Collaborative Software Design

Preece, Rogers et al (1995) described the iterative design process of prototyping, evaluation, and development, that specifically incorporates the users’ feedback about the design as the software is developing. They name this process the Star Model (Preece et al, 1995) of software design and state that this iterative process in fact most closely reflects much software development practice. This model was adopted as the software design methodology for the project.

Collaboration

During the analysis of the data, observations of engagement as experienced during groupwork, raised questions about the collaborative process of learning. Shrager (1995) defines collaboration as “the process of *shared creation*: (emphasis in the original) two or more people with complementary skills interacting to create a shared understanding that none had previously possessed or could have come to on their own” (p. 33). He states that collaboration is generally poorly understood but is becoming increasingly important as professional specialisation increases. Without it he suggests, little creative innovation will occur.

Conclusion

The constructivist approach of using the learning by designing approach within the situated context of multimedia design, was deemed appropriate for this study because it challenges learners to grapple with representing their understanding of the play-devising subject domain, within the context of developing a multimedia software compendium to teach their peers. It has been argued (Jonassen, 1994; Papert, 1993a; Perkins, Goodrich, Tishman, & Owen, 1994) that this approach stimulates generative learning and challenges learners to revise and extend their mental models of the subject domain.

Mind tools to scaffold and extend the participating drama education students' thinking and creativity, were provided by the use of multimedia computers. It was also aimed to stimulate a rich understanding of the multimedia design world.

The situated context of the study provided the participants with an authentic activity which motivated them to adopt specific cognitive roles from which to negotiate and clarify their understanding of the underlying principles relevant to their discipline.

This was framed in a group context where negotiation, collective problem solving, the clarification of concepts and misconceptions, and collaborative practises could be developed.

Combined, these elements provided a rich ground to study what learning processes would be triggered by this combination of factors. The literature

also suggests that a result of this approach is mindfulness, and motivation to learn, because it stimulates engagement with the subject matter.

The next section will examine the process of engagement as explained by flow theory (Csikszentmihalyi, 1992) and will present the argument that engagement is necessary if skills are to be developed to successfully grapple with complex learning tasks. This is seen essentially as constructivist.

Flow Theory

People who learn to control inner experience will be able to determine the quality of their lives, which is as close as any of us can come to being happy.

(Csikszentmihalyi, 1992, p. 2)

In this section flow theory will be introduced and explained. This will be followed by a description of a number of the significant flow concepts referred to throughout the study. Next, the educational significance of flow theory will be discussed and this section will conclude with an explanation of the theoretical framework of the study.

Flow theory, or the psychology of optimal experience as its author Csikszentmihalyi (1992) calls it, is characterised by absorption or a sense of timelessness and is recognised in many different cultures around the globe. This experience is commonly aligned with immersion in a challenging and worthwhile activity which stretches a body or mind to its limits and provides us with "a landmark in memory for what life should be like" (p. 3).

Flow may not necessarily always be pleasurable, because a swimmer's lungs may be burning as they push themselves to win the race, but it leads to a sense of "mastery",... " a sense of *participation* in determining the content of life " (Csikszentmihalyi, 1992, p. 4)

Csikszentmihalyi (1975) reports that during interviews people would frequently spontaneously use the word "flow" to describe this state. He therefore studied the state of flow to isolate the key elements so that his research might be used to improve the quality of people's lives.

Background

Csikszentmihalyi's (1975) work on optimal experience began with his doctoral dissertation which focused on the study of what motivated young artists to create paintings. He then extended his research to study several

hundred “experts”, people focused on their preferred activities such as art, athletics , music, surgery and chess. Wishing to know if the flow experience occurred in daily life, Csikszentmihalyi, M.I and Csikszentmihalyi, I.S. (1988a) developed a tool to sample the experience of adult workers. They further refined this sampling technique and with the help of this tool, their research team and later their colleagues around the world, collected both qualitative and quantitative data about “the state in which people are so involved in an activity that nothing else seems to matter” (Csikszentmihalyi, 1992, p. 3). The quantitative data provided scientific validation for his theory.

Their findings point to the fact that flow is experienced in all cultures, by all classes and ages, and by both women and men. Although flow is a state that people access naturally, many people who do not exert some effort to have a degree of control over their consciousness, find it difficult to encounter it regularly in everyday life (Massimini & Carli, 1988) .

The Pre-conditions for Flow

Csikszentmihalyi (1992) states that flow is characterised by the following specific components, most or all of which are experienced during flow:

- A challenging activity that requires skill;
- The merging of action and awareness (ability to concentrate);
- Clear goals and feedback;
- Concentration on the task at hand;
- The paradox of control (confidence in one’s capacity to act);
- The loss of self-consciousness; and
- The transformation of time (the experience of time bears little relation to the clock);

The Relationship Between Flow and Complexity

Flow theory (see figure 2 below) indicates that a person experiences flow when the challenge they are facing (labelled as A1 or A4) is commensurate with their skill level. If the challenge they face is higher than their skill level (labelled as A3), they become anxious, if the challenge is lower than their skill level (labelled as A2), they become bored. If the person increases their skills to match the challenge however, they will re-enter the flow channel at a higher level (labelled as A4). As the flow experience is very satisfying, it provides motivation to engage with a task and to constantly

maintain equilibrium between task and skill level by refining skills and increasing the complexity of the task.

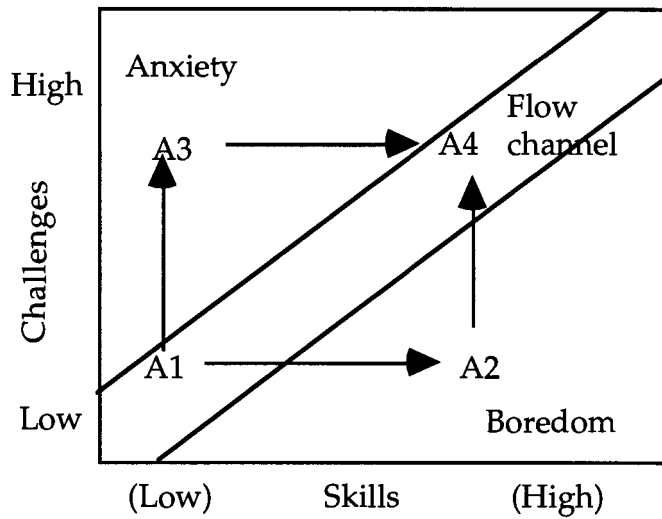


Figure 2. "Why the complexity of consciousness increases as a result of flow experiences" (Csikszentmihalyi, 1992, p.74)

Although Csikszentmihalyi, M. and Csikszentmihalyi, I. S. (1988a) gathered voluminous data on mood to verify people's experience of flow, their choice to use the ratio between the challenge and skill levels to define flow, was based on its analytic independence. The supplementary reports of mood were then used to confirm or disconfirm the reports of flow. Initially it was thought that challenge and skill merely had to be in balance, but over time it became apparent that *the challenge and skill levels had to be in balance as well as above average* for that person, for them to also be feeling strong, alert, happy.

The most central element (of flow) however, seems to be the balance between the perceived challenge of the activity and a person's skills. One must experience the activity as presenting opportunities for action that are well meshed with one's talents. Only when this balance occurs does the opportunity exist for enjoyment and deep involvement.

(Larson, 1988, pp. 163-164).

The Experience Sampling Form (ESF)

Csikszentmihalyi's (1975) research was initially of a qualitative nature. With his colleagues, he came to require data that were not retrospective and solely reliant on memory (Csikszentmihalyi, M. & Csikszentmihalyi, I.S. 1988a). They therefore devised a methodology which they called the Experience Sampling Method (ESM), which was implemented and refined

by a number of large scale, international studies over the following decade (Csikszentmihalyi, M. & Csikszentmihalyi, I.S. 1988a). The method used a “beeper” which would randomly signal the study participant 8 times during the day, to fill out an Experience Sampling Form (ESF) questionnaire “on the spot”. The questionnaire required that the participant rated a number of categories regarding their state of consciousness, affect, activation, cognitive efficiency and intrinsic motivation. The ESF also included open ended questions regarding the context that influenced the respondents’ “state of consciousness”.

The challenge and skill signifiers for flow were imbedded amongst other questions and required a simple rating from 0 (low) to 9 (high) for the questions “Challenges of the activity ”, and “Your skills in the activity ” (Csikszentmihalyi, M. & Csikszentmihalyi, I. S. 1988a).

The Systematic Assessment of Flow in Daily Experience

The ESF was used by Massimini and Carli (1988) who studied 47 secondary Italian school students between the ages of 16 and 19. The study was devised to establish which “contexts of every day life make the flow experience more likely to occur” (p. 267). They collected a total of 25 ESF self reports from the 47 students at random times during the day.

Massimini and Carli (1988) found that for a person whose mean level of challenge is 6.0, the rating of a specific situation as presenting a challenge level of 5.0 would be relatively low, but for another person whose mean challenge level was 2.0, the same rating of 5.0 would constitute an exceptionally high level of challenge.

Massimini and Carli (1988) categorised the combinations between the level of each person’s perceived challenges and skills into eight different ratios between the individuals’ standardised challenge and skill scores:

- channel 1. High challenges and average skills (arousal);
- channel 2. High challenges and high skills (flow);
- channel 3. Average challenges and high skills (control);
- channel 4. Low challenges and high skills (boredom);
- channel 5. Low challenges and average skills (relaxation);
- channel 6. Low challenges and low skills (apathy);
- channel 7. Average challenges and low skills (worry); and
- channel 8. High challenges and low skills (anxiety);

The eight channels were illustrated by the following diagram.

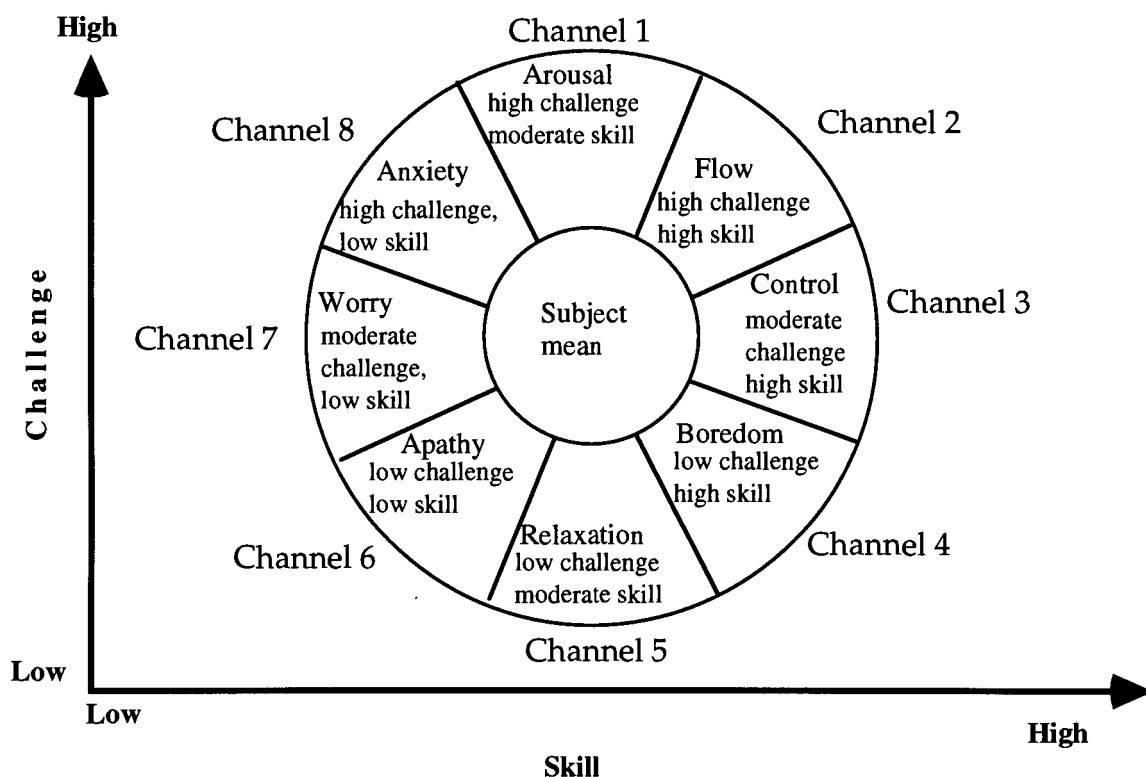


Figure 3. A model for the analysis of experience. (Massimini, F. and Carli, N., 1988,p.270)

They acknowledged that these categories simplified the data and omitted the representation a number of possible combinations, for example average challenge and average skill. These general categories were nevertheless found to be helpful in illustrating the major effects of the various skill/challenge combinations.

Strategies for Building Flow

Csikszentmihalyi (1992) expressly wished to avoid giving recipes for creating flow, aiming instead to challenge readers to reflect on his stories ordered into the framework of theory and to relate them to their own lives. Nevertheless, the following strategies are outlined within the text of his book (p. 97).

These are:

- to set an overall goal, and as many subgoals as are realistically feasible;
- to find ways of measuring progress in terms of the goals chosen;

to keep concentrating on what one is doing, and to keep making finer and finer distinctions in the challenges involved in the activity;
to develop the skills necessary to interact with the opportunities available; and
to keep raising the stakes if the activity becomes boring.

This list formed part of the conceptual framework of the study which will be presented at the end of this section on flow. It was also addressed in detail during the discussion in Chapter Seven and used as an A4 poster to remind the participants of the flow process, during the study (see Appendix C).

Flow Concepts

The following concepts are fundamental to understanding flow theory and are therefore referred to throughout the study. These concepts are introduced below, and their specific relationship to the study is explained at the end of this section.

The role of goals.

Goals are seen as central motivators of action leading to flow, especially when chosen by the individual. Csikszentmihalyi (1992) states that when people are pursuing goals they “experience a sense of control which is absent when behaviour is not motivated by consciously chosen goals” (p. 242). Once a goal is chosen, the sub goals or tasks that are required, become apparent, leading to the skill, challenge, feedback, and flow cycle.

Csikszentmihalyi (1992) describes the iterative cycle between goals, which drive the creation of self, and in turn influence a person’s choice of goals. This is illustrated by the adolescent who chooses a profession and then focuses on developing the relevant skills and social trappings of that profession.

Attention as psychic energy.

As also confirmed by the information processing model (see Figure 1) Csikszentmihalyi (1992) points out that attention allows the selection of information from the millions of pieces of information that make up everyday life. Furthermore, it assists the retrieval of relevant related information from the long term memory, allowing comparison, evaluation,

and decision making in the working memory. However, Csikszentmihalyi argues (1992) that the ability to sustain this attention beyond the immediate moment requires a degree of discipline which some people learn to develop and which other people never learn to value.

The mark of a person who is in control of consciousness is the ability to focus attention at will, to be oblivious to distractions, to concentrate for as long as it takes to achieve a goal, and not longer. And the person who can do this usually enjoys the normal course of everyday life.

(Csikszentmihalyi. 1992 p. 31)

Csikszentmihalyi (1992) describes attention as psychic energy because “without it no work is done, and in doing work it is dissipated” (p. 33). He states that it can be focused “like a beam of energy” (p. 33), energy that “can be invested in innumerable ways, ways that can make life either rich or miserable” (p. 33). This is due to that fact that the attention “determines what will or will not appear in consciousness” (p. 33) for example, in the same situation one person seeks opportunities for enjoyment, whilst the other seeks evidence of danger.

So how is attention developed? Csikszentmihalyi (1992) suggests that there is no easy formula but that it requires a commitment both to sustaining focus on a task when attention shifts through the various states of entropy, as well as observing the thought processes in daily life and choosing to seek the opportunities for enjoyment inherent in ordinary situations. Csikszentmihalyi’s (1992) Strategies for increasing flow (see above), also aim to fine tune the attention span.

Entropy and negentropy.

Csikszentmihalyi (1992) names those forces that disrupt a person’s ability to focus on a task or situation as psychic entropy. Feelings such as fear, rage, apathy, and anxiety, are examples of responses to common life experiences that disrupt focus and create inner disorder. He states that psychic entropy occurs very readily for many people when their personal goals are not met. Csikszentmihalyi (1992) points out that it is a person’s interpretation of an event that determines how they respond. For example, one person will simply worry about a lack of money, whilst another will plan a course of action and follow a clear sequence of achievable goals.

Negentropy is Csikszentmihalyi's term for optimal experience or flow which occurs when "all the contents of consciousness are in harmony with each other, and with the goals that define the self" (Csikszentmihalyi, M. & Csikszentmihalyi, I.S. 1988b, p. 24). In this state, psychic energy becomes freely available because there is no disorder in consciousness, no conflict or threat to redirect attention away from the chosen goal.

Microflow and anti-flow.

Csikszentmihalyi describes "small, almost automatic behaviour patterns which are not extrinsically rewarded yet appear to have a necessary function", as microflow (1975, p. 141). These "noninstrumental" or "trivial" behaviours include daydreaming, doodling, chewing, chatting, cigarette smoking, humming and reading. "Everyone develops routines to fill in the boring gaps of the day, or to bring experience back on an even keel when anxiety threatens" (1992, p. 52). Csikszentmihalyi found that these activities may "perhaps (be) essential to normal functioning" (Csikszentmihalyi, 1975, p. 177), because they help "to impose order in consciousness" (1992, p. 52). When these activities were stopped, Csikszentmihalyi (1975) observed that people frequently became increasingly irritable, lost concentration and became depressed thereby experiencing what he termed as anti-flow.

Complexity.

Differentiation implies a movement toward uniqueness, toward separating oneself from others. Integration refers to the opposite: a union with other people, with ideas and entities beyond the self. A complex self is one that succeeds in combining these opposite tendencies.

(Csikszentmihalyi, 1992, p. 41)

Just as the sustainment of the balance of challenge and skill builds increasing complexity in learning and accomplishment, so does the flow experience build an increased complexity in the person or self. Csikszentmihalyi (1992) states that this occurs through the two processes of *differentiation* and *integration*. He suggests that the concept of complexity has become confused with difficulty when it is equated with differentiation. However, using the metaphor of the car engine, he describes how the jumble of parts become a coherent whole through their integration. In the same manner, he has found that a person who values only differentiation may have accomplished great things, but is also likely to be immersed in self-centred egotism. Equally, a person who has chosen only integration will

be secure, but will lack their autonomy and individuality. Csikszentmihalyi states that flow, through immersion and skill development, leads to a self-confidence and enjoyment that builds the complexity of the self.

The autotelic experience.

Most enjoyable activities are not natural; they demand an effort that initially one is reluctant to make. But once the interaction starts to provide feedback to the person's skills, it usually begins to be intrinsically rewarding.

(Csikszentmihalyi , 1992, p. 68)

Csikszentmihalyi uses the word Autotelic derived from the Greek, *Autos* meaning self and *telos* meaning goal, therefore "a self that has self-contained goals" (1988, p. 209), meaning someone who originates their own goals rather than being directed by social conventions and biological needs.

The autotelic personality.

An autotelic person is never bored because they interpret challenges as opportunities for action rather than as threats, thereby turning potentially entropic experience into flow.

Csikszentmihalyi (1992) shows that the flow model directly indicates the process required to develop an autotelic self (pp. 208-213). Autotelic people find it easy to set and commit themselves to goals, and to increase their skills and monitor the feedback as required. Because they have ownership of the goal, they are also more able to adapt it as required. They also learn to immerse themselves in an activity by assessing appropriate opportunities for action. This is facilitated by directing the attention away from the self and taking interest in external circumstances and people. Autotelic people commit themselves to sustaining their focus, thereby avoiding one of the most common distracters, self-consciousness. These elements can be developed in any order, whether choosing a goal, developing skills, cultivating the ability to concentrate or banishing self-consciousness, "once the flow experience is in motion, the other elements will be much easier to attain" (Csikszentmihalyi, 1992, p. 212). Finally, autotelic people have learned to take joy in the simple pleasures offered by their immediate circumstance, such as stopping to appreciate the colour of the light or watching children play, or simply appreciating their work.

Csikszentmihalyi cites neurological research (1992, p. 87) that found that intrinsically motivated people require fewer external cues to represent their environment in consciousness, thereby giving them more flexible attention and autonomy due to being able to restructure their experience internally. A study of cortical activation found that people who report frequent experiences of flow relaxed when they had to direct their attention, in contrast to others who became more activated when they were asked to perform the same task. Whether these abilities are genetic or learned was not established. Csikszentmihalyi (1992) states that "the findings could be explained in terms of learning rather than inheritance" (p. 88) and that further research is required.

Logan (cited in Csikszentmihalyi, 1992, p. 90) found that some people had survived gruelling hardship by intuitively applying the principles of flow, thereby turning barren external circumstances into experiences that they could subjectively control. He studied many accounts of people who had faced difficult situations such as those who were lost in Antarctica or were exposed to prolonged solitary confinement in prison. Logan found that these people all studied their environment minutely to discover opportunities for action within their limited means. They then set appropriate goals and closely monitored their progress. As their initial goal was reached they increased the complexity of the activity. Two of the examples Csikszentmihalyi (1992) gives are: a pilot who was imprisoned in North Vietnam for many years, who imagined himself playing eighteen holes of golf every day. Although emaciated, he played an excellent game on release; and Eva Zeisel, a ceramic designer imprisoned in solitary confinement in Russia for over a year, who occupied herself amongst other things, with gymnastics, mentally playing chess against herself, and memorising poems she had once composed.

Logan (cited in Csikszentmihalyi, 1992) concluded from his studies, that the strongest trait of survivors of extreme adversity is a " 'non self-conscious individualism' or a strongly directed purpose that is not self seeking" (p. 92).

Conversely, there are two conditions that prevent the experience of flow. These are: the fragmentation, or conversely; the excessive rigidity, of the attentional processes. These conditions manifest at a personal level as self-consciousness and self-centredness respectively, and at a social level as anomie (a state in which social norms become muddled or lost) and alienation (Csikszentmihalyi, 1992, p. 86).

The autotelic family.

Rathunde (1988) engaged in a longitudinal study of 193 talented teenagers and their families to identify the contexts and the dynamics of contexts that facilitated flow.

He found that Autotelic families provide a supportive framework for learning, leaving members free to immerse themselves in what they are doing. The qualities provided by Autotelic families (Rathunde, 1988) are:

Choice, of task without coercion or neglect;

Clarity, the provision of focus and feedback with clear parental support and expectations;

Centering, the experience of parental interest in the intrinsic value of what is being done;

Commitment, the safety to put aside defences and become unselfconsciously absorbed in the task at hand; and

Challenge, the provision of increasingly complex problems and situations to stimulate engagement.

Rathunde (1988) found that teenagers from homes that provided these characteristics were happier, stronger, more cheerful and satisfied when at home with their families, but also when studying alone and at school. It was only in social environments that their peers from non-autotelic families reported equally positive feelings.

Flow and design.

Whilst categorising autotelic experiences for their research analysis, Csikszentmihalyi, M. and Csikszentmihalyi, I. S. (1988b) found the following experiences grouped together;

Friendship and relaxation;

Risk and Chance;

Problem Solving;

Competition; and

Designing or discovering something new.

The first four categories include a number of subcategories, for example; Problem Solving includes "solving a mathematical problem", "assembling equipment", "playing poker", and "exploring a strange place".

Csikszentmihalyi, M. and Csikszentmihalyi, I. S. (1988b) asked people representing a wide range of activities, to classify their activity according to

these categories. For example, older dancers, female chess players and composers were found to identify their activity as being most like “solving a mathematical problem”. Even during his early work, Csikszentmihalyi (1975) saw design as “a unique experience, different from the others; this item represents a creative dimension” (p. 27). The dimension of design was consistently rated highly for flow by all groups. He found that “regardless of the activity, people who perceive what they are doing as primarily creative, rather than competitive, are also motivated by intrinsic rewards” (1975, p. 32). This is a key element in flow.

The Educational Relevance of Flow Theory

A fundamental quest of educators has been to find ways of making learning more enjoyable so that their students’ performance might increase. Csikszentmihalyi (1992) shows that performance gains are based on an increase in the complexity of a task, so that the student is challenged to develop their skills to sustain their experience of flow.

In theory, it is simple enough to make any learning task enjoyable: find out what the student's skills are and what their level is... then devise limited but gradually increasing opportunities for the expression of those skills. The learning will then become intrinsically motivated.

(Csikszentmihalyi, M. & Csikszentmihalyi, I.S., 1988b, p. 205).

This reflects the theory of the Zone of Proximal Development (Vygotsky, 1986) and in fact extends it through the focus on engagement. Engagement as a process appears to be implicit in ZPD theory, but does not appear to be explicitly mentioned in the relevant literature.

Rieber (1996) points out that the clear model of engagement that flow theory presents, may provide a significant tool for increasing students’ motivation to learn. A prescriptive model for increasing intrinsic motivation which thereby extends a person’s ability to increase the complexity of their learning, appears to provide a significant educational tool and therefore warrants further exploration by educational researchers.

Summary

Flow theory describes an optimal state of absorption, where unself-consciousness and timelessness are experienced, along with a fluency and strong focus. This state comes about most easily when a person is pursuing

clear goals, which provide immediate feedback, at a challenge level that is above average for that person and which they meet with an equal level of skill. As the challenge of a task increases, a person is motivated to maintain their experience of flow by increasing their commensurate skills. As their skills increase, increased opportunities for challenge are perceived. Therefore, the flow state provides an intrinsic mechanism for building increasing complexity into daily life experience, be it work, recreation or study. This complexity builds an integrated person, confident of their skills and with the ability to immerse themselves, enjoyably, in their work.

Flow theory has been applied and tested extensively throughout the world and has been found to be experienced by people in most cultures, experiencing many conditions including extreme hardship.

To provide additional information after extensive interviews, a measuring tool called the Experience Sampling Form (ESF) was developed to assess flow in daily experience. This allowed people to rate their mood, feelings, motivation, cognitive efficiency, and energy levels. This tool also provided analytic independence by facilitating the analysis of flow through comparing the relationship between people's perceived experience of challenge and skill. This tool led to the categorisation of eight independent channels which identified degrees of flow.

Csikszentmihalyi (1992) and his colleagues have identified a number of flow related concepts. They found that attention is a form of psychic energy. Through consciously directing the attention, people are able to transform negativity or disorder in consciousness which they termed entropy, into the ordered consciousness synonymous with flow or negentropy. They also found that people generate microflow through the practice of small ritual behaviours such as doodling or smoking as a way to combat entropy. They also found that when deprived of these activities, people experienced anti-flow or irritability, depression and loss of concentration.

To distinguish why some people readily experienced flow, and others not at all, Csikszentmihalyi and his colleagues (1992) looked at neurological functioning and the influence of the family. Some of their findings included: that people who readily experience flow found it relaxing to concentrate and required less external support for their mental processing; and that self conscious people and self centred people found it much more difficult to immerse themselves in intrinsically motivated tasks. They also

found that there is a connection between a person's family attitude and their experience of flow. They found that people from families which had allowed them to choose their own tasks and had supported and encouraged their immersion, were more able to immerse themselves in later life.

Csikszentmihalyi (1992) has also found that design is the activity most universally reported to rate flow. This suggests that the activity of designing provides most potential for immersion and the development of complex skills and understandings.

Implications for the Study

Flow theory was chosen as one of the theories to guide the conceptual design of this study because it effectively augments constructivist theory. Although there is little acknowledgment of the importance of social interaction in flow theory, both theories agree that intrinsically motivated learning provides the most meaningful learning, and both place the onus on the learner to actively participate in their learning. Csikszentmihalyi (1975) also provides a relevant and dynamic model for increasing engagement in the learning by designing process however, and suggests that an understanding of the flow process (1992) allows the learner to consciously increase their ability to engage with complexity.

It was anticipated that due to the intrinsically motivating nature of the design process, the project would provide excellent opportunities to study flow. A number of questions that arose during the study included: what variables would influence the experience of flow?; how easily could Csikszentmihalyi's (1992) model be adapted for use?; and how closely would the skill and challenge balance provide an effective index to flow? These questions are addressed in the individual case studies and discussed in the findings in Chapters Seven.

The following aspects of flow theory were implemented in this study.

A question (see page 55) used in a previous flow study (Allison & Duncan, 1988) which was framed around a description of flow, was used in the initial interview.

A question (see page 56) was included in the interview to determine whether the participant was a member of an autotelic family.

The ESF was used in the collection of data and is described in the methodology and data collection sections (see Table 1).

The repeated completion of the ESF by the participants, stimulated metacognition about the flow process.

The principles outlining “the conditions of flow” (see Appendix C) were discussed with the participants at the outset of the project, to allow for their participation in their process of optimising flow. The principles were also printed up as an A4 poster and pinned on the noticeboard.

Participants were encouraged to seek their own tasks within the context of the software design project, and to take some responsibility for structuring their own goals, in line with the conditions for flow (Csikszentmihalyi, 1992). Due to time constraints, lists of tasks were also prepared for rank ordering and as a guide to progress. This is described further in Chapter Four.

At the summation of the project the participant’s understanding of flow theory was further explored with their participation in a final focus group.

Theoretical Framework

The theory underpinning this study determines what is asked, learned and how the data are interpreted. Cogent theories on which to base the study design have been chosen and outlined in the review of the literature. This section illustrates the relationship between constructivism and flow theory (see Figure 4).

As explained in Chapter Two, constructivism emphasises the construction of meaning. Learning in this study was stimulated through the process of learning by designing. This learning occurred in the situated context of designing multimedia software. This required the participants to review and extend their understanding of play-devising through the process of discussing and collaboratively designing, a multimedia product. This process was scaffolded through the provision of preliminary and ongoing information and practical assistance, and through the provision of multimedia computers and software which provided the participants with powerful mind tools.

The process of designing multimedia provided the participants with tasks at varying challenge levels. These required the participants to acquire the relevant skills so that they could meet the challenge. It was anticipated that the balance between the challenge and skill levels would indicate the experience of engagement or flow, and that this would motivate further learning, so that this balance would be maintained.

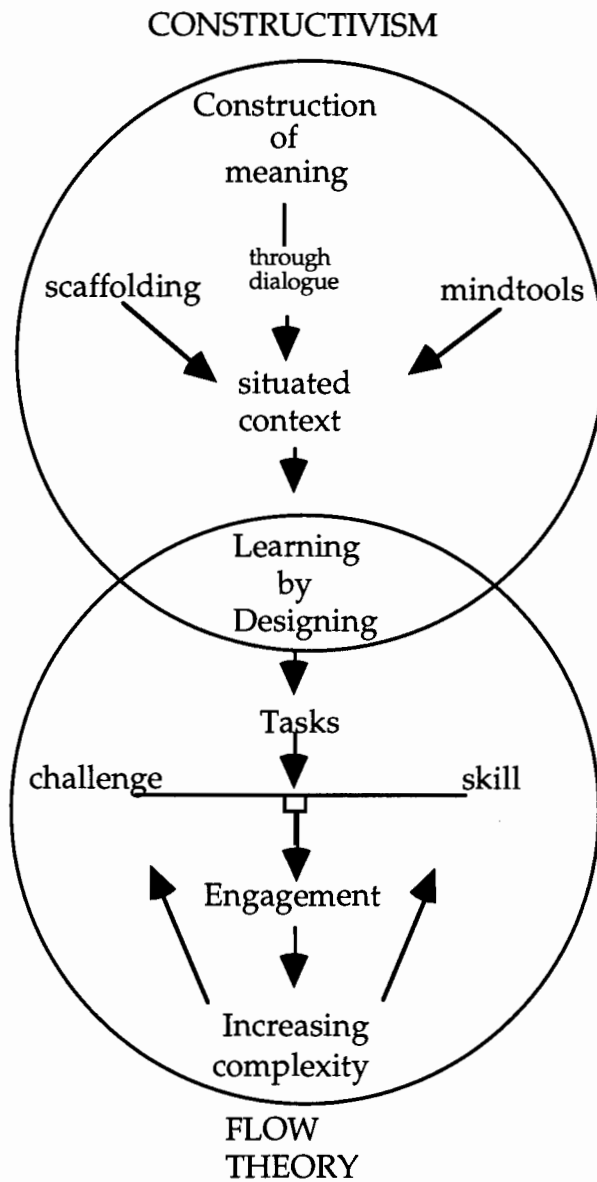


Figure 4. How constructivism informs learning-by-designing and thereby provides the context for stimulating flow to enhance learning.

Methodology

Introduction

The current study is a qualitative case study which also utilises some appropriate quantitative data. This section outlines the interpretivist and objectivist research paradigms and briefly presents the origins and forms of the interpretivist tradition. Next, the reason why case study methodology was chosen is explained. Finally to establish the rigour of the study, the issues of reliability and validity are presented, and the issue of convergence, the issue of whether the qualitative data and quantitative data describe the same phenomena, is discussed.

A Comparison of the Objectivist and Interpretivist Paradigms

Objectivist research emphasises the precise and objective measurement of observable phenomena under stringently controlled conditions, often using calibrated tests or standard instruments. Objectivist researchers have generally required that quantitative data be collected using precisely controlled experiments whether these experiments were testing scientific or human phenomena. A feature of a quantitative approach is that it can compare and assign statistical significance to the reactions of a representative number of people to a specific set of questions. This can provide broad, generalisable sets of findings which are presented as objective accounts of phenomena. This approach to research is dependent on the careful construction of the instrument of research, which in education is generally a restricted-response survey or series of test items. These are frequently administered in a controlled environment and in a standardised manner. The survey or test items thereby become the main instruments of the research (Patton, 1990).

The fact that quantitative research depends on standardised questions to allow generalisation, means that answers are by necessity limited to specific pre-determined categories (Patton, 1990). This disregards information related to individual circumstances and perspectives, and therefore limits insight into why or how a phenomenon has occurred (Yin, 1989).

In recent years, interpretivist research has become widely valued as a research method because it collects qualitative data within naturalistic

settings and can provide a depth of information often not available to quantitative research (Patton, 1990).

Interpretivist researchers, in contrast, don't believe that there is one objective truth but that there are multiple realities. These are accessed through open-ended interviews, observation and written documents, for example flow charts and concept maps. Interview data consist of direct quotations from people about their experiences, understanding, feelings and opinions. Observations provide detailed descriptions of people's activities, behaviours, actions and interactions as well as observable organisational practices. Written documents, such as quotations and excerpts from programme records, reports, diaries and written responses to open-ended written questionnaires are analysed (Patton, 1990). This type of "fine grained" (Kozma, 1994, p 115) information is frequently required in the social sciences, anthropology, nursing and education.

Interpretivist research generates large volumes of data and generally, restricts the number of people under study. It can however, provide rich ground for insight. In qualitative research, the researcher is generally the instrument of the research and therefore the validity and reliability of the data depends largely upon the researcher's experience and training and their sensitivity, integrity and skill in observing, eliciting and analysing the data (Patton, 1990). As the researcher is not constrained by the predetermined categories of analysis of quantitative questionnaires, a greater openness to the data is afforded, thereby allowing fresh insight to emerge regarding the phenomena under study.

To protect the credibility of their research, interpretivists take care to provide verbatim accounts and to document both the researcher's biases and the process followed during analysis to arrive at the findings. Guba and Lincoln (1981) state that loss of rigour "is more than offset by the flexibility, insight, and ability to build on tacit knowledge that is the peculiar province of the human instrument" (p. 113). It is also recognised that qualitative studies cannot be reconstructed precisely because human behaviours and settings are never static and studies are often undertaken to record processes of change (LeCompte & Goetz, 1982). Although qualitative researchers don't aim to generalise in the manner of quantitative research, being wary of stripping the context from the data, they advise that idiosyncratic research should be avoided by thinking "beyond the narrow confines of the data to ... other applications of the findings" (Patton, 1990, p. 489). This allows

working hypotheses to be generated that can be extrapolated to other settings (Patton, 1990).

Interpretivist and objectivist approaches to research both have different strengths and weaknesses and therefore are alternative approaches to research. These methodologies are increasingly used in combination, especially for large scale evaluation studies. This allows for the collection of the most meaningful combination of data to suit a particular research focus (Yin, 1989, Patton, 1990) thereby allowing a more comprehensive understanding to be obtained.

The need for interpretive insight is also stressed by Strauss and Corbin (1990) who say “theoretical sensitivity refers to the attribute of having insight, the ability of giving meaning to data, the capacity to understand, and the capability of separating the pertinent from that which isn't” (p. 42).

Implications for the Study

This study adopted an interpretivist approach to gain a fine grained description of a small and bounded real-world event. Quantitative data was also collected through the use of the Experience Sampling Form (ESF) (Csikszentmihalyi, M. & Csikszentmihalyi, I. S., 1988a). This data was used to triangulate the qualitative data. This process of triangulation will be discussed in more depth later in this chapter.

In the current study, longitudinal data collection was not an option, however, an organising theory focused the study analysis, theoretical sensitivity was aimed for, additional data was gathered to test emerging hypothesis and alternative hypotheses were sought.

Perspectives of Interpretivist Research

Interpretivist research practice has been cultivated in the social science disciplines. Methodologies have been developed, determined by their focus and needs and founded on each discipline's theoretical underpinnings. A description of a number of the main schools follows. Although none met the specific requirements of the current study, a number of their methodologies were adopted.

A brief summary of Patton's (1990) description of the major perspectives follows.

Ethnography originated from Anthropology and studies the existing culture of a group of people. Participant observation is employed, wherein the researcher is immersed in the culture under study and analyses the data from a cultural perspective.

Phenomenology originated from Philosophy, and was developed into rigorous science through the Frankfurt school in Germany (Weininger, 1995). It focuses on the distillation of the structure and essence of an experience or phenomenon as shared by groups of people, for example ageing, marriage or motherhood.

Hermeneutics developed from theology, philosophy and literary criticism and informs all qualitative research through its study of interpretive understanding. Hermeneutics is grounded in the understanding that reality is constructed and therefore interpreted from the perspective of the researcher and the participants in the study. It uses a circle or spiral of explication which ends "when a sensible meaning and coherent understanding, free of inner contradictions has been reached" (Kvale, 1987, p.67 cited in Patton, 1990, p. 84).

Heuristics derived from Phenomenology and was developed from the base of Humanistic psychology. It emphasises connectedness and relationship. It legitimises the researcher's personal experience and foregrounds their reflections and insights. The rigour of heuristics is provided by the systematic observations and depth of dialogues with self and others who are experiencing a particular phenomenon. The participants are frequently encouraged to adopt the role of co-researchers.

Ethnomethodology originates from sociology and asks how people make sense of their everyday activities "so as to behave in socially acceptable ways" (Patton, 1990, p. 73). Ethnomethodologists study the tacit and taken-for-granted norms of a community by bringing them to the surface through experiments that disrupt ordinary events. Examples of this are the simple experiments of facing the wrong way in a lift or not shaking hands when being introduced.

Grounded theory is a term used in qualitative research to mean the generation of theory grounded in data. The researcher approaches the data without expectations, and searches for categories or "dimensions of analysis" (Patton, 1990, p. 44) to emerge inductively from the data, until the

data is finally exhausted. These categories begin to form into patterns, thereby providing the "ground" from which the theory is developed.

Action research is a self-reflective spiral process of observing , reflecting, planning and acting (Kemmis & McTaggart, 1990). It is "a critical evaluation of practice within a democratic framework" (McNiff, 1994, p. 4) by the participant practitioner, where the context of practice provides the case for study. Action research is therefore used to enhance practice, or to test assumptions of theory in practice through implementation and evaluation (Hopkins, 1993).

Initially, action research methodology appeared to suit the requirements of this study because I was personally participating in the facilitation role and was interested in increasing my skills in this role. On reflection it was recognised that action research was not suitable for a number of reasons. The first is that it aims to find the answers to specific problems that arise in ongoing professional practice. The current study however was seeking to gather data about a new and unique situation. Secondly, action research as a reflective practice requires sufficient time to allow the iterative spiral of observing, reflecting, planning and acting to develop. The time span available to the current study was insufficient to allow this cycle full implementation. Finally, the participants of the study were not stake holders in the research, as in the case of co-teachers for example. This meant that they could not make decisions regarding the final form of the research or be asked to contribute too much of their time.

A decision was made to use broad case study methodology as outlined by Patton (1990). In a field with numerous authorities on the subject of methodology, the selection of one authority allowed for consistency and coherence within the structuring of the work.

A number of methodologies from the above general areas were adopted, particularly the concepts of participant observation, enlisting the study participants as co-researchers through the process of dialogue, the understanding of the constructed nature of thinking, and the inclusion of reflections and insights.

The qualitative paradigm offered themes well suited to the study requirements. It allowed a focus on a real-world event occurring in a natural setting. The holistic perspective allowed the rich complexity of the

collaborative design process to be described within the context of the study, based on “thick descriptions” (Patton, 1990, p. 375) and direct quotations reflecting people’s personal experience. Although it is understood that complete neutrality is not possible, as far as possible, a stance of empathic neutrality was taken, allowing the insights generated through personal contact and participation, to emerge.

Case study

A case study that portrays an educational problem in all its personal and social complexity is a precious discovery.
(Stake, 1988, p. 254)

Qualitative case studies are frequently used in educational research because they can focus on the learning process and richly describe the student, the situation and the resulting interaction, thereby allowing individual outcomes to be evaluated (Patton, 1990). Because the current study aims to describe, illustrate and explain what students learned from the design process; as well as their process of engagement, case study methodology was chosen as the most appropriate research methodology.

Case study methodology also allows: the combination of qualitative and quantitative data (Yin, 1989); addressing the “how” and “why” in the research question (Yin, 1989); defining specific study questions ahead of time (Yin, 1993) and; testing emerging hypotheses (Levine, 1990). In the current study: both quantitative ESF data and qualitative data are used; the research questions were formulated ahead of time; the focus was on the how and why of learning and engagement by design; and hypotheses were tested as they arose, through focus questions.

Case study reports are narratives written in a manner accessible to the non-specialist. They aim to describe a case in enough depth so that an outsider can understand the mechanisms and factors which affected its outcomes and to uncover patterns which emerge from the data, which go beyond mere description. Although the analysis does not suggest causal relationships, it aims to bring to light interrelationships and links between the elements studied (McMurray, 1994). Case study reports also aim to: provide a compelling and robust account (Yin, 1989); to describe the case in “depth and detail, in context and holistically” (Patton, 1990, p. 54); thereby developing an explanation based on “fine-grained, moment-by-moment observations” (Kozma, 1994, p 115); which allows “linkages and inter-

relationships between the elements studied” to be suggested (McMurray, 1994, p 19).

The case study report also aims to promote empowerment, resonance (Lincoln & Guba, 1990), reflection and action (Adelman, Jenkins, & Kemmis, 1976) and a balanced perspective best illustrated by the words of Stake (1988) when describing the work of his colleagues.

Smith and Pohland were working on a conceptual structure, building up an understanding, perhaps as would an author of a TV documentary or a biographer telling a story of one person's life; drawing some conclusions, yet leaving room for readers or listeners to make up their own minds (p. 255).

These attributes were aspired to in the current case study report.

Finally, as stated in the rationale, the aim of the current study is to describe and explain a novel and complex environment and thereby provide an authentic source of new ideas and hypotheses for teachers (Salomon, 1994). The case study therefore provides a strong methodological foundation, ideally suited to this requirement.

Validity

To address the issues of threats to credibility of qualitative data, Le Compte, and Goetz (1982) translated the positivist tenets of validity and reliability to the qualitative traditions of research.

To establish the validity of research, it is necessary for the researcher to demonstrate that the propositions and findings they generate match the causal conditions under study (LeCompte & Goetz, 1982). Patton says, “The qualitative researcher has an obligation to be methodical in reporting sufficient details of data collection and the processes of analysis to permit others to judge the quality of the resulting product.” (1990, p. 462) How these requirements were addressed by the current study is discussed in the following section.

External Validity

External validity addresses the issue of the extent to which research findings are applicable to other groups. Patton (1990) states that the issue of generalisability can be contentious in the research profession. Interpretivist researchers tend to disagree with the assertion that rigorously controlled

experiments can be generalised to real world events which are inevitably subject to contextual influences, whilst objectivist researchers argue that qualitative research can be so idiosyncratic as to offer little or no insight beyond their own settings. Patton cites Cronbach et al (1980, in Patton, 1990) as offering a "middle ground" (p. 489) in this debate with their concept of "extrapolation" which requires that the researcher reflects on the wider application of their findings, to other similar settings, and provides thoughtful insights regarding the lessons they have learned and the future potential applications of their work. To facilitate extrapolation, thick descriptions of the contexts, methods and analysis have been included in Chapters Three, (Data collection), Four (Data analysis), Five (the Background of the case study), Six (the Five Case studies), to allow the reader to judge whether the study resonates with, and can inform their own educational contexts. The Discussion in Chapter Seven reflects on the lessons learned and how the study might have been improved, and hypotheses for further educational research are proposed in Chapter Eight to suggest how the findings might be adapted to other educational settings.

As is frequently the case with qualitative research, in the current study the sample of participants is not particularly representative of the general population of drama education students. This is explained in the data collection section in Chapter Three. To the extent that flow theory categories were used for analysis, the problem of using constructs that do not compare across groups was avoided.

Internal Validity

Internal validity asks whether the researcher is actually observing and measuring the causal conditions of the situation (Lincoln & Guba, 1990). Traditionally, interpretivist research claims high internal validity derived from the richness of the data and the interpretive value of the analysis techniques.

Although the current study does not have the benefit of having collected data over the longer term, a number of other qualitative requirements for high internal validity were met. The researcher was a participant observer. Concepts that were formulated during the study were discussed with the participants to check for accuracy. The qualitative method of including the participants' own perspectives verbatim has also been used to promote internal validity. The effects of the participant observer on data collection

was discussed with the participants and the resulting discussion documented. Furthermore, rival explanations were sought, negative cases inspected and the data triangulated.

Testing rival explanations.

Once the data have been analysed, it is important to look for competing themes and explanations, both inductively, by seeing how else the data might be organised, as well as logically, by seeing if there are other logical possibilities that can be supported by the data.

Negative cases.

When patterns and trends are identified, it is important to scrutinise those instances that don't fit these patterns as they may frequently extend, change or cast doubt on the emerging perspective. The negative cases in this study have contributed rich ground for comparison and discussion.

Triangulation.

Methods triangulation draws the source of the data from both qualitative and quantitative data. The ESF developed by Csikszentmihalyi, M. and Csikszentmihalyi, I. S. (1988a) was the quantitative tool used in the current study. It is sometimes argued that the comparative analysis of quantitative and qualitative data presents difficulty in establishing whether the data have "converged" (Patton, 1990. p. 467) and that care must be taken to monitor this. Convergence describes "what things fit together", (Patton, 1990, p. 403) leading to the classification of data. This issue arises because a quantitative category by the same name may in fact describe a different phenomena than the same term viewed from the qualitative perspectives. In the current study however, the quantitative aspects of the ESF were specifically constructed and refined by Csikszentmihalyi, M. and Csikszentmihalyi, I.S. (1988a) and their colleagues to elucidate the theory of flow, thereby ensuring that the terms used described the same phenomena.

Data triangulation requires the cross checking of data from different sources (Patton, 1990). In the current study, the data collected from interviews, observations, focus groups and documentation provided the material for data source triangulation. The final focus group also provided an opportunity for emerging hypotheses to be discussed with the participants for clarification.

Reliability

Reliability is based on two assumptions. These are: that the study is replicable; and that two or more people can collect and have similar interpretations of the data.

External Reliability

As mentioned, replicability was not a particular aim of the current research. Corroboration with observers and critical friends was sought, to check the interpretation of key points. Ethical and logistical protocols informed the process of writing field notes, one of the primary data sources, and were adhered to as far as possible for the current study.

Internal Reliability

Yin (1989) states that "The general way of approaching the reliability problem is to make as many steps as possible as operational as possible and to conduct research as if someone were always looking over your shoulder" (p. 45). In the current study all phases of the research are explicated, including: the research assumptions and biases; data gathering procedures; and the various decisions regarding analysis and study design.

Fittingness

As qualitative research relies on the skill and experience of the researcher as the instrument of the research, the credibility of the researcher is highlighted. As a Masters student, research is a learning process for me, and my methodological skills are therefore developing. However, I believe that my professional background has provided me with a range of other skills that are well suited to the requirements of qualitative research.

My work as a psychiatric nurse, rehabilitation counsellor, teacher and lecturer has given me considerable interpersonal and group facilitation experience to which listening, observation, empathic neutrality, accessibility and the ability to build a climate of trust are fundamental.

Bias

All the above procedures are aimed at limiting the researcher's biases in data analysis and interpretation. Nevertheless, Patton (1990) suggests that neutrality and impartiality are difficult to achieve and that it is important

for researchers to use their own behaviour as a source of data and to state their preconceptions so that their effect on analysis can be understood. To satisfy this requirement, ideological bias is addressed in the review of the literature and reference to the fields notes is included as appropriate.

To further allow elucidation, self-reflective fieldnotes were made during the study and referred to in writing this thesis as a source of data, as appropriate. Also, as far as possible, care has been taken to explicate all study related decisions such as observational focus, analytical coding decisions and selection criteria. The participants' perceptions were sought during group discussions to confirm or refute particular understandings and perceptions.

Conclusion

Qualitative case study methodology was chosen for the research design because the research questions sought to answer the "how" and "why" of flow theory. The learning by designing project provided an excellent case for study, and qualitative methodology allowed the researcher to take the role of participant observer. The fact that the case study report aims to provide a resonant, accessible narrative to the non-specialist, providing sufficient detail and depth to be able to suggest links and inter-relationships between the study elements whilst still allowing the reader sufficient room to make up their own mind, was also seen as an important element in choosing the study design.

Steps taken to ensure the validity of the data include the methodical reporting of sufficient detail to allow the reader to judge the resulting product. To avoid idiosyncratic research, extrapolation of the study findings was aimed for by suggesting a number of hypothesis for further testing in a variety of educational settings. Internal validity was aimed for through the inclusion of the participant's verbatim accounts, rival explanations were sought, negative cases presented and the data triangulated by comparison against the quantitative data of the ESEs, as well as cross checking it against the interview data, the group discussion transcripts, and documents produced during the study. The emerging hypotheses were discussed with the participants in a focus group for clarification. Reliability was aimed for by checking the interpretation of key points with critical friends and explicating all the steps of the research process. All effort was taken to ensure that as far as possible, this report provides a valid and reliable contribution to educational research.

CHAPTER THREE

Data Collection

This chapter details each of the procedures and instruments used to collect data for the study. The data collection methods and data collection points are presented in a table next to the related research questions. A table is also provided to illustrate the times that the data was collected. Finally the study participants are also discussed.

Procedures

The data collection procedures employed during the study are detailed below.

Interviews

The framing of a question can pre-empt a person's response by assuming that a certain condition, feeling or response is present (Patton, 1990). Care was taken therefore, to frame questions so that they were truly open ended and non-directive in order that the interviewee could draw from their own experience and would feel free to elaborate. The same range of topics for each interview was covered.

Four of the five participants were interviewed in a side room, on the first two days of the study. These interviews lasted between 12 to 25 minutes, and were conducted whilst the interviewee's peers were working alone or in pairs in the main work area. One participant who attended erratically and also generally left early was interviewed at a lunch time. All the interviews were recorded on audio cassette tape and transcribed verbatim, soon after the conclusion of data gathering.

Most of the interviews commenced with a descriptive statement of flow gleaned from Allison and Duncan (1988) who used this statement when they interviewed women regarding their experience of flow and anti-flow during their working day.

I am going to read you a description of a state of mind. After I read it I would like to ask you to what degree you experience it and answer some other questions about it.

When I stop to think about it I realise that an important part of this state of mind is enjoyment. I get so involved in what I'm doing, I almost forget about time. When I experience this state of mind, I feel really free from boredom and worry. I feel like I am being challenged or I that I am very much in control of my action and my world. I feel like I am growing and using my best talents and skills; I am master of my situation. (p. 121)

This statement was used at the beginning of the interviews to elicit the participant's recollections of their experiences of flow. The two other main open ended questions asked were "What attracted you to participate in this project" and "How did your family support your learning as you were growing up". The latter was prompted by Csikszentmihalyi's (1992) statement that people who's parents "promoted unselfconscious individuality" (p. 93) are more likely to experience flow. Participants generally gave a useful word sketch of their family in response.

Observations

Reflective fieldnotes recording descriptions of events, feelings, and reactions were recorded at some length, at the end of each day. It was initially attempted to write fieldnotes during the day, but this proved too difficult to sustain, as the demands of the project left little scope for disengagement.

The Experience Sampling Form (ESF)

The ESF (Csikszentmihalyi, M. & Csikszentmihalyi, I. S., 1988a), described in the review of the literature, was printed on a double sided sheet of paper and administered on the first day of the study. It is reproduced below in Table 1, to assist the reader in understanding the data.

Table 1

The Experience Sampling Form (Csikszentmihalyi , M. & Csikszentmihalyi, I.S. 1988a, p. 254)

Date:_____ Time Filled out:_____Name:_____

As you finished your task...

What were you thinking about?_____

What was the MAIN thing you were doing?_____

What other things were you doing?_____

Why were you doing this particular activity

() I had to () I wanted to do it () I had nothing else to do

	not at all			som ewh at			quite		very	
	0	1	2	3	4	5	6	7	8	9
How well were you concentrating?										
Was it hard to concentrate ?	0	1	2	3	4	5	6	7	8	9
How self-conscious were you?	0	1	2	3	4	5	6	7	8	9
Did you feel good about yourself?	0	1	2	3	4	5	6	7	8	9
Were you in control of the situation?	0	1	2	3	4	5	6	7	8	9
Were you living up to your own expectations?	0	1	2	3	4	5	6	7	8	9
Were you living up to expectations of others ?	0	1	2	3	4	5	6	7	8	9

Describe your mood as you began to fill out this questionnaire:

alert	0	<input type="radio"/>	.	-	.	<input type="radio"/>	0	drowsy
happy	0	<input type="radio"/>	.	-	.	<input type="radio"/>	0	sad
irritable	0	<input type="radio"/>	.	-	.	<input type="radio"/>	0	cheerful
strong	0	<input type="radio"/>	.	-	.	<input type="radio"/>	0	weak
active	0	<input type="radio"/>	.	-	.	<input type="radio"/>	0	passive
lonely	0	<input type="radio"/>	.	-	.	<input type="radio"/>	0	sociable
ashamed	0	<input type="radio"/>	.	-	.	<input type="radio"/>	0	proud
involved	0	<input type="radio"/>	.	-	.	<input type="radio"/>	0	detached
excited	0	<input type="radio"/>	.	-	.	<input type="radio"/>	0	bored
closed	0	<input type="radio"/>	.	-	.	<input type="radio"/>	0	open
clear	0	<input type="radio"/>	.	-	.	<input type="radio"/>	0	confused
tense	0	<input type="radio"/>	.	-	.	<input type="radio"/>	0	relaxed
competitive	0	<input type="radio"/>	.	-	.	<input type="radio"/>	0	co operative

Did you feel any physical discomfort as you completed the task?

Overall pain/discomfort?

none			slight		bothersome				severe	
0	1	2	3	4	5	6	7	8	9	

Please specify:_____

Had you been working alone? () With others () How many ?____

female_____ male_____

Indicate how you felt about your activity

	low high									
Challenges of the activity	0	1	2	3	4	5	6	7	8	9
Your skills in the activity	0	1	2	3	4	5	6	7	8	9
Was this activity important to you?	0	1	2	3	4	5	6	7	8	9
Was this activity important to others?	0	1	2	3	4	5	6	7	8	9
Were you succeeding at what you were doing?	0	1	2	3	4	5	6	7	8	9
Do you wish you had been doing something else?	0	1	2	3	4	5	6	7	8	9
Were you satisfied with how you were doing?	0	1	2	3	4	5	6	7	8	9
How important was this activity in relation to your overall goals?										

If you had a choice ;

Who would you be with? _____

What would you be doing?_____

Since you last filled out this questionnaire has anything happened or have you done anything which could have affected the way you feel?

Nasty cracks, comments etc?

The open ended questions on the ESF proved to give excellent ongoing feedback. Because qualitative research affords the opportunity to adapt to unforeseen circumstances I was able to append the following additional three questions to the ESF on the second day of the study, to gain better insight into the study issues.

Table 2

The additional three questions appended to the ESF

- a) How do you rate your recent work period in terms of flow? (from 1 to 10)
- zilchflying high
- 0 1 2 3 4 5 6 7 8 9 10
- b) If below 7, what might help to increase your feeling of flow right now?
- c) (by the way) Any new or deeper understandings about playbuilding this session ?

The random polling procedure used by Csikszentmihalyi, M. and Csikszentmihalyi, I. S. (1988a) was not appropriate for the current study as it was not the purpose to sample all daily experience. As the focus of the study was on the experience of flow related to the design process, it was assumed that people were likely to be experiencing flow and would best be allowed to immerse themselves in their chosen task. After a discussion with the group about the appropriate times to fill out the ESFs, I decided that it would be most appropriate for participants to fill them out after each significant design session, whilst changing from one task to another or breaking for lunch or tea.

The ESF data were later compared with observations made in field notes about the same events and with documents that were produced during the same ESF period, providing data source triangulation.

Discussion Groups

Informal discussion groups were held with all participants at the start of each day, to plan the day's activities. This also provided the opportunity when required, to ask reflective questions to clarify observations. The answers to these questions were recorded in fieldnotes.

The following discussions were taped, transcribed and analysed.

- a group progress reporting session;
- a paired work session;
- a preliminary design discussion; and
- the final focus group.

A focus group (Patton, 1990) was held on the last day of the study to highlight key issues. This proved to be an efficient way of gaining insight into the participants' understanding of the flow process as well as allowing several other issues that arose during the study to be explored. The focus group also provided an opportunity to bring a sense of closure to the project. Emerging hypothesis were discussed with two educational colleagues, to assess the soundness of the researchers perceptions. Unfortunately the opportunity for member checking (Stake, 1995), the "presenting of draft materials to members for confirmation and further illumination" (p. 171) was not available due to the fact that the participants graduated and travelled far afield before the data were analysed and compiled.

Documentation

All the documents that were produced during the design phase of the study were kept for analysis. These included concept maps, flowcharts, preliminary sketches, rough notes, “brains storms”, photographs of the white board and the participants, as well as computer files saved at various stages of completion.

Open-ended Questionnaires

A questionnaire was used at the completion of the study (see Appendix E) to gauge each individual's responses to the study.

Data Collection Methods, Points and Times

Table 3 below illustrates how and when the data for each research question were collected.

Table 3

The research questions, data collection method and data collection points.

Research question	Data collection method	Data collection points
1. What learning gains are made by tertiary students from participating in the process of multimedia design?	Contextual questions. Field notes/ observations. Open ended written question (on ESF) and documentation. Audio recording.	During work sessions. Written up at the end of each day. At the end of every focused work period. During preliminary design work, group progress report, content writing session, and final focus group.
2. How does flow theory inform the experience of engagement or “flow”, during the process of multimedia design?	Interviews. Experience sampling forms (ESF). Contextual questions. Audio recordings. Field notes/ observations	First 2 days of study. As participant's changed task. As appropriate. During content writing session, the final focus group. End of each day.

Table 4
Data collection times.

	Prelim	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Interviews		*	*				*
ESFs		*	*	*	*	*	*
Field notes	*	*	*	*	*	*	*
Documentation	*	*	*	*	*	*	*
Final Focus group							*
Working groups	Interface discussion			Paired work		Small group	
Questionnaire							*

Participants

The participants were five second and third year art education students attending a university. Three of the participants had prior computing experience, two having developed skills in Pascal and C programming, the third using computer recreationally and for word processing. The remaining two participants joined the study just before the commencement of the intensive design phase and had little or no experience with computers. Each of these five students had chosen to participate at the end of a very busy study schedule at the beginning of their holidays. The participants in the study are not necessarily representative of their peers.

The six day design workshop was run over a two week period, during which time the five students worked together, assisted at times by a graphic designer/programmer, myself as project manager, computer adviser and instructional designer, and their drama lecturer as content expert, to design and produce a number of features of the IMM software.

Conclusion

This chapter has described and illustrated the procedures and instruments that were used to collect the data. Chapter four will describe how the data were analysed. Information regarding the play-devising process, workshop context, daily schedule and tasks will be given in Chapter Five.

CHAPTER FOUR

Data Analysis

This chapter describes the processes used to organise the data, how the categories for analysis were arrived at, how the data were displayed, and how the data were analysed. This will be linked to the previous chapter on data collection and the following chapter which reports the data in the form of case studies.

Miles and Huberman (1994) illustrate the iterative process used in this study of data collection, data display, data reduction, and conclusion drawing in the following manner.

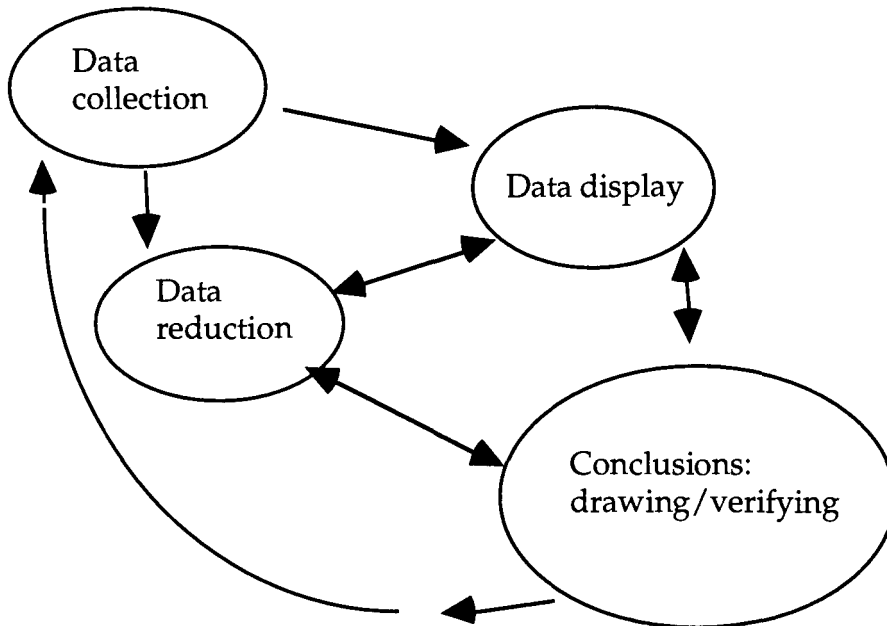


Figure 5. Components of Data Analysis: Interactive Model (Miles & Huberman, 1994, p. 12)

Data Reduction

All the ESFs, transcribed interviews, group discussions and final questionnaires were filed by name and date. This hard-copy data file was used to allow quick cross-checking. This was especially necessary in correlating the ESFs against the daily field notes. The electronic version of the field notes, interview data and various small group transcriptions allowed for key-word searching and data transfer to the working documents.

The field notes, ESF qualitative data, interviews, questionnaires, and discussion transcripts were printed, sorted and notated in the margin with simple codes which identified the learning and flow related events which arose for each participant. This process was guided by the study questions. The first question "What learning gains are to be made by tertiary students from participating in the process of multimedia design" led to the above data being categorised under the broad headings of learning about play-devising, computers, multimedia, flow, Other.

The second question "How does flow theory inform the experience of engagement or "flow", during the process of software design?" led to categories derived from the flow theory literature (Csikszentmihalyi, M. and Csikszentmihalyi, I.S., 1988a). In the first instance, these were: (a) previous experiences of flow (b) the influence of the family on learning; and (c) instances of flow experienced during the study.

As the data were selected, simplified and focused, (Miles & Huberman, 1994), they were collated into the individual case studies. These were initially organised by the headings of background, participation, experience of flow, and what each person learned. These data were then integrated and written up, care being taken to maintain the strong links between them and their context, with constant reference to the field notes, documentation, group and interview data.

On reading these initial case study drafts, it became apparent that the context of each day's activities needed to be described more fully. On a later iteration it was also decided to add the specific ESF ratings for challenge and skill to each activity description. This was initially to answer questions that arose regarding the degree of flow that the various activities afforded. However, scrutiny of the ratings also indicated discrepancies in the skill and challenge indicator for flow, because of numbers of instances when flow was reported in the absence of this balance. The flow ratings were then cross-checked against the mood ratings. For example, a report that someone was feeling alert, happy, or involved, provided confirmation that flow was experienced even when the challenge and skill levels were not in balance. This cross-checking also provided substantiation for the participant's self-ratings for flow.

On the next iteration, Massimini and Carli's (1988) channels for flow were added to the case studies, as these gave a tested indicator to the emotional

experience of participants who were not experiencing flow. It was recognised that the channels they defined could only give a broad indication as to the participants emotional experience, as Massimini and Carli stated that they had purposely limited the range of challenge and skill combinations to 8, to prevent unnecessary complexity in their analysis.

Finally, during the writing of the discussion and the findings, it became apparent that the initial flow study question was too broad and it became necessary to differentiate between the participants' natural processes of engagement and the processes used to deepen their experience of flow. Hence the initial study question pertaining to flow, "How does flow theory inform the process of engagement or "flow" during the process of multimedia design?", was clarified by the addition of the following two subsidiary questions.

- i. How does flow theory inform student's natural process of engagement?; and
- ii. How can flow theory be used to deepen student's experience of engagement or "flow", during the process of multimedia design?

Data Display

The compilation of "an organised, compressed assembly of information that permits conclusion drawing and action" because "extended text can overload humans' information processing capabilities" is recommended by Faust (1982, cited in Miles & Huberman, 1994).

To avoid this a number of data display procedures were used. As the records were sifted, a summary matrix (see Appendix J) was drawn up to illustrate the similarities, differences, variables and themes between the five cases. This was used to inform the first write up of the five-case summary.

Concept maps were used to summarise the key points and themes which arose in writing up the case studies for each participant. These were drawn together for the final discussion.

Each person's ESFs: challenge, skill and flow ratings were collated into a spreadsheet to allow calculation of mean, and a numerical comparison between individuals.

The process of analysis involved many iterations, at each stage it was necessary to return to the original data. Data were then clustered, teased out, drawn into summaries, displayed and written into the study.

Conclusion Drawing and Verification

Miles and Huberman (1994) state that starting from the beginning “the qualitative analyst is beginning to decide what things mean - is noting regularities, patterns, explanations, possible configurations, causal flows, and propositions” (p. 11). They argue that conclusions should be held lightly, and that openness and scepticism should be maintained, however, “the conclusions are still there, inchoate and vague at first, then increasingly explicit and grounded” (Miles and Huberman, 1994, p. 11). Indeed this process was experienced during the study, as findings were checked against data and the literature, and a deeper explanation was sought.

Questions that arose during the workshop were checked with the participants and more data collected, questions which arose later were checked with observers where possible.

Conclusion

This chapter describes the study’s application of Miles and Huberman’s (1994) iterative process of data analysis, through the process of displaying the data, reducing them, drawing conclusions and verifying these against a further study of the data, leading to further display, reduction and verification.

The following chapters presents the context and background to the study. Chapter Six presents the results in the form of individual case studies and a summary, Chapter Seven discusses the findings to the research questions and the themes arising from the study, and Chapter Eight presents the Conclusions, Implications for further practice and for research.

CHAPTER FIVE

Background and Context to the Case Studies

Introduction

The following section establishes the context for the case studies and provides an outline of the daily activities of the CD-ROM design project. Chapter Six presents the five case studies followed by a brief summary and a comparison which contrasts some of the ESF results. Chapter Seven discusses the findings of the study, and brings together a number of issues and themes arising from the individual case studies.

Background

Video recording of the drama class workshops had begun at the beginning of second semester 1995, due to the need to collect the content materials for the drama education CD-ROM project.

Several weeks into filming, the class members were shown some of the digitised video footage on a computer that was brought into their theatre workshop for this purpose. The aim was to orientate them to the requirements of the project, and to help them relax in the camera's presence. Fortunately the group included several students who had participated in a previous drama CD-ROM project and were therefore fairly familiar with the process. A questionnaire was distributed to gather some broad suggestions for the CD-ROM design and also to ascertain if there was any interest in actively participating in the design process. Several students expressed their interest in this, and they were invited to attend a series of informal planning and design meetings. These meetings also served as a pilot for the study.

In all, six of these meetings were held. Ideas for interactively representing the play-devising process on CD were brainstormed and discussed in depth. Frequently, members struggled to integrate the strengths and limitations of the technology with ways of representing the play-devising process with integrity.

An abbreviated transcript of one of these discussions follows here. The members participating in this particular transcript also participated in the

actual study and are called by the pseudonyms of John, Kimberley and Nathan. The extracts were taken from the third preliminary design session, and were chosen for two reasons. Firstly, by introducing the reader to some of the play-devising concepts, they serve to extend the background to the study. Secondly, they also illustrate the reflective dialogue characteristic of many of the interface design meetings, showing how the participants grappled with representing underlying principles of the play-devising process. Summaries have been used to link the dialogue extracts.

During the discussion regarding the layout of the main screen, the participants had decided to have a central interactive Playbuilding area represented by a floating stage, where users of the CD-ROM could experiment with utilising and juxtaposing the various elements of the play-devising process. It was suggested that icons for each individual element should circle the screen. These would link to theory, exercises and examples. As it had been agreed that the discussion would focus on the element of movement, there was some explanation for my benefit about how movement can be pared and stylised to bare gestures to dynamically communicate an emotion.

Kimberley for example if someone wants to say I'm sorry and they've just realised they've done something wrong, they might say to the person I'm sorry, I didn't mean it , or perhaps they could just bring their hand to their mouth as they realise what they've done and for the audience that is probably more interesting than someone saying "I'm sorry" if someone just goes (demonstrates with gesture).

Nathan and even taking it to the abstract..... a montage or an image, that feels like a sorry.

This led to a discussion of how movement might be abstracted on the CD without prescribing specific answers, so that it might act as a resource to stimulate innovation.

Nathan if you had a CD that had a list (we) brainstormed, completely different ways of doing this , a certain scene, they could look at that and compare it to their scene or whatever, its like completely abstract and they hadn't considered it in the first place, you'd (the user) get a wider view than you'd normally get,...

This led to an extension of previous discussions about how the CD-ROM could avoid being prescriptive as this would be contradictory of the openness of the play-devising experience where any object, theme or keyword could be used to trigger a play.

John Learning as a discovery, if you could line up on the screen, four characters, still images of four people, each one frozen into a certain position, (gesturing) one like this, one like this anything like that, and you give the person using it the question, "place these characters on the screen, in a still scene representing anger" and they can then put these figures around the screen as they see anger. And then you can say, "using these same figures, place them to represent sorrow or happiness" and allow them to discover how using the same movement, same shape (in different juxtaposition), can illustrate these as well.

A familiar concern re-arose, as to how this might be done within the limitations of the technology, before the conversation returned to the need to avoid betraying the open endedness of the play-devising process.

John Its not saying there's an answer to this, its showing them and letting them play with the idea that the whole theme of tableaux is just staying still and trying to give a feeling out of that stillness, so they can play with it... that's more as a students aid than as a teachers aid though.

The group then discussed how the individual characteristics of movement might be portrayed.

John OK, as a demonstration of heaviness and lightness and fast and slow that is interactive in some way, you could have a character walking around on the screen and every time the user, - there's a pile of rocks or something in bottom corner -, every time they put a rock on someone, they get lower and lower, every time they take one off they get higher and stuff like that, or you could just press a word like heavy and you hear a voice saying "heavier" and every time the character gets a bit closer to the ground.

Researcher you could almost have arrows

Kimberley mmm degrees of weight

John if you want to make it fun you could pile rocks onto them, or use the arrows

- Researcher have a big hand push em down
- John or even a teachers' voice, as though its telling the character, so eventually it could show how heavy a character can get by sliding across the ground (pause) and it wouldn't have to be animation, it could just be video of someone walking around and we could do that walking around at different levels in a circle

With the space limitations on the use of video always in mind, the discussion returned to which media and software to use, as they refocussed on the design of the main screen and how to present information for each of the individual elements eg. space, voice, and objects.

- John ...tell them (the user) what they need to know on the outside and then they can go to playing with it all with the playbuilding section of it. Now see how you can put all of these together using our guidelines, because we still have to have constraints because we can't make it huge.
- Kimberley for each one I can see, ... information, an interactive exercise where they actually have to do something and then an example of just you know, five slides, a very tiny 5 second movie, of how that worked in our situation, an example in each module, - maybe that's too small, don't know, cos I'd like each module to have something engaging.
- Nathan I reckon it'd be best to learn the different bits, its like you learn movement by itself, and then you add it in, cos we did a lot of that - just separating the movement or an element and doing the simplest thing, It shouldn't be like a book, ... you should have something to do in most of these areas - you can expand quite a lot, if you want the best understanding in the smallest space you probably want some sort of engagement you know, you want people to want to try things out.

After the discussion touched on how the CD-ROM could be used in the teaching context, it returned to ways of re-integrating the individual elements, and how to optimise the multimedia format.

- Nathan Getting across the feeling that you're putting things together, - that they work together somehow, ... I'm still working on the abstract somehow rather'n footage, because you can watch that on the video, and video footage with explanations, you can watch a video or read a book, so why use a computer, you know what I mean?

Nathan cont. So unless you go to something more abstract like shapes or forms or something ... you can represent using a computer easier than video footage, and you can manipulate them in some way, but (pause)

I did drawing last semester, all we were drawing was a box with a slit in it and there was two tennis balls or something, and we'd put them in a different position but everyone's picture of that had a different relationship between the tennis balls, based on where they were and the lights, some where hiding round the corner, some were like facing each other and you know. Just from shapes you got this image that there was a relationship, these things had personality. So if you give that to shapes on a computer screen you know,...

John that's good, that's where we can do the old moving-the-characters-around-on-the-screen.

Kimberley yes

Nathan you can have really strong big shapes and sort of small weeny shapes interacting and then you can see humans in a video clip acting out a situation and then users can change the positions of the shapes and see how they interact. Not exactly artificial intelligence but really simple, you know what a shape does, or what a certain kind of person does, um , sort of the smaller shapes may move back away from the larger shapes , and may form groups (laughs) or something like that, ...

John yea, I know, in that case all we can say is "look what happens when you do this" that's all we can do for them on this workbench, and feeling, ok, you can put the characters where you want and now look what happens.

Nathan Sim Play.

Kimberley I think that can be very effective , I think that if basically you have direction, you have a person standing face forward and the heads turned that way, you can put that person there or there, and you can have lots of people facing different ways or looking at one person, and it doesn't have to be a look, it could be some sort of shape.

Nathan what if you modelled like, a circle for a head and a circle for two eyes you know what I mean, like a cartoon image of a person, using one of these programs, I was thinking what you were saying about a person looking in one direction.

John and you turn it yourself?

Nathan yea, or they'd naturally react, like you'd put a big person in front and it'd naturally turn away, something like that, with the idea that if it is a lower shape it wants to get away from the bigger shape or a smaller shape wants to climb on top of a bigger shape, something like that, some sort of relationship, cos you know in playbuilding you don't often think about what's going to happen, but sometimes you do, but sometimes you don't.

Kimberley you go with the flow.

These meetings served to establish a relaxed and informal atmosphere between myself as researcher/production manager, and the participants as designers. My influence on the group and on the process of implementing flow theory, is discussed in Chapter Eight. Workloads precluded further meetings during the second half of semester. It was decided by the design group, that a focused period at the end of semester would allow work on the CD-ROM to progress and would also provide a suitable context for this study. Initially the hope was that the design process might occur in a beautiful and relaxing bush setting so that there would be opportunities for end of semester relaxation, but the logistics of hardware requirements and the family responsibilities of one of the key participating professionals, precluded this from occurring.

As several members of the initial student group were offered employment at the end of semester, it became necessary to find at least two more members for the project. A meeting was therefore advertised via a poster and the project was explained to the small group of students who responded, but the notion of spending six days in a computer lab during the holidays was not attractive to most, although one extra member, Valerie, was found. Days before the project started with four participants, a fifth participant, Sonya, heard about the project by word of mouth and volunteered. She was from a different, graduating class but had been involved in the previous year's CD-ROM project and was therefore familiar with some of the concepts.

It was explained to the participants, that during the six days of the project they would have access to three professionals to provide them with scaffolding for the relevant skills they required for designing the software. The graphic designer/programmer shall be called by the pseudonym of

Debra Anne for the purpose of this study. The participants' drama lecturer, was subject matter expert and shall be called by the pseudonym of David. I also fulfilled the roles of instructional designer/project manager and videographer.

The participants were asked to assist in developing software that they themselves would readily choose to use, both as students in the tertiary environment, and also as teachers in secondary schools.

The participants were also offered three software familiarisation workshops in the week before the design project. These workshops introduced both the uses of the software, and the concepts behind graphic manipulation, animation and sound editing respectively. It was explained that they were not required to master the software beyond the rudiments, as the focus was not to teach them interactive multimedia programming or graphic design. They were encouraged however to develop sufficient skills so that, with troubleshooting support when required, they could implement a draft or prototype of their ideas by capturing video, designing and implementing simple navigable interfaces and animations, manipulating text, editing graphics and sound, and juxtaposing these within an authoring environment. The aim was to provide them with adequate support, tools and skills to represent their knowledge of the play-devising process, in the context of prototyping a piece of software which was accessible and motivating for other teachers and students to use.

Although in practice the participants often chose to work in pairs, sufficient computers were available to allow each to use their own. Each computer was equipped with an external cartridge drive to allow the transfer of large files, and a full suite of software. Other available equipment included a scanner, a VCR, and a video camera.

A number of parameters were determined at the outset of the study period.

These were that:

The CD Rom that they were designing was aimed at their student peers and also at secondary teachers. It was assumed, that because they were from the target audience, that their ideas would assist to make the CD as accessible and effective as possible;

Computer skills were not a pre-requisite for participation and software skills would be taught in the week preceding the workshop;

It was not expected that the participants would complete any modules, but that they would map out the prototype which would be completed by the professional software designer, graphic artist and programmer, unless they chose to remain involved in the project over the semester break;

The 6 day design workshop would also precede a two day TV studio session, during which time they would be filmed for additional instructional content for the CD;

The project would provide the research data for my Masters thesis about flow theory and learning by designing;

In order to facilitate the design process a software programmer and graphic designer would be available to implement some of the software as the they worked, thereby allowing them to see their ideas realised as far as possible, in the time available;

They could select tasks they would most like to develop skills in, be it authoring, graphic design or digital video production;

Several design parameters had been established in the preliminary sessions as demonstrated in the previous transcript. New participants were welcome to challenge these, but it was explained that involved discussion had determined them and they were invited to reflect in depth before offering other approaches and solutions.

The Workshop

The CD-ROM design workshop was held on the University campus, over six non-consecutive days over a two and a half week period. The project days were staggered to allow me to collate information and frame further questions, as well as plan and prepare further project requirements. The participants contributed to the overall timetabling of the workshop so that it could fit in with their schedules. The room selected for the project was about 8 by 10 metres, and was used during semester by sessional staff and post graduate students. This room was chosen because it was away from the student's class and lecture context, the study aiming to create a more

egalitarian atmosphere for the participants. Nevertheless, the room was rather dark and had to be artificially lit and ventilated and was accessible only via a small anteroom. This reduced air flow and light even further. Two vinyl sofas were brought into the room, along with several arm chairs to make the room as pleasant as possible and a coffee and tea making facilities were also provided. The larger room and anteroom contained all the necessary computer equipment.

By the time that the study commenced, dreams of creating computer simulations dissolved as the pragmatic need to develop the prototype eventuated within the parameters of the software's and programmer's capabilities. Also, access to the free-lance programmer's time was greatly curtailed at the last moment, due to unforeseen circumstances. The prototype design therefore quickly simplified to that of an interesting compendium.

Day one

On the first day, an informal orientation clarified remaining questions regarding the research, and the learning by designing and flow theories. The ESFs were distributed and each of the principles of flow was discussed. The participants were also asked to co-research this issue, through offering their insights and observations. After this an A4 poster of the flow theory principles was pinned to a notice board in the room for the participants to read and refer to.

The first session of the day was primarily focused on clarifying the scope of the contents of the CD-ROM and was facilitated by David. Using concept mapping techniques (Ault, 1985; Buzan, T. & Buzan, B. 1993), subject headings and sub-headings were brainstormed. David listed, linked and moved various headings on the white boards as they were redefined by the group and topics became merged or separated after discussion. The group looked relaxed and informal with several people putting their feet up on chairs. This session took up much of the morning.

In the afternoon, David suggested that the group split into two. One self-selected group consisted of all the females, Kimberley, Sonya and Valerie. This group worked on developing the content. The other group consisted of Nathan and John working with myself on interface design.

Day two

In preparation for the second day of the project, I drew up two lists of tasks which people could choose. One focused on interface design, the other on designing the video content.

The participants were invited to select the interface design or the video/content design tasks, splitting into two groups. Each group was then asked to rank order the tasks on their list according to their preferred sequence, and to tick off completed tasks. It was also clearly stated that it was not expected that they would complete all the tasks on the lists that day. The lists were greeted with anticipation, Sonya stating that seeing it all as do-able objectives made it all seem significantly easier. Individuals chose their group according to the tasks that interested them or they felt best able to complete. The group then watched the video which had been shot during the previous semester of their class's play-devising workshops whilst I completed some production tasks, expecting them to initiate their next activities when they were ready. This did not occur however, and the group was still watching the video when I returned.

After a break, both groups became absorbed in their respective tasks. By lunch time, each group had appeared to make considerable progress.

After lunch, the small groups continued their work. The interface group became very involved in drawing lots of icons in soft pencil on two large sheets of paper, joining them together on a pin board. The drawing illustrated the connections and interactions between the various branches, in a manner resembling the flowcharts used in computer programming. On the other side of the room, Sonya and Valerie the two computer novices, used a word processor for the first time to document which specific video footage should to be used to illustrate the various topics.

Day three

As the previous task lists had been effective at focusing the workshop, I brought updated lists on the third morning but enthusiasm was not nearly as high this time. Sonya commented that it seemed like a lot of work. When asked why people hadn't initiated their task the day before, they stated that they felt unable to take leadership.

John was absent on the third day, and his presence was missed by the others who commented on it at various times during the day. The group was generally tired and listless, Nathan commenting on it being a low energy time of year for him. Kimberley and Nathan worked together to draw up the storyboards for the branches they had designed with John the day before. Sonya stated that she was very tired. To motivate her, I showed her and Valerie a multimedia CD-ROM designed in London, which had a lot of interesting, experimental sound effects and animations. They then searched for relevant images from the video to use for background screens. Before lunch, Kimberley presented her storyboards to the group.

After lunch, Kimberley clarified the storyboards with David, whilst Valerie and Sonya typed the location and quality of the various video sections into the computer. This process is commonly referred to as video logging. At the same time, Nathan worked with Debra Anne the graphic designer/programmer, learning how to achieve specific results with the authoring/animation software called Director (Macromedia, 1995).

Later in the afternoon, Kimberley learned from Debra Anne how to initiate the bouncing of her ball with a mouse click in Director (Macromedia, 1995).

Day four

The weekend break had allowed me to develop an onscreen prototype of the student's design so that everyone could see the results of their work.

As a reminder, I had also written a list of design focuses, some trigger words for creativity, and Perkin's (1986) knowledge as design heuristic on the white board. I expected that everyone would now be able to continue their chosen tasks and set their own goals. After a brief discussion the group looked enthusiastically at the prototype of the project so far and David made suggestions for specific changes. This information was not directly relevant to Nathan and Sonya who although disinterested, did not initiate their own tasks. When finally participants did begin to work, Nathan and John continued their design work, whilst Kimberley and Sonya began to enter text onto the prototype. Valerie worked on the sound design and learned how to compress video.

After lunch, Nathan and John began to implement their design in Director (Macromedia, 1995) later assisted by Debra Anne while Kimberley

and Sonya continued their work entering the text onto the prototype screen. Valerie experimented with Photoshop on one computer whilst digitising video on the other.

Day five

Hardware problems prevented the video being digitised as planned. Having thought it appropriate not to prepare a task list for the day, so that everyone could plan their own tasks, I was in fact approached on a number of occasions to organise people. I therefore called a meeting to discuss what needed doing, but again, a small group became absorbed in a discussion of details whilst others were excluded.

After this session, Nathan typed up a video list compiled by David, of the footage that was still required for the CD Rom, whilst Kimberley tried to explain various computing concepts to Sonya who was operating the computer. Valerie continued with her Photoshop explorations whilst fighting computer lock ups during the video compression.

After lunch, Kimberley became deeply immersed in designing the "linking" branch, whilst Nathan worked on another computer, developing some interactive introductory screens. Valerie learned the basics of video editing whilst Sonya continued developing the content text.

Day six

Day six began with a sociable off task discussion, after which we moved to the campus television studio to prepare for the upcoming video shoot.

After lunch, I asked the group to fill out the final questionnaires and to participate in the final focus group as Valerie and Nathan had to leave early.

The afternoon was quite chaotic, several computers failed and left Kimberley with nothing to do whilst they were checked by a technician. Two musicians/sound engineers arrived to discuss the requirements for sound for the project, whilst two members arrived to move equipment out of the room. Nevertheless, Sonya and Kimberley managed to continue on their respective tasks of content and screen design until about 4.30pm.

The activities for the six days are summarised on the following page.

Activity Summary

The sessions listed below were the projects' key activities. ESF's were completed after each of these activities except as stated in the case studies.

Table 5

The daily activities performed by each of the participants

Time	Activity	Participant(s)
Day One		
am	Mapping the contents.	All
pm	Content organisation.	Sonya, Kimberley, Valerie
	Interface design.	Nathan, John, Researcher
Day Two		
am	Video viewing and logging	All
after coffee	Video logging and selection	Sonya and Valerie
	Interface and navigation design	John, Kimberley, Nathan, Researcher
pm	Video logging and selection	Sonya and Valerie
	Interface flowcharting	John, Kimberley, Nathan
Day Three		
am	Viewing a CD ROM and video logging and selection.	Sonya and Valerie
	Storyboard design	Kimberley and Nathan
pm	Programming director	Nathan and Debra Anne
	Clarifying storyboards	Kimberley and David
	Completing video logs	Sonya and Valerie
late pm	Programming Director	Kimberley and Debra Anne
Day Four		
am	Viewing the prototype and group discussion	All
after coffee	Writing content	Kimberley and Sonya
	Designing a specific branch	John and Nathan
	Sound design	Valerie

Table 5 cont.

Time	Activity	Participant(s)
Day Four cont.		
pm	Programming Director	John and Nathan
	Writing content	Kimberley and Sonya
	Experimenting with Photoshop	Valerie
Day Five		
am	Group discussion	All
after coffee	Typing up a shot list	Nathan
	Writing content	Kimberley and Sonya
	Video compression and Photoshop experimentation	Valerie
pm	Programming the "linking" screens in Director	Kimberley
	Programming opening screens in Director	Nathan
	Writing content	Sonya
	Video compression and Photoshop experimentation	Valerie
Day Six		
am	Group discussion	All
	Studio shoot rehearsal	All
pm	Final focus group	All
after coffee	Writing content	Sonya
	Programming in Director	Kimberley

Conclusion

In this section, the context to the case studies has been established, and the programme for each day has been described. The next chapter presents the five case studies and summarises and compares their results.

CHAPTER SIX

Results

Introduction

This chapter presents the results in the form of five case studies. Each study begins with an introduction to the participant; explaining his or her reason for participating, and describes their family's support for their learning, as well as their previous experience with flow. Each case study then describes the person's participation in the project, and outlines their day-by-day sequence of activities matched with their ESF ratings. Finally the results from their ESFs are summarised, key points arising from the data are discussed, and a summation of what they learned from participating in the study is provided.

At the end of the case studies, a summary collation of the five case studies is presented. The summary compares and contrasts the results, explores a number of anomalies and provides some of the answers to the research questions.

The following chapter, Chapter Seven will discuss the study's implementation of flow theory, and will bring together the discussion issues and themes arising from the individual case studies.

Case Study One - John

Background

At the time of the study, John was in his early twenties and had just completed his second year of a BA in Education majoring in Drama Education. He described himself as "adept" with computers and had experience with programming in Pascal on IBM compatible computers.

John was one of the three people who had been involved with the project since the first design meeting. Although his attendance at these preliminary meetings was erratic, his love for game design and programming combined to keep him attending meetings when he could.

When asked to describe how his home life supported his learning, John replied that his father is a "producer type person..." who wants him to go out and "make something (of himself)..." "He is a business man himself and made it on his own..., he very much wants me to be that". It didn't matter what John did, "so long as I make money.... he doesn't want me to be a (pause) weed or whatever, a parasite". This is a direct antithesis to what Rathunde (1988) describes as Centering, a characteristic of autotelic families; where the family express interest in what a child does without extrinsic demands. Contrary to this, John, a slender actor, student-teacher, scriptwriter and theatre director says that his father sees John as "working against his (father's) ideals" apparently because the product that John produces is not tangible either as a physical object or, during his training, as financial reward. Commitment, another characteristic of autotelic families, described as the trust that allows a child to be without defences in an autotelic environment, also appears to be strongly lacking. It appeared that John's father's expectations of him to be something he was not, had affected their relationship. John stated that his father "does not see what I am... which is very annoying and frustrating" and that the animosity between them extends beyond the "traditional father/son thing". As John's mother died during his adolescence, and his sister has very little contact with him, it appears that John has had few if any, of the benefits of an autotelic family.

When asked to respond to a description of flow he initially hesitated "umm, I never, I don't really know, I don't really lose track of time very often...". On reflection John stated "When I'm playing computer games I lose track of time ve-e-r-ry quickly and very easily, and on the (Inter)net its

very easy to lose track of time, ... or when I'm reading a book". John's ambivalence about whether he experienced flow surfaced again during the interview.

John ... I don't really take into account anything else going on around me, when I sit down to write I'm wanting to write. That's the only time I really get into the flow of things I think.

Although writing was an activity that John valued and identified with deeper flow states, it appeared that restlessness disrupted his focus against his wishes even when he was writing, as indicated by the following statements "(I) can't really get into my writing too long, I have to sit back and think about what I'm doing and what's going on". Yet when prompted he remembered other flow activities as well.

Researcher Do you experience flow doing physical things?

John Physical things as in drama and stuff like that, when we're doing drama pieces , I really get into the flow when I'm rehearsing for a play that's going to be on.

Later in the conversation when John was talking about working in a job he said "so I guess I go into it (flow) when I'm working on something".

John also made a number of other references to becoming restless during his interview, stating that he found it difficult to stay in one spot for any length of time. This suggests that his immersion in any activity was frequently disrupted, thereby impairing his experience of flow. Restlessness became a theme of inquiry for this case study.

Project Participation

As indicated in the extract transcript of the preliminary design meetings (see page 67), John was strongly committed to optimising the interactivity provided by multimedia. This was stimulated by his interest in computer role-play games which caused him to search for techniques to extend the interactivity of the software interface, a characteristic which had, in his experience, been fairly restricted in much multimedia design. For example, at the first dinner meeting, he and several others discussed at length the possibility of providing a number of play-devising elements which the user could then manipulate in a wide variety of combinations to simulate the play-devising process. As explained earlier, this idea was dropped when it

was realised that this could give the user the impression that the possibilities for devising plays might be restricted to the provided objects and stimuli, a notion in direct contradiction of the play-devising premise that *any* object, sentence or stimulus can provide a starting point for devising plays. However, this quest for interactivity continued strongly throughout the project.

John's attendance for the preliminary design meetings was never assured in advance. It therefore came as no surprise that during the intensive design and production stage of the project, his attendance remained sporadic. He stated that a number of influences were responsible for this. Besides the demands of his end of semester social life, he also experienced difficulty with not being able to smoke indoors, and was frustrated about having to use Macintosh computers instead of the IBM compatibles he was much more familiar with. He also experienced frustration with his lack of programming skills using Director (Macromedia, 1995). On one occasion at least, he was strongly affected by conflict with his peers, and he also found it difficult to be cooped up in an air-conditioned room during sunny Australian summer days. All these are examples of entropic influences, issues that conflict with an individual's goals and distracts them from focusing on what they are doing. These will be explored in more depth during this case study and in the discussion in Chapter Seven.

John's perceived competence with computers may have hindered his motivation to attend the preliminary software practise sessions, perhaps even causing him to underestimate the complexity of the Director (Macromedia, 1995) software. Without having invested sufficient time to understand the basics of this tool he lacked the foundation from which to implement his ideas. John therefore found himself dependent on the programming support person, Debra Anne, who visited only sporadically, in order to produce his prototype screens. Considering that he had spent so little time learning the software, it is noteworthy that he and Nathan managed to create and link some screens before Debra Anne showed them how to implement some of their design ideas.

On the first morning, when the group was called over to the table for the planning discussion, most members were busy on the computers and John remarked that they all just wanted to play. Because John had not attended the software familiarisation sessions he had little chance to use the Macintosh computers, and it is also likely that the call to meet reminded

him of his class work from the only recently completed semester. However, once settled, John appeared to adapt well to the required task. He made appropriate contributions to the discussion and, with feet up on a chair, looked relaxed. During the later part of this session, whilst his peers were either listening to the conceptualisation of the play-devising process, or bored by the instructivist tone that had begun to develop because David had switched into teaching mode, John began "drawing a program flowchart". He stated on his ESF that he was participating because "he had to" as well as "wanting to do it", that he found it reasonably easy to concentrate and was quite involved in the process. Although to an observer John looked like he was doodling, he drew a flowchart (see Figure 6 below) which later became the starting point for the afternoon's interface design discussion. On his ESF he rated the challenge of the activity at 6 and his skill level at 6. This was noteworthy both because his peers all gave this session a much lower rating, and also because there was a balance between his challenge and skill ratings. These ratings were not significantly above his mean however, suggesting that he was well occupied but not experiencing the immersion of flow. He stated on his ESF however, that given the choice he'd be "working on my computer" and that he was "recovering from an early morning".

In the following discussion, the ESF ratings for challenge, skill and flow will frequently be abbreviated to c, s and f, for example, c6, s6, f 6. In some cases the flow rating is followed by an asterisk (f*) to indicate that on this occasion flow was not rated.

On the afternoon of the first day, John participated in a design discussion with Nathan and myself about the program's functions and the connections between the various subjects. On completion of this session, John's ambivalence was reflected in his comments on his ESF. He stated that he was tired and that he would prefer to be in bed sleeping, and that he wanted to smoke. Despite these entropic pressures, he also recorded that he felt quite happy and involved, and rated the challenge of the afternoon's activity along with his skills in the activity, at seven. Again he perceived the challenge of the task as equal to his skills, and this time these levels were above his mean, showing that he may have experienced flow if the other factors had not disrupted his attention.

John also said that he wished we had six weeks rather than six days to complete the design. This comment suggested a degree of involvement in

the project as well as a degree of concern about its perceived size and complexity.

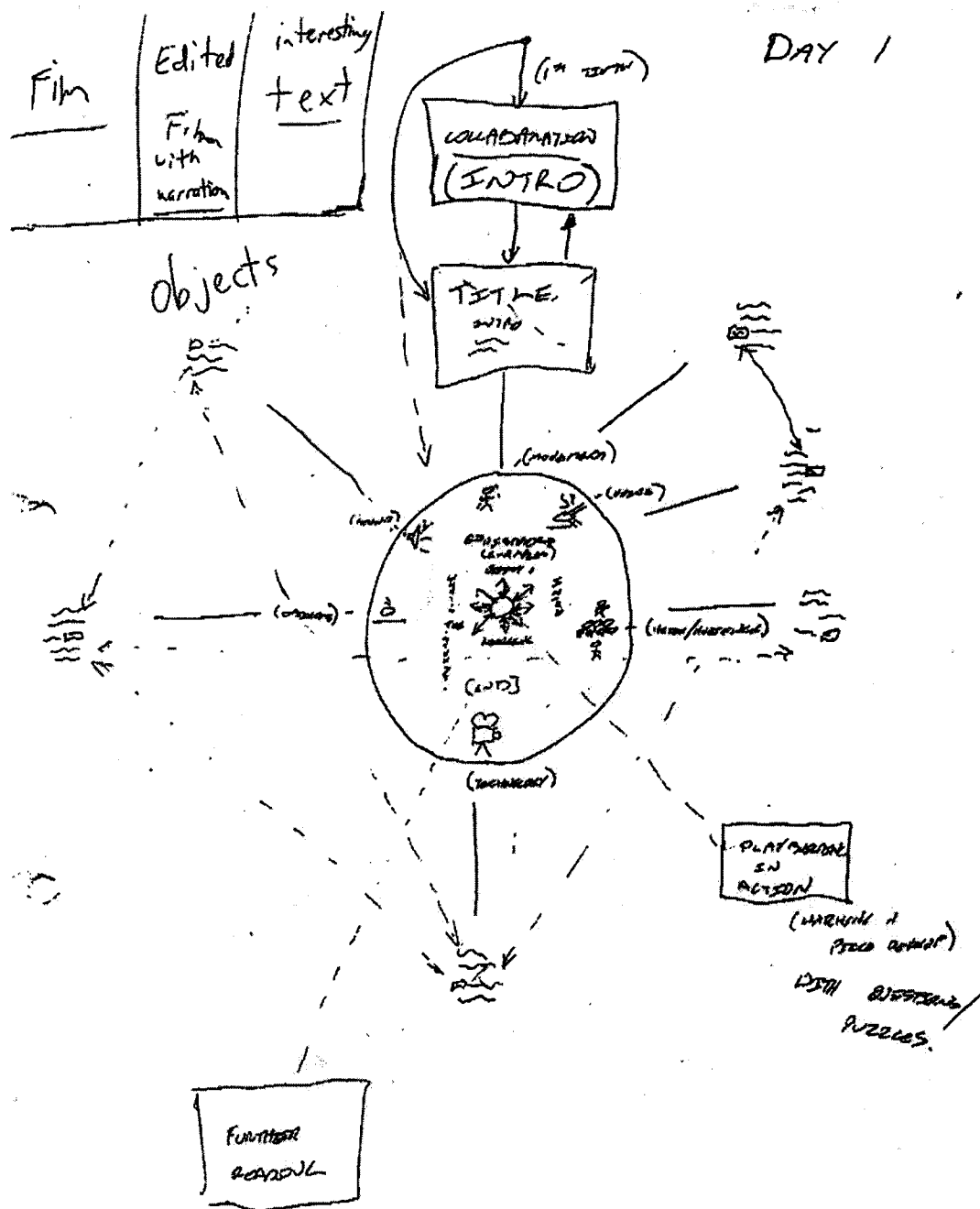


Figure 6. John's first day opening menu flowchart

On the second morning, John arrived late and again reported suffering tiredness after a very late night. As the group was engaged in the rather passive activity of reviewing the video footage shot during the previous semester's workshops, his tiredness could easily have been exacerbated. Instead of falling asleep, John again initiated an activity that supplemented

the task by "studying the shotlist". He appeared to be comparing the previously written description of some of the video footage's sound, content and framing, with the footage on the screen and studying or critiquing the approach taken in the documentation process. He rated the morning's flow at six after having initially circled and then crossed out the number five, indicating that the morning was only just above average. It appears that his rating of eight was due to the fact that he was able to discern the complexities of the task, and that this kept him alert, so that the passivity of the video viewing that his peers were experiencing was ameliorated. John's peers awarded the challenge a maximum of four, thereby indicating that they did not perceive the challenge inherent in the task. John offered suggestions for increasing his engagement by his response to the question "what might help to increase you feeling of flow right now?" by replying "doing something more hands-on, like cutting film/designing storyboard."

After this session, John teamed up with Nathan and Kimberley and struggled with design details such as deciding which were sub-topics, and which topics were related, and how to best show these links. John reported proudly on his ESF that he was involved in "creating an excellent and simple interface" and in the manner of flow experience had totally forgotten his tiredness, stating that he was alert, involved and clear. He rated the challenge, skill and flow of this task at eight. He also stated that if he had the choice he would be "jumping around". It is not clear what prevented him from doing this, whether it was the constraints of participating in a conversation which kept him in one spot or whether he felt socially constrained to behave appropriately.

After lunch, John's group became very involved in flowcharting, drawing numerous icons on large sheets of butcher's paper. After this session, John rated both the challenge and skills of this activity at six, with his flow at seven, and reported on his ESF that he was thinking about "any holes in our interface plan". However, his flow was not strong enough to mask his tiredness which was starting to surface again and he reported that he wished that he could "smoke as well". The discomfort of nicotine dependence appears to have stimulated some of the previously described anti-flow, and brought his focus back to his customary physical restlessness.

John was absent on the third day, which prompted Sonya to state that she had slept very little the night before, thereby implying that she could also have chosen to stay home. It appeared that John's absence had an unsettling

effect on the group and it took some time to build the engagement. I showed them a lively piece of IMM software to inspire them to pursue their current tasks. In the afternoon, Kim mentioned on her ESF that she missed working with John. She had found his enthusiasm and ideas for storyboarding very supportive of her own involvement and was strongly affected by Nathan's negativity, with whom she was attempting to work on this task.

John next attended on the fourth day of the project. This was the last day that he participated in the six day design and production phase of the project. Again, he reported extreme tiredness for most of the day. After a slow start, John teamed up with Nathan to focus on the design of a specific branch. After only forty five minutes on this task, they finished the session and proceeded to read the newspaper. John wrote on his ESF that he was "wanting to role-play" or be in bed sleeping, suggesting that the former would provide him with sufficient challenge to keep his attention off his tiredness (c4, s5). In contrast to these low ratings, he rated his flow at eight, perhaps because as his ESF indicated, his satisfaction with what he'd done was seven. Despite the tiredness, he may also have experienced flow from collaborating effectively. This is suggested by the fact that their drawing indicated a comprehensive and clearly thought-out structuring of the subject domain (See Figure 7). To check this hypothesis I compared Nathan's ESF for this session with John's, and found that Nathan also appeared satisfied with the session, having drawn circles linking the five and seven for flow. However, Nathan stated that to experience higher flow he'd need "more sleep I'm afraid". Nathan gave a maximum rating for involvement and a high rating (eight) for both succeeding and satisfaction with what they had done.

During their next session Nathan and John began to implement their design in Director (Macromedia, 1995) John reporting later that his intense discussions with Nathan prevented them from beginning their work in Director earlier. After having created a preliminary screen layout with locaters for text and images, John, (from my notes) "instructed" Nathan to update myself and Valerie on their progress and wandered over to where Sonya and Kimberley were working. In my notes I described him from his wide stance and hands-on-hips body language as "taking a male stance" with them, and I heard Kimberley say that he wasn't contributing but criticising.

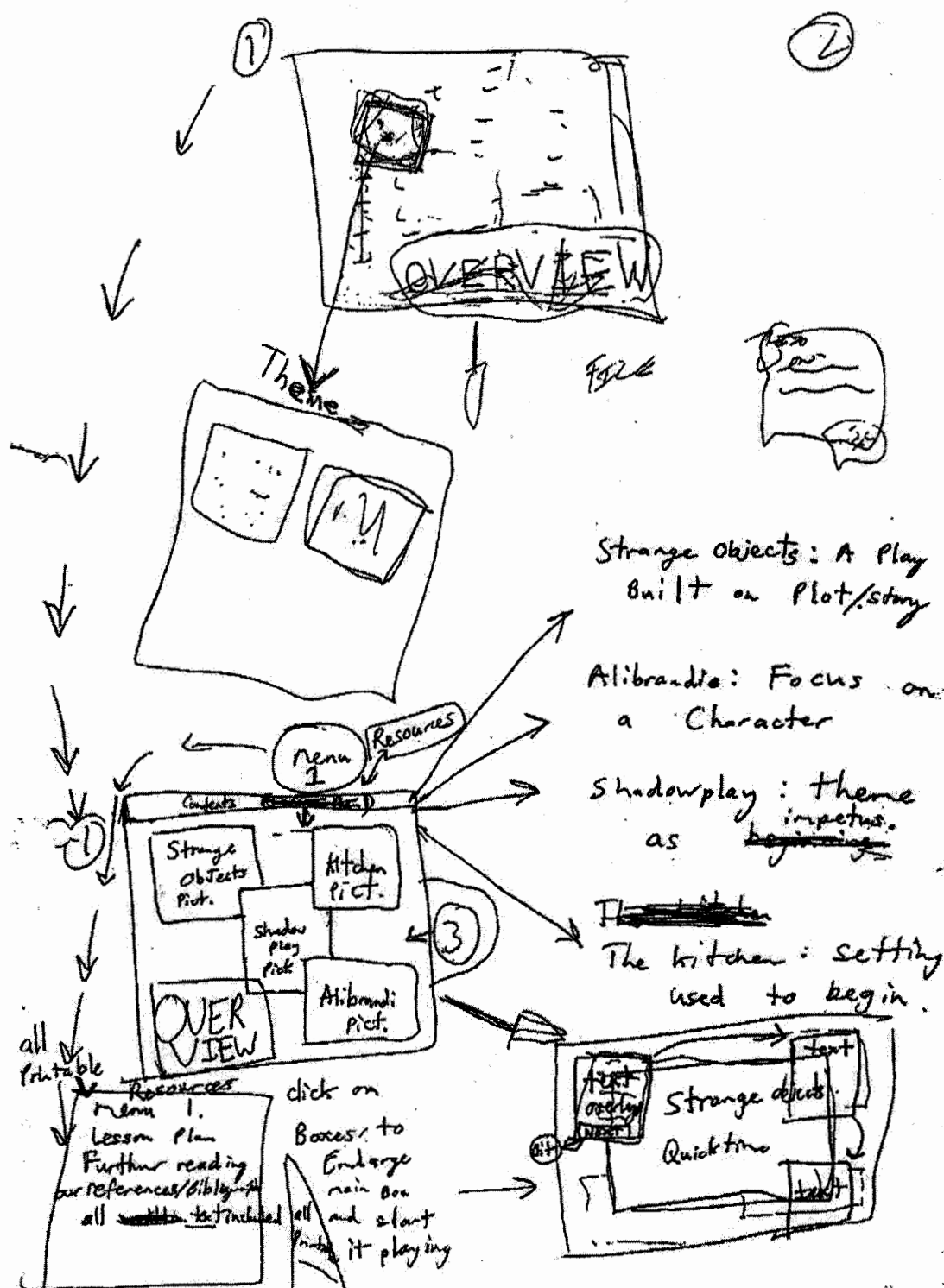


Figure 7. John and Nathan's Play branch design

As my attention was on Nathan's update I only noticed John's return and his remark on his ESF of "I now understand why nobody wants to work with Sonya (or whatever her name is)". During his interview he explained that his restlessness effected him strongly during this session. "I just

couldn't concentrate on learning Director". When he'd wandered over to see what Kimberley and Sonya were doing, he'd been told "to get lost" by Sonya, after offering what he stated was a suggestion but had been interpreted as criticism. He indicated that he had been incensed and shaken by this interaction. It is likely that the complexity of learning Director with its concomitant high challenge level, shifted John into a restless or mildly anxious state, causing him to want to break focus. It is possible that he vented this during his interaction with Kimberley and Sonya, without being particularly aware of how confrontational he appeared.

John's ratings for this session reflected a low point for him, with a challenge level of 9 contrasted with his skill level of 3 and a flow rating of 2. This matches Massimini and Carli's (1988) high challenge and low skill level, which they identify as channel 8, anxiety. It appears from his comment about Sonya, that he was rating both the Director (Macromedia, 1995) session, as well as the effect of the interaction that had just occurred. It is possible that Director was so different from other software that he had used that he was unable to transfer his knowledge to the task, or, in his tired state, to break its complexity down into recognisable tasks.

During his last recorded session on the afternoon of the fourth day, Debra Anne assisted John and Nathan with Director (Macromedia, 1995). Although Nathan commented on his ESF that Debra Anne had "taken over" the Director session, John looked interested in her programming efforts and reported verbally that he was beginning to understand the programming. His ESF showed an interesting mix of characteristics. He rated his concentration as eight, his mood as more drowsy than alert, and that he was passive, more bored than excited, and that given the choice he would be working on the computer. He also rated the challenge of this session at five, possibly because he was watching Debra Anne, whilst his skills were rated at four but nevertheless he again rated the experience of flow at eight (c5, s4, f8). Massimini and Carli's (1988) categories have not included an equivalence for this rating, which appears to be a moderate challenge and moderate skill level and might be categorised as passive interest. His mood ratings indicate some ambivalence, but it is possible that he indeed was experiencing a degree of flow if he was gaining information relevant to increasing his skills.

Later in the afternoon John looked very absorbed as his ideas started to take shape on the screen, with small photographs expanding to fill the

screen when clicked and text boxes popping up when the relevant icon was clicked, but he did not complete an ESF before going home. In his interview he stated "Highlights, seeing an idea actually working on the computer. We didn't get it exactly the way we wanted with that clicking on the screen and it expands out, but it did at least do that... (researcher's note: it worked but with a few bugs). It looked good to have something like that happening."

When asked if the aforementioned rebuttal from Sonya influenced his non-attendance for the remaining two sessions, John stated "don't like to use excuses -not really- might've been so subconsciously". Instead he stated that his non attendance was due to social circumstance. With much of the design work done, John expressed frustration with not being more skilful with Director (Macromedia, 1995) and later, that he expected others would implement his ideas. As he stated, he did the work he wanted to do and he may have felt that due to the time constraints imposed by the project, his contribution was complete.

Summary of Flow Experiences

Table 6
John's daily ratings for challenge, skill and flow.

	Day 1		Day 2		Day 4				Mean
Activity	dc	id	vv	id	id	id	pd	pd	
Challenge	6	7	8	8	6	4	9	5	6.6
Skill	6	7	5	8	6	5	3	4	5.5
Flow	*	*	6	8	7	8	2	8	6.5

Note: dc=discussion, id- interface design, vv= viewing /logging video , pd= programming director * not recorded

John recorded a flow rating of eight on three out of the six occasions that he had the opportunity to rate flow. His mean for flow was 6.5.

John's mean for the perceived challenge of tasks was just over 1 point higher than his mean for his perceived skill level, which suggests that his overall experience related to channel one or arousal. It is noteworthy that four out of his eight ratings indicate a balance between the challenge of a task and his skill level, suggesting that he may have had some facility for maintaining the skill/challenge balance, and also that on two occasions that

he reported a flow of eight, his challenge and skill levels were below his mean. This will be discussed further in Chapter Seven.

Discussion

As mentioned in John's background, he had difficulty in recognising the concept of flow initially, although on reflection he recalled numerous flow occasions. If, for the purposes of scrutiny, John's score of two is removed on the day that he was very tired, his mean for flow increases to 7.8. This raises the question, why did he find it so difficult to recognise flow? The following discussion attempts to answer this question.

John's flow ratings had two particularly interesting features. He rated the challenge of a task equal with his skill level on 50% of his ratings, and he also perceived the challenge of two tasks where his peers did not.

Even the most favourable external conditions do not guarantee that a person will be in flow. ... Optimal experience depends on a subjective evaluation of what the possibilities for action are, and of one's own capacities.
(Csikszentmihalyi, 1992, p. 154).

John's ESF profile indicates that he may have been particularly skilful at recognising his opportunities for action. On two occasions, he recognised opportunities for action in situations that bored his peers. In the first of these instances, the meeting on day one, John and Valerie were the only people who rated the challenge of this task at 6, everyone else's ratings was 3 or below. The second morning's video viewing was rated at a challenge level of 8 by John, whilst Kimberley followed with the next highest rating of four. This suggests that John perceived a level of complexity in some tasks that was not apparent to his peers.

With tasks that his peers found less challenging, John found augmentory activities which appear to have assisted the construction of meaning for him and raised the challenge of these activities to match or exceed his skill level. This was illustrated by his design of the flowchart during the content discussion and the comparison of the completed shotlist against the video footage. John rated the challenge of the task of viewing the video and the shotlist correlation as higher than his skill level. This suggests that he had sufficient understanding of professional video production to recognise the potential complexity of the task.

As there is only one occasion when John rated a challenge to be below his skill level, the hypothesis is suggested that, if it is customary for John to recognise and grapple with the challenge inherent in a task, he may be predisposed to Massimini and Carli's (1988) channel one experience of arousal, described as a high challenge level with a moderate skill level. This could alternate with the channel eight, experience of anxiety, described as high challenge and low skill. This was the state that he experienced on occasion whilst programming in Director (Macromedia, 1995). This would contribute to his restlessness. It is also possible that John had learned to offset his natural restlessness somewhat by raising the challenge of the task through finding augmentory activities, and thereby maintaining his skill and challenge match.

It may be that John has a physical predisposition towards restlessness, as suggested by his wiry built and by his statement "don't necessarily want to leave what I am doing, even when I'm doing my favourite thing like writing, I get restless".

The opposing hypothesis that John's restlessness is caused by an intelligent mind which does not have sufficient stimulation can not be entirely discounted, even although his ESF profile during the study, indicates that he was challenged rather than bored. This quickness of mind was illustrated on the fourth day, when, although tired, John and Nathan required minimal time to produce an apparently well structured and comprehensive flowchart. This suggested that they were able to establish categories, distil priorities and determine relationships between topics very quickly. John also mentioned that he preferred not to plan his writing too far in advance.

I ... can think it out right to the end and then I don't want to write it any more because I've already thought about it all. ... It's like I've already played the story out and I don't want to play it out a second time.

This evidence of boredom was later reiterated.

In order to work effectively and at my highest capability I must be allowed to move from one subject to another, lest boredom sets in. ... If I'm forced to stay on one thing for too long... it becomes tedious. ... I like to jump around occasionally... to look at something else that's going on, see if I can do anything there.

This issue of boredom, a theme in the study, is discussed in more depth in Chapter Seven. Nevertheless, John's ability for finding challenge in situations during the project suggests that he broke focus because the task generally became too complex for him, rather than that it was not challenging enough. It is likely that when there were no ready answers in sight, the natural and substance tensions in his body distracted his focus easily.

This raises the issue of substance use. It is known that although smoking and coffee drinking are used to stimulate micro-flow, they also heighten physiological tension, or anti-flow, in the case of coffee through stimulation, and in the case of smoking, through the indisputable irritant effect of nicotine withdrawal. These habits provided John with continual reasons to break his focus and in the case of smoking, forced him to move away from his work environment entirely.

It appears, as illustrated by John's experience of flow in the afternoon of the first day of the project, that as John emerged from a task the irritant effect of his substance dependency, coupled with his own physical tension, disrupted his recollection of the flow he had just experienced. As Csikszentmihalyi (1992) states, it is not possible to be aware of being in flow, because this awareness disrupts it. It is therefore possible that John rarely reflected on his absorption, thereby making it difficult for him to identify moments of flow during his interview until he had some time to reflect.

John also mentioned that he was a clock watcher. Clock watching is inimical to absorption as suggested by the interview trigger "I get so involved in what I'm doing, I almost forget about time". However, clock watching was something that John used to advantage when he took leadership roles amongst his peers. He illustrated this with the statement that whilst devising theatre "often people go off and talk about what they did last Tuesday and all that sort of stuff. I've found that I'm very much the time-keeper when it comes to devised pieces". John's leadership skills appear in part to have been stimulated by his quest for high challenge. By taking on a leadership role, John was in fact choosing to go against the flow generated by socialising and relaxing, to pursue the goal and therefore presumably his flow; of devising theatre.

As John was no stranger to taking a leadership role, he frequently opened himself to criticism as well as praise. It was therefore slightly surprising that

he was so sensitive to the rebuttal from Sonya and Kimberley. It can be argued, that if John was rejected for his intrinsic interests and goals by his father, he may have become more sensitive to criticism and rejection. It is therefore possible that the anticipation of criticism had predisposed him to some self-consciousness which may also have effected his immersion in flow (Csikszentmihalyi, 1992). The relationship between flow and self-consciousness will be explored in more depth in Nathan's case study.

John's self-direction plus his skill at seeing opportunities for action suggests that he was autotelic. This is contradicted however by his restlessness, which prevented him from sustaining immersion, except in rare cases as for example when he was involved in role playing. It is possible that John's tendency to a high metabolic rate, to use socially accepted stimulants, to seek challenging tasks, to watch the clock, and to recognise the challenge inherent in tasks, more quickly led him to experience degrees of anxiety, leading to restlessness. This restlessness then disrupted his focus, thereby precluding him from entering the flow state more deeply or frequently, or from recalling it afterwards.

What John Gained Through Participating

John indicated his deepening understanding of the underlying framework of play-devising with the statement that he now realised that the "components of Playbuilding are very strongly linked". He said that in relation to flow he had learned to "keep people concentrating but in a calm, free atmosphere".

John's involvement in the interface design process extended his understanding of the multi media environment and in his final feedback sheet stated that he had learned that "it is easier to show than to tell, easier to do than show". John said at the completion of the project that "I have it a part of me now that I can do something like that (design multimedia software)".

Case Study Two- Kimberley

Background

Kimberley, at the time of the study, was in her early twenties and had recently completed her second year of a BA in Education (Communications) majoring in Drama Education. Kimberley's experience with using computers was limited to word processing and playing computer games on her father's computer.

From the start, Kimberley showed great enthusiasm for the project. She came to the first project-design dinner meeting and attended all of the following evening meetings, even although she had to come to these meetings straight from her work. When asked during her interview what attracted her to become involved, she said "It was a social situation and it was with people I know and people I like and, I'd like to see playbuilding on CD-ROM as well, and the further, the deeper I go, the more I'm enjoying it." Her motivation to participate remained strong throughout the project. "It's just wanting to see the finished project and wanting to... belong in the process... I'm also learning a lot about programming and the software we've been using. It's been really interesting."

When Kimberley was asked about her family she replied;

My family are my ultimate role models. They motivate me a great deal... My mum had to quit school when she was young because she had to look after the family because they were all sick, and... she's basically pushed everybody aside who's said she can't have a career, and she's worked her way up through the ladder. Her own motivation is motivating for me. She's up the top of the ladder now, and she's really happy where she is, and she's still studying, with a full time job and a family.

On another occasion Kimberley said that her mother involved her family in her study for her Masters degree. Kimberley described how all the members of her family read and critique'd her mother's writing, and cheerfully said that they'd all be Masters by the time her mother had finished her studies. About her father who had recently begun studying at university she said;

He got huge enjoyment out of learning,he speaks with such passion, because he loves what he's learning and he

loves what he knows and he wants to learn more and he's really, really motivated, and his passion is so motivating, and that passion is what I want as well.

On meeting Kimberley's father, this passion for learning and his general enthusiasm were clearly evident. Besides his strong interest in a wide variety of subjects he also expressed an apparently sincere interest in people.

During the main interview, Kimberley responded to the description of flow by recounting a recent experience that occurred during her work as a social trainer for people with disabilities. The flow reference has been italicised for emphasis. Whilst showing a client (a man with an intellectual disability) how to use chopsticks she found that;

... he was so happy when he had learned, and he had so much fun doing it, he couldn't believe that he could do it and he enjoyed it so much, it just reminded me of how I felt (when I was learning to use them). It's a pretty tricky process *and time just flew by when he was doing it..* I have a Chinese uncle and he was always trying to teach me how to use the chopsticks and I'd always try to find out how to hold them differently, how to hold onto each chopstick differently and how does it work, ... maybe you can stab the food and cheat and all this sort of stuff, stab the food instead of picking it up or using two hands instead of one hand.

This simple playful learning episode illustrates all the characteristics of the autotelic experience because *clarity* (clear goals and feedback in the learning task), *centering*, (the experience of genuine interest in what the learner is doing), *choice*, (having a variety of possibilities from which to choose within the context of the task), *commitment*, (trust to become unselfconsciously involved) and *challenge*, (commitment to provide learning opportunities at a level appropriate to the learner), were all present.

Project Participation

Kimberley showed evidence of flow during the preliminary software familiarisation sessions. Her introduction to Director (Macromedia, 1995) saw her become completely absorbed in experimenting with various animation options.

On the morning of the first day of the study, Kimberley looked relaxed and alert although her ESF suggested that the challenge at 3, was quite low

for her although it matched by her skills at 4 suggestive of a channel five or relaxation experience. The fact that she managed to stay interested in the rather long concept design session, even when it began to resemble a lecture, may be due to the fact that she recognised its importance to the overall project as evidenced by her rating of 9 for this question. She also reported feeling "quite happy but just a little overwhelmed by the task ahead of us". Although the immediate task had apparently been fairly easy for her, her comment suggested that the concept mapping process had caused her to realise the full scope of the play-devising process.

On the afternoon of the first day, Kimberley's discomfort with her content group session was indicated by the greater disparity in her challenge at 3 with her skills at 6. This is suggestive of a Channel six (Massimini & Carli, 1988) or boredom experience. Her ESF corroborated this with the following ratings out of nine; a five for concentration, a three for living up to her own expectations, a two for satisfaction with "how you are going". Her mood ratings tended to drowsy and passive. She also indicated that she would rather have been working with John on the interface design and that "working with Sonya was a little distracting".

In the late afternoon Kimberley again became immersed in flow whilst making a ball bounce across the screen using Director (Macromedia, 1995). Her immersion was evidenced by her sustained focus whilst her female peers who were sitting in close proximity, and with much hilarity, searched out naked images of filmstar Brad Pitt on the World Wide Web. Sonya remarked that the third years (herself and Valerie) were reading the oestrogen pages whilst the second year was working. Kimberley continued working, unperturbed by the comment. She became unabashedly excited, jumping up and down and cheering with delight however, when she succeeded in animating the ball. She did not fill out an ESF for this session, apparently because it was in her leisure time.

On the morning of the second day, during the viewing and logging of the video, Kimberley's commitment to the project again appeared to sustain her interest when her peers appeared less committed as evidenced by their disinterested demeanours. This was indicated by her rating of 9 for the importance of this activity to her overall goals. She kept notes about what she regarded as appropriate video grabs and reported that the challenge for the activity was 4, whilst her skills for the activity were 6. This was commensurate with her flow rating at 6. These ratings don't have a direct

equivalence in Massimini and Carli's (1988) model, although "cheerfully dutiful" might have described her ESF profile. She stated that her flow would have been stronger "if I was with others who were more concentrated". As Csikszentmihalyi (1992) corroborates, it is very difficult to accomplish any focused task in a group, unless the other participants are equally willing to focus. This is discussed further in Chapter Seven.

Before lunch, Kimberley elected to work with Nathan, John and myself, on organising the sub-topics and map of the software. She rated this experience in terms of a flow of 7, the challenge being much higher this time at 9, and her skills were rated at 7. Clearly this activity had more to offer her in terms of complexity.

After lunch she continued work with this group, discussing and sketching the structure of the program onto the large flowchart. Kimberley rated her experience of flow at the maximum of 10 for this session, whilst the challenge and skills of this were both rated at six. This was the only occasion when Kimberley's ratings corroborated the Csikszentmihalyi, M. & Csikszentmihalyi, I.S. (1988) statement "it is only when challenge and skill ratings are *above average, in addition to being in balance*, that a state of flow is experienced" (pp. 322-323, italics added for emphasis). This topic will be explored in more depth in the discussion in Chapter Seven.

Two factors appear to have contributed to this particularly high level of flow. Firstly, Kimberley particularly valued working with John and secondly, she also was excited by an insight that had struck her. On her ESF she reported this as "the links are unavoidable in designing this program- we have to include them". During her interview she expanded this with:

I can see its so complex! And now I'm wondering, you know, who invented this thing? I was just looking at this massive flowchart and I thought, who did this? Who put all the links here and where did it come from? It came from people who were playing, Playbuilding..., its a lot more complex , a lot deeper than I originally thought it was. Building scenes and whacking them together, a lot more complex than that.

This insight regarding the inextricably linked nature of all the play-devising topics stimulated a number of ideas for her about how this might be mirrored in the interface, with the links onscreen actively demonstrating this interconnectedness. These ideas provided the stimulus for her implementations in Director (Macromedia, 1995) on day five of the project.

After Nathan and John headed home on the second day, Kimberley continued working on her own, storyboarding the various topic screens. Working alone proved rewarding and challenging for her.

I was in a flow experience, I was storyboarding... which I found really, really interesting, it was hard without having another person to ask, should I be doing this, should I be going on, but I developed my own system and I thought, this is the way I'm going to do it and.. it's really easy for me to do in these steps and I'll put numbers on everything and I know what I'm doing, just wanted to keep going with it.

This description indicates that Kimberley had set her own sub-goals for this task, and it appears that the immediacy of the feedback she received from the completed storyboards helped her to sustain a high level of flow (9), even although the challenge was low (4) and her skill was moderate (6). The disparity of the ESF profile for this session did not fit within the Csikszentmihalyi, M. and Csikszentmihalyi, I. S. (1988a) flow profile and will be discussed in more detail in Chapter Seven.

On the morning of the third day of the project, Kimberley continued with her storyboarding but struck conflict with Nathan. Her flow level plummeted to zero on this occasion because "he didn't find storyboarding important which made it very difficult to work", again illustrating the necessity for focused collaborators. Kimberley rated the challenge on this occasion as 4 and her skills at 5. As John didn't attend on this day, she didn't have his support to break the deadlock.

Continuing work on the storyboards, her deep immersion became evident when she had difficulty stopping work to join the group for coffee and cake.

I did all those storyboards and I could have done ten more, I could have done thirty more because there were so many different... storyboards (that she could have included). I felt like I had a product anyway,... I didn't know what time it was and.. I didn't want to go to lunch and I didn't want to get up and I told everyone to go away, leave me alone. ... I hadn't finished all of them,... but I still felt like I'd achieved something, I don't know what, but when I was in that flow I felt like I'm getting something done now.

Kimberley did not complete an ESF after this session but it can be inferred that she had experienced a strong flow state.

After explaining her storyboards to the others, Kimberley checked them with David. Valerie and Sonya logged video footage of a devised performance across the room from them. On her ESF she stated that she was "Going through the storyboards" as well as "sneaking peaks at the (name of play) video". Her lack of focus on her primary task was probably due to the fact that it was not very important to her as evidenced by the rating of 4 for this question. This was also reflected in her ratings (c2, s3, f5) and reiterated by her comment "I was very distracted (my fault) by the video".

Kimberley spent the rest of the afternoon developing her skills in Director (Macromedia, 1995), initially with Debra Anne, and later on her own. Working with Debra Anne proved to be the most engaging of these sessions as reflected by her high ratings (c9, s8, f8). For the last session of the day she tried to implement the scripting she had learned so that her animated ball could begin to bounce when clicked. This was clearly less rewarding (c4, s3, f7). This lower rating may have been because she wasn't happy with her progress as indicated by her rating of 4 for the question "were you satisfied with how you were doing?"

On the fourth day of the project, after the morning discussion session, Kimberley worked with Sonya on writing the content, firstly for the "Objects" module and then for the "Space" module. Her ratings for these sessions before and after lunch were c 5, s 7, f 9 and c 6, s 7, f 8 respectively. Her flow ratings of 9 and 8 suggest that she experienced strong engagement with the activity. These sessions are discussed in more depth in Sonya's case study.

Late in the afternoon Kimberley learned how to digitise video and to work with scrolling text for the content in Authorware 2 (1994), rating this session at challenge 6, skill 7 and flow 9.

Each of this day's sessions fits most closely with the Massimini and Carli (1988) profile of channel 3 or control, (moderate challenge, high skill) yet her flow reports were confirmed by her mood ratings. This was another case of clear disparity with the flow model, which will be discussed in Chapter Seven.

After the fifth day's rather fragmented group discussion regarding interface design issues, Kimberley reported "I was quite involved in the

conversation but not “flowing” and that “better communication (on my part also) during the discussion” would have helped to increase her flow. This was supported by her low ratings (c3, s 4, f 6).

During her next session writing content for the Actor/Audience relationship branch with Sonya, Kimberley became somewhat frustrated when Sonya chose to operate the computer. This was a task that she had commandeered until now. As Sonya was still very slow at finding her way around the computer, Kimberley stated “I was worried about wasting time and I wanted to get much more done in the space of time that we had” and that it would have taken her “about a third of the time”. Her ratings (c 5, s 6, f 6) indicated that the challenge was moderately low, but not low enough to suggest that she was bored. After reading this feedback on her ESF, I suggested to her to develop the “Linking” screens on another computer. She had the choice of using the simpler Authorware 2 (1995) program, but the interactivity afforded by Director (Macromedia, 1995) was attractive and she became absorbed in this activity for the rest of the afternoon. At 5.15 pm she stated on her ESF that the challenge of the activity was 9, her skills were 6 and that her flow at 9 “would have been 10 if I could work the software”. She was about to record her voice-over when I left at 6.15pm that day, which suggests that she had again become immersed in a flow state.

On the last morning of the project, after the rehearsal for the upcoming film shoot, Kimberley reported experiencing a challenge of 4, skill level of 7 and a flow of 7 in relation to the rehearsal, stating that her flow would have been higher “if the task was a little more challenging... but the task didn’t require high skills”.

Summary of Flow Experiences

Table 7
Kimberley’s daily ratings for challenge, skill and flow.

Day	Day 1		Day 2		Day 3					Day 4			Day 5			Day 6	mean	
	dc	cp	vv	id	id	st	st	st	pd	pd	cw	cw	dv pa	gl	cw	pd	rs	
Challenge	3	3	4	9	6	4	4	2	9	4	5	6	6	3	5	9	4	5.1
Skills	4	6	6	7	6	6	5	3	8	3	7	7	7	4	6	6	7	5.8
Flow	*	*	6	7	10	9	0	5	8	7	9	8	9	6	6	9	7	7.1

Note: dc=discussion, cp=content planning, vv- viewing /logging video, id- interface design, st= storyboarding, pd= programming director, cw= content writing, pa=programming authorware, dv= digitising video, gl= group discussion, rs=rehearsal * not recorded

Kimberley's challenge mean of 5.4 and skill mean of 5.9 are lower than her flow mean of 7.1. Her skill mean at .5 above her challenge mean, suggests that she didn't see most tasks as very difficult and that she had high confidence in her skills. The three times that she rated a challenge above six, (at nine) were: once when she was discussing interface issues with John and Nathan who were engrossed in the programming design; and twice when she was programming in Director (Macromedia, 1995). These tasks clearly offered her the most challenge due to their greater complexity.

Kimberley experienced a flow of eight on two occasions, nine on four occasions and one flow of ten, thereby indicating that she experienced flow for seven out of a total of seventeen self reports.

On the only occasion that Kimberley reported a flow of ten, she rated her challenge and skill levels equal at six, just above her mean, which supports Csikszentmihalyi, M. and Csikszentmihalyi, I.S. (1988) model of flow which says that the challenge and skill levels need to be equal and above average.

Discussion

Kimberley showed on a number of occasions that she was able to sustain high levels of concentration for long periods. This concentration was especially in evidence whilst she was learning to animate using Director (Macromedia, 1995). The following statement referred to her determination to achieve the smooth animation of her two "filmstrip" images to meet and cross onscreen like stage curtains, something that had developed serendipitously from experimentation.

I had a goal (to animate the images in time with a piece of music) and I didn't want to stop until I got that goal.... I just want to keep going. And I didn't want to go to lunch when I was doing the serendipity program, I just wanted to sit down. I was willing to leave, you know, the toilet, oh for another hour, I can get this done,... I just wanted to reach the goal.

During the final focus group, in answer to whether it was easier to divide an assignment into small tasks, she stated "I find it easier to have one flow, like do three thousand words in one go... just one long flow ..." indicating that sustained immersion was her preferred way of working. This absorption is described by Csikszentmihalyi (1992) who states that "having an autotelic self implies the ability to sustain involvement" (p. 211).

As Csikszentmihalyi (1992) states, the intrinsic reward for being able to focus on a task and developing skills to match the level of challenge, is generally a quick increase in skills. Kimberley's increase in skills was clearly in evidence from the preliminary design stage, with an early success in animating two objects that looked like filmstrips to open and close like stage curtains set to music. This experience motivated her to attempt more complex animations on later occasions for example, on day three she focused on "programming the cast member to play and loop when clicked". Interestingly, when she was introduced to Authorware 2 (1995), Kimberley was surprised at how simple it was to use in comparison to Director (Macromedia, 1995), and thoroughly enjoyed using it. Authorware uses a flowline metaphor which is less complex and in many ways quite different from that of the Director interface. It is likely however, that her experience with Director provided her with schemata that she could now transfer readily onto the Authorware environment. However, as soon as she began to do some interactive design work, she returned to using Director, because she wanted the wider range of animation options available. This showed that she had developed some confidence with the use of this more complex tool, and was not afraid to embrace it when it was most appropriate for the task.

Another factor that allowed Kimberley to become absorbed so readily in the various activities, was her apparent lack of self-consciousness. Csikszentmihalyi (1992) states that self-consciousness is one of the most common sources of distraction. He found that involvement pushes self-consciousness out of awareness, and conversely, that a lack of self-consciousness allows involvement to occur. Kimberley's usually relaxed, chatty and informal manner suggested that she was naturally unselfconscious. When her programmed pieces worked, she would express her elation with little apparent inhibition, for example, by jumping up and down excitedly whilst laughing and clapping her hands. Kimberley's lack of self consciousness was also evident from her ESFs. Of her sixteen responses to the question "How self conscious were you ?" she answered zero for Not at all, eleven times out of sixteen, her other ratings being 1 for very slightly - three times, and two for slightly - twice.

It is likely that Kimberley's unselfconsciousness protected her from having to win peer favour. For example, she was able to sustain her immersion in her animation efforts despite significant distractions on the

afternoon of the first day, when Sonya and Valerie were admiring Brad Pitt. If Kimberley's family supported her to immerse herself in daily activities through their commitment (the safety to put aside defenses) and centredness (support for the intrinsic value of an activity), it is likely that she was protected from having to develop self-consciousness as a defense against criticism (Rathunde, 1988).

Kimberley also verbalised how she came to understand the importance of having an autotelic attitude during her final year at secondary school. When describing studying for her Tertiary Entrance Exam, she stated that initially she was very worried that it would be "horrible", "but... I found it really easy. It just depends on.. how you learn, who you're with, and.. if you can make it happy, if you can make it a good experience".

Kimberley showed evidence of being strongly self-directed. Her willingness to find her own activities was evident on at least six occasions, notably on four occasions when she stayed behind to develop her skills with the Director (Macromedia, 1995) software.

Csikszentmihalyi (1992) states that "a person who is never bored, seldom anxious, involved with what goes on, and in flow most of the time may be said to have an autotelic self" (p. 209). As the term autotelic implies that a person is intrinsically motivated, this described Kimberley well. She was noteworthy for the enthusiasm she showed whilst participating in the design project and in fact, for most of the things she talked about. Although Kimberley worked long hours in her social trainer work, she appeared to have extraordinary stamina and rarely appeared tired. This may be because her attention was on what she was doing and therefore away from any possible physical discomfort, a characteristic according to Csikszentmihalyi, concomitant with flow. As a number of Kimberley's autotelic traits were also evident in her father, as well as reflected in her description of her mother, it suggests that her family provided her with with an autotelic environment to support her learning.

Kimberley indicated that she saw the project through an autotelic perspective with her statement "it's just like a computer game for me, ... getting to use the software and trying out what I want to try out and doing what I want to do. I'm allowed to play! We're Playbuilding a CD!"

This exuberant statement illustrates a phenomenon described by Rieber (1998) who maintains that when learners design games they “construct their own ‘flow’ experience”.

What Kimberley Gained Through Participating

Kimberley’s focus on the interface design and writing of the contents gave her several insights about the play-devising process. Along with her previously mentioned insights regarding the importance of links and the complexity of the play-devising process, writing the content for the Leaders role branch caused her to also realise that “Playbuilding and its facilitation is not understood by many drama teachers. However these teachers believe they do know Playbuilding.” It appears that Kimberley’s understanding of the teacher’s role had crystallised through having to represent it on a computer screen.

Having the steps of building flow explained was also very helpful for Kimberley. She adopted some of the flow terminology and stated that she found it most useful to have “clear stated goals (provided by Leonie or myself) to reach” and then to “take it step by step - don’t set the goal or skill level too high” and to “keep a watch nearby - time flies”. Kimberley also had another important insight about the relevance of flow to daily life.

I was sitting in a hotel with my boyfriend thinking I’m totally in the flow now, and I was thinking about that with relationships about how I was in the flow in this relationship, I can see how it is in relationships ... I can see how that works.

Massimini and Carli (1988) also refers to this phenomenon, describing a person who found a natural balance between his skills and challenge levels in the company of his partner, and therefore frequently experienced flow in this relationship.

Kimberley now also has a much clearer idea of the skills and steps required to design multimedia software. She has also experienced fun and success in using complex animation and photo-imaging software and has discovered that she has good capabilities in this area.

Case Study Three- Nathan

Background

At the time of the study Nathan was in his early twenties, and was at the end of his second year of a BA (Media) after completing an elective Drama Education unit as part of this award. He had studied computer programming at a Technical college and at University, and had designed a number of computer games.

Nathan grew up in a country town with a family who he perceived as being indifferent to his learning "they didn't encourage or discourage, they weren't really there, so just didn't care". Nathan felt thwarted in his adolescence by the poverty of information in his environment.

When I was young in (a country town)... I was really interested in specialised knowledge, I was really looking to find how the machine worked, the computer worked, and you just can't find that at the local library, a country library.... and there's no contact with the outside world basically.

From these descriptions, it appears that he did not have the benefit of an autotelic family to support his learning.

Nathan was certainly no stranger to flow, he frequently engaged in complex activities such as programming, editing video and writing scripts. In these instances he would become fully immersed in the activity, as the following description of editing video action scenes illustrates.

I'll see it coming in my head and I'll hit the pause at the same time, it's almost like an intuitive edit. And when I start getting that happen, that's when things happen really quickly and I edit really quickly.

This statement illustrates what Csikszentmihalyi (1992) calls "the paradox of control" (p 59), the confidence in one's capacity to act and to apparently "reduce the margin for error to as close to zero as possible" (p. 60). Nathan also reported flow states when he talked about programming. "When things work as they're supposed to and you have that sense that everything, your program is being built up incrementally,... like you do what you think should work and it works." He describes slowly piecing together an understanding of what is happening, allowing him to test and fix problems effectively. "You're creating something, a bigger program, a better program."

This describes Csikszentmihalyi's (1992) incremental development of complexity model, where the challenge of a situation is commensurate with a person's skill level and both increase at the same rate.

Nathan's absorption in complex tasks also translated into a dislike for "hackwork", a term he used for the work of implementing a designer's ideas. The concept of hackwork became one of the themes for his case study.

Nathan became interested in the play-devising CD ROM project because it connected his interests in video production, drama and computers and he anticipated that he might get involved in some programming. If not, he thought that he'd at least have the opportunity to learn about and "play with some high tech computers". He also saw it as a good thing to put on his resumé.

Project Participation

Nathan usually had a serious and quiet demeanour and he rarely contributed to social conversations, mostly choosing to eat lunch on his own. This could be because he had little interest in social chatter but it also appeared to be caused by shyness. During focused group discussions he came alive however, and contributed fluently. This can be seen from the preliminary design transcript on page 67 where he contributed equally with John and significantly more than Kimberley. This suggests that he was self-conscious in unstructured social situations.

Nathan's great motivation for participating in the project was his love for software design. He spurned the common "page turning" format of much multimedia design which under-utilises the capability of the computer, and wished to explore a level of interactivity that is rarely offered in multimedia due in part because of the complexity of programming that is required.

He established that the event driven Lingo programming language (Macromedia, 1995) which is built into the Director environment "looks quite good for this specialised (multimedia) thing".

I think the possibility is there to create some sort of... would you say intelligence? not really but... (what) I'm thinking of are termed as finite state machines... basically an object or an actor that has several states to be in and... it exists throughout the whole basic thing.... It's not artificial intelligence, it's less than that, it's kind of like a defined artificial intelligence, basically an object that can walk and it walks basically...

where you press the mouse button... or things happen, it depends on what you press. Anyway, I 'm just... having a look at Lingo, its a bit more complex than I expected... it could be interesting (laughs).

This attraction to incorporating some simple levels of artificial intelligence into the interface was expressed on a number of occasions, as for example illustrated in the earlier transcript extract (see page 67) when he explored the possibility of making objects onscreen suggest qualities of movement by having them interact at a simple level.

Nathan was strongly attracted to complex programming challenges, as also illustrated by his attraction to building contextual responsiveness into the CD's navigation. He enthusiastically explored a variety of ways of illustrating the inherently interlinked nature of the play-devising topics through the use of context relevant links which would become visible on the related topic screens.

Concomitant with Nathan's preference for high challenge as represented by his love for complex design, was the previously mentioned dislike for the low challenge of "hack work". He intimated that he required high challenge indeed to stay interested in a task, when he described during his interview, the complex work of normal video editing - as opposed to action sequence editing - as hack work. He illustrated this with the example of Alfred Hitchcock who "used to say that filming... was just a chore, so he'd just get some cinematographer to do that bit because he'd already figured out what was going to happen". Nathan had found that "planning (designing) is more interesting than just implementing" and was afraid that as a programmer, he would be the one in the back room doing the "hack work" of implementation rather than designing. He stated that this consideration had caused him to lose interest in programming some years earlier.

In contrast to his quietness, Nathan frequently gave more detailed feedback than the others when he filled out the ESFs, suggesting that he was thoughtful and wished to communicate, and that the written comments on the ESF provided him with an effective vehicle for this. His comments generally appeared very open and honest, for example after the first morning's discussion he reported feeling "tiredness, wanting to move on, overloaded with (apparently to me) unimportant information..." and "little opportunity for engagement with subject for too long. David gave a lecture?

Why?”. During our final focus group he confirmed this issue of honesty by saying “I was pretty blunt when I was feeling stuff”.

Nathan frequently arrived looking very tired and reported tiredness on five of the six days of the study. It was therefore surprising to find that he also reported experiencing flow on four of the six days. With the first heat of summer setting in, he explained that his tiredness was in part due to the time of the year mixed with a number of late nights, and during the final focus group he explained “a couple of times I was just dead and um... it had nothing to do with this”. Nevertheless, tiredness is far more apparent if a person’s challenge is too low and they become bored. As indicated by his interview and substantiated by his ESFs, he perceived all but his design and programming sessions as providing low levels of challenge. As he did not see any opportunities for action, his tiredness was no doubt exacerbated. This will be explored in more depth in the discussion in Chapter Seven.

As the morning of the first day was slow to start, Nathan struggled to stay awake during the morning content discussion. After lunch he became very involved in the small group discussion regarding interface design however, excited by notions of navigating so that two sections might show related links en-route. He reported his challenge at 7, which was well above his mean of 5, and his skills at 6. The following mood responses were polarised to the positive end of the scale; proud, sociable, active, strong, alert, happy, involved. He also commented on his ESF that “I probably talked too much?” suggesting a degree of self-consciousness on reflection, although his contribution had appeared entirely appropriate. Although no flow rating scale was yet available, it can be concluded that he had experienced either a state of flow or arousal.

The video viewing session on the second day was another slow start for Nathan. He reported that there was too much video to watch in one sitting and that “having a clearer goal. Having some director or leader in charge of feedback” would have increased his experience of flow. His ratings (c1, s4, f3) confirmed this feedback.

After morning tea he returned to navigation design however, and again his demeanour was transformed. With his group he struggled with (from my notes) “what were subtopics and which were related topics and how to visualise these”. This time he reported his challenge at 7 (after crossing out 9 and 8) and his skills at 8. He circled 9 for flow. His positive mood ratings

also included excited, and open and a rating of 9 for relevance to his overall goals.

After lunch, Nathan's group returned to flowcharting and (from my notes) "enthusiastically reported flowing". Nathan had to leave early for an appointment and promised to fill out his ESF and return it the next day. This did not occur. He left in high spirits, apparently having again experienced flow.

It was on the afternoon of this day that I'd been contacted to recommend someone for a part-time job well suited to Nathan's skills and interests. I had recommended Nathan and been assured that he would be able to fit the work around his project times whilst the study was still in progress.

During the morning discussion on the third day, Nathan reported being tired, saying that this was a pretty low energy time of the year for him. This tiredness was apparently exacerbated by being asked by Kimberley to assist with storyboarding the design. Nathan explained later that he rarely planned in such detail when he designed. Instead he preferred to plan specific sections on paper, and then to program from screen to screen in the manner of his video editing, "on the fly". This strategy was possibly used to avoid the perceived boredom (low challenge) of having to document his design carefully. He balked when Kimberley insisted on storyboarding every screen with him, before beginning the implementation. She reported that Nathan "didn't find storyboarding important which made it very difficult to work" and rated the experience at zero flow. Nathan in turn wrote "hack work, ... I don't know how necessary doing so many storyboards was, but Kim said it was necessary". His rating (c1, s4) confirmed his lack of flow (3).

During Kimberley's report to the group to explain the storyboards Nathan (from my notes) "looked half dead". I therefore suggested that he work in Director (Macromedia,1995) to begin to implement his design. He promptly became deeply absorbed with creating a little animation. He had to be reminded to have lunch and his ESF reported that "making a sprite animate on the Director screen" rated a challenge of 8, skill level of 7->6 and his highest recorded flow of 10. This illustrates the energising effects of the flow experience.

After lunch, Nathan continued working on his sprites assisted by Debra Anne. They experienced some problems with debugging the scripting language in Director (Macromedia,1995) and when he filled in his ESF he stated "We tried to cram too much little bits of learning all at once. Too much fragmentation in learning". This was confirmed by a challenge level of 8, skill level of 6 and flow level of 7/8 which suggests that he was in channel 1, arousal.

On the fourth day Nathan arrived exhausted. He fought with sleep while David discussed specific design changes that were required and then chose to work with John on designing a specific branch. This was described more completely in John's case study and will also be explored in the cross-case analysis. This activity was done on paper, in forty five minutes and he reported in his ESF (c6, s6, f 5-7) that he needed more sleep, yet he also gave a maximum rating for involvement and an eight for both succeeding and satisfaction with their work.

Next he attempted to continue to implement his design in Director (Macromedia, 1995) but found that there was "No quick info about simple Director commands eg pause for mousepress, couldn't remember it". His tiredness appears to have undermined his resourcefulness as the help file gave quite specific information about commands. To enter flow, Nathan would have needed to reduce the challenge initially, and then increased his skill gradually, however, his tiredness precluded him from breaking the task into simpler sub tasks. His challenge and skill ratings (c9, s6, f3) would be described as high challenge, moderate skill = channel 1, or arousal in Massimini and Carli's (1988) model. In this instance however, as the low flow rating indicated Nathan appeared to be experiencing tired frustration.

By 3.20pm Nathan clearly should have been home sleeping instead of trying to program. His ESF states that all he could think about was sleeping and that the challenge was 9, his skills 0 and his flow 0.

On the fifth day, in my field notes, I yet again thanked Kimberley for picking Nathan up on her way in, because left to his own devices I very much doubted that he would have found the energy for undertaking the fifteen minute walk to get there.

On this day, Nathan again started the day badly (challenge and skill levels not recorded, flow 0) due to the group discussion that did not involve him.

He stated that the "room is making me a zombie, need air" and "doing something might be nice". When he asked me what he could be doing, apparently having decided to leave the programming alone for a while, I suggested typing up the shotlist for the studio filming session that was coming up. This required interpreting David's scrawly handwriting and typing this list into the computer. Nathan rated this activity as having no challenge (0), and his skills at nine suggested that he was over qualified for the job, nevertheless he stated he experienced a flow level of 6-7. This latter figure is more suggestive of Massimini and Carli's (1988) Control channel 3 (moderate challenge, high skill), rather than the Boredom, channel 4 suggestive of the low challenge and high skill ratio. Nathan's comments elucidated this with the comment "started doing the "hack" work I wanted to get done. It was actually enjoyable."

On the sixth day of the project, Nathan participated in the studio rehearsal. After lunch, in a jovial mood, he held the microphone to record the final focus group and caused great peels of laughter on several occasions with his clowning. On one occasion, when it was his turn to speak, he looked overtly startled when he realised he needed to speak to the microphone and then took on the role of the reporter causing Kimberley to say "check out the smile!". His contributions to this session were thoughtful and his only ESF for the day, filled in at 2.35pm after "talking giving feedback", rated his experience of challenge at 5, skills at 4, and his flow at 9. He also rated his self-consciousness at 4-5, suggesting again, that on reflection he was bit shy.

This was another occasion where his flow was possibly derived from other external factors than the challenge skill balance as discussed in Chapter Seven.

After his initial enthusiasm, Nathan's increasing tiredness, listlessness and loss of motivation to learn Director (Macromedia, 1995) and implement his design, troubled me. This was evidenced by the fact that I startled awake very early in the morning after the fourth project day, and wrote down the question "when did Nathan lose ownership of the project?". On the last day of the project, whilst I was giving him a lift home, he volunteered the information that his goals within the project had been diverted because he'd started his new job and he could now see his way clear to buying his own computer. He indicated that this had become his overriding preoccupation.

Summary of Flow Experiences

Table 8
Nathan's daily ratings for challenge, skill and flow.

	Day 1		Day 2		Day 3		Day 4				Day 5		Day 6		Mean	
Activity	dc	id	vv	id	st	pd	pd	pd	pd	pd	pd	gd	ts	pd	gd	
Challenge	0	7	1	7	1	8	8	6	9	7	9	0	0	7	5	5.0
Skill	1	6	4	8	4	6.5	6	6	6	4	0	0	9	5	4	4.6
Flow	*	*	3	9	3	10	7.5	6	3	4	0	0	6.5	6.5	9	5.2

Note: dc=discussing content, id- interface design, vv- viewing/logging video, st= storyboarding, pd= programming director, ts= typing script , gd= group discussion * not rated

Out of the fifteen ESFs that Nathan filled in over the six days, he documented only three clear instances of flow. He reported two flows of nine and one of ten. The two flows of nine were linked to an interface design discussion and a lively group discussion on the last day. The rating of ten was related to a Director (Macromedia, 1995) programming session. As mentioned previously, two other instances of flow after his interface design groups, were observed although no ESFs were completed.

Nathan's tiredness influenced his scoring on a number of occasions, most noticeably on days four and five when he recorded two zeros. Although this tiredness must be taken into account, flow theory suggests that activities targeted at the right level would have helped him forget his tiredness, as for example occurred when he transformed from extreme tiredness to flow when he first began programming in Director (Macromedia, 1995).

Nathan's challenge mean of 5, which was higher than his skills mean of 4.6, was influenced by the ratings on the fourth day, when his tiredness was too great to allow him to face the complexity of programming in Director (Macromedia, 1995). His flow mean of 5.2 was influenced by his lack of interest in the group activities and again by his tiredness on the fourth day. Nathan's profile also shows that the interface design discussions and the programming sessions rated generally fairly highly.

Discussion

It was apparent from observation and from his ESFs that Nathan's tiredness mostly surfaced during groupwork when he was not directly

engaged in a design or programming activity. However, on these occasions he did not actively seek to participate or to choose an alternate task that interested him.

It therefore appeared that Nathan was not an initiator of activities, not even on his own behalf. On a few occasions, as for example on the first day when David was discussing the content parameters with the group, social courtesy required his attendance. On a number of other occasions however, he was free to seek out a meaningful activity to engage himself apart from the group, yet he chose to remain passive, even when it had been made clear that he was free to initiate his own activities within the context of the project.

The participants had been specifically invited to select tasks and initiate their own project activities on the second day of the project when we talked about the qualities of collaborative environments. It therefore appears that Nathan may have been experiencing degrees of “learned helplessness”, a state described as “the reduced motivation to control events”, along with “an impaired ability to learn to control a situation” (Miller and Norman, 1979 cited in Biggs & Moore, 1993, p. 275) which has been observed in institutional environments.

It also appears that learned helplessness may take some time to change. On the occasion when I noticed Nathan yet again nodding off during a group activity, I encouraged him to experiment in Director (Macromedia, 1995). He became so absorbed in exploring the Lingo programming environment that he only stopped for lunch after several reminders. Yet this did not set a precedent for him, because the next day he was again observed sitting passively through a group session when he would have gained more from initiating his own task.

Csikszentmihalyi (1992) emphasises the importance of a person setting their own goals and states that resignation can result when a person’s goals remain outside their reach, as they frequently must in institutional environments. This suggests that Nathan would have particularly benefited from designing his own task list. That the task list was not very effective for Nathan was reiterated by his comment on his final feedback sheet that he had difficulty “finding his own tasks” and “selecting from a long list”. This issue will be explored in more depth in the final discussion in Chapter Seven.

Nathan's low challenge and skill ratings for tasks that did not involve design or programming along with his habit of dozing off, suggested a strong channel 6 apathy profile. Because he was not able to perceive his opportunities for action with these activities, it suggests that he probably perceived them as "hackwork". The apathy induced by inactivity clearly exacerbated his tiredness.

Self-consciousness is also one of the stronger flow inhibitors identified by Csikszentmihalyi (1992). He states that when someone is afraid of creating the wrong impression or of doing something inappropriate, their attention becomes fragmented and they are unable to focus on a task sufficiently to become absorbed. Although Nathan was no stranger to flow when working alone as indicated during his interview, his self-consciousness may have prevented him from initiating activities to avoid attracting attention to himself.

Being offered a job also influenced Nathan's motivation and tiredness by changing the focus of his goals and therefore reducing his motivation to learn project-related skills.

A change occurred for Nathan on the fifth day when he "started doing the "hack" work I wanted to get done. It was actually enjoyable." It appears that this change occurred because the study "foregrounded" the participant's processes of learning in a manner that caused Nathan to reflect metacognitively (Flavell, 1985; Dansereau, 1987) as the following statement, made during the final focus group indicates.

How you're learning is more important than exactly what, in a way. ... It's like when you're in the flow, you don't notice and everything, but when you're not... maybe you just hack away or you give up, but with this sort of knowledge maybe you think, how else can I do this.... So when it's not working, how can I get closer to it, its like awareness.

Nathan then cited an example, "last night I was cleaning for two hours, I didn't notice it at all... I was like setting goals, clean this floor, ... then the next one was vacuum this". Later during the discussion he also said "...its almost like I'm setting goals a few sentences ahead, you know, I keep, I'm always there."

If Nathan has grasped this principle of transforming ordinary "hack" experience through recognising the opportunities for action, he will have

learned a significant lesson of flow. As Csikszentmihalyi (1992) says "the autotelic self transforms potentially entropic experience into flow" (p 209). Nathan reported encountering fundamental flaws in his programming in the past, which showed up only once the program was too far advanced to be adapted. This was primarily due to his aversion to the hackwork of detailed planning. It is therefore to be hoped that his understanding of the process of setting appropriate level goals will transfer to contexts where he may really benefit from this ability to engage with a task effectively.

As indicated in his interview, engaging with complexity was strongly motivating for Nathan. Whenever he participated in designing, even when tired, he would become more animated and actively involved in the conversation or task. The process of extensive discussion about design also turned out to be very motivating for Nathan. "Yeah, that was my highlight, creating the ideas that could be in it" along with "airing my views about CD design". He was surprised that the non-programmers in the group had such good ideas and that they gave such positive support for his ideas. "I just perhaps didn't expect... so much feedback as I've been getting." These design discussions always rated as flow experiences on his ESFs but it is not clear whether this was due to the process of designing or to the opportunity for collaboration.

I've had ideas about these things for myself, and having a place to air them... to put them out at least for discussion ... that's good, always makes you feel a bit egotistical, (laughs)... that's probably the main highlight I've had.

Nathan certainly enjoyed the synergy, "the combined effect that is greater than the sum of its parts", (Oxford dictionary, 1995) of the collaborative process,

(You) throw an idea out and have other people ... go against you or with you or give other ideas as well ... you develop other people's ideas more than they do ... like you'll say an idea and people will get a different idea of what you said and they'll come out with that and you'll think that's better.

Nathan's description of collaborative design is reminiscent of a statement by Cleese (cited in Schrage, 1995) who described the "shared creation" of collaboration.

The really good idea is always traceable back quite a long way, often to a not very good idea which sparked off another idea

that was only slightly better, which somebody else misunderstood in such a way that they then said something which was really rather interesting (p. 33).

When observed in collaboration with his peers, it appeared that Nathan's normal reticence to speak was forgotten, presumably because he felt competent and involved, thereby reducing his self-consciousness. It is interesting to note that Nathan's self-consciousness appeared to return straight after these discussions as indicated by his comment on his ESF after the lively session on the afternoon on day two, when he asked if maybe he had talked too much. Yet Nathan's participation was always observed to be appropriately animated and his contributions were thoughtful and relevant.

Although Nathan enjoyed complexity and appeared to be skilful within the domains of programming and video editing, tasks which require implicit goal setting and ordering, the simple job of rank ordering the daily task list seemed to pose him with difficulty. Nathan preferred being given a single task at a time instead of having to choose from a list.

(It is) a bit daunting to have a big sheet with all the things on it, because... the good thing about breaking things down.. to attainable goals is that usually you've got one or two or three things that you can do next, where if you have a list of goals you think what do I do next? there's no next step to move on to.

As Nathan was clearly experienced with implicitly setting his own goals for tasks, this comment suggests that this difficulty arose for him because he did not experience ownership of the task list. This is discussed in more detail in Chapter Seven.

What Nathan Gained Through Participating

The collaborative design process provided Nathan with some positive social experiences which appear to have built his self confidence and self esteem, as well as his esteem for his peers and for the collaborative process.

Nathan's involvement with the interface design process provided him with a strong catalyst to clarify and extend his understanding of the possibilities, as well as the limitations, of multi-media software design. This work also involved him in distilling the principles behind the play-devising process. His appreciation for its complexity and interwoven nature increased, along with his understanding of the issues involved in

translating a complex subject credibly into an interactive multimedia environment.

Nathan's exposure to Apple Macintosh computers and to current multimedia related software packages has been assimilated into his already significant store of computing knowledge. This has given him a useful foundation to build on, especially if he endeavours to work in this field in the future.

Although Nathan reported having difficulty dealing with lists of goals and prioritising them, he stated that he had become aware of the process of explicitly planning his own sequences of achievable goals to generate flow. It appears that he thereby may have begun to reframe the term "hack work", realising that he has some control over his enjoyment of an activity.

Case Study Four- Sonya

Background

Sonya was in her early twenties and had just completed her third and final year of a Bachelor of Education degree, majoring in Drama Education, when she participated in the study. Sonya had no previous experience with computers and was invited to join the study when one of the other participants left to take a job. Arriving on the first day of the study, she had missed the software familiarisation sessions.

Sonya's motivation for participating in the study was;

Two things, I've always wanted to become computer literate because I've always had an interest in it,... also the playbuilding side of it, I thought that would be good. ... I've got a month between finishing uni and starting my summer job,... so I know this a good opportunity to spend some constructive time, instead of just watching the soaps every day.

This latter statement is consistent with the motivation of an autotelic person who actively seeks opportunities to learn, generating flow by increasing their psychological complexity (Csikszentmihalyi, 1992). Sonya also recognised and avoided the entropic effect of television viewing, which Csikszentmihalyi (1992) states is frequently characterised by apathy due to the insufficient challenge that it provides.

Sonya's family appears to have provided her with at least three of the five qualities of an autotelic family. These are choice, centering and commitment. She states that with her father away, all three sisters and their mother developed capable and independent personalities.

We're close, a close family, but not sort of in a Brady bunch kind of way,... I think we all have very realistic concepts of who we all are in our family because at times in our lives when we moved, we only had each other... we're realistic in the sense that we accept everyone's faults.

This statement suggests that commitment was present in her family. Commitment provides safety for a child to set aside their defences so that they may become unselfconsciously absorbed in a task.

I could go home and have a huge argument with one of my sisters or something and five minutes later it'll be forgotten about... no-one expects me to do anything other than I am and I'm doing, and ...they're very supportive umm, very strong too, my parents, my mother in particular is very, very strong , and it's all rubbed off on us.

This statement describes the characteristics of centering and choice. Centering is defined (Csikszentmihalyi, 1992) as a child's perception of their parents' genuine interest in the task they are engaged in instead of being focused on extrinsic rewards. Choice, the ability to choose from a variety of possibilities is also indicated by her statement. This acceptance and support was important to Sonya. She talked at some length about the importance of her travels in providing her with the freedom to develop a self-concept not limited by the perceptions of her friends and acquaintances.

Csikszentmihalyi (1992) states that a task does not need to be self chosen to generate flow, once the moderately high challenge to skill balance is reached. Nevertheless, it appears unusual that Sonya responded to the description of flow only with examples of extrinsically motivated tasks.

When I do assignments and I don't really want to do them, and you put them off... but when you actually sit down and get into it, and you realise that its actually quite enjoyable to do it, the sense of fulfilment you get when you actually researching it and writing it. So in that sense I experience it a lot.

This initial resistance to immersion is not uncommon when complexity is high, and is described by Csikszentmihalyi (1992) as "most enjoyable activities are not natural; they demand an effort that initially one is reluctant to make. But once the interaction starts to provide feedback to the person's skills, it usually begins to be intrinsically rewarding" (p. 68).

When asked to cite other instances of flow, Sonya did not give examples of hobbies, instead citing learning to drive and the activities of daily life.

I just think when you immerse yourself, you can make a walk down the street interesting if you do it in the right way. ... I think its a Buddhist thing or a Zen thing, ... so when you're walking walk, and sleeping sleep, ... and put all your energy into what you are doing at the time, because you can't split it in two and do different things.

Csikszentmihalyi (1992) concurs with this perspective, stating;

Being in control of the mind means that literally anything that happens can be a source of joy. Feeling a breeze on a hot day, seeing a cloud reflected on the glass facade of a high-rise, working on a business deal, watching a child play with a puppy, drinking a glass of water can all be felt as deeply satisfying experiences that enrich one's life (p. 213).

Initially Sonya's answer suggested that not only was she able recognise and verbalise the state and characteristics of flow, but she possessed the insight to optimise her own experience of flow, a strategy Csikszentmihalyi (1992) suggests will greatly improve the quality of daily life. In retrospect however, it appears that Sonya was speaking from an intellectual rather than from experiential understanding, certainly in the light of her fairly infrequent reports of flow experienced during the project.

Project Participation

It was unfortunate that Sonya missed the preliminary software familiarisation sessions because the opportunity to gain an overview of the function and use of the various application packages was not again formally available during the workshop. Coupled with her general lack of experience with computers, this appears to have restricted Sonya's options for participation, because she was unfamiliar with the issues related to interface design.

Consequently, Sonya mostly focused on two tasks during the project. The first was logging the video and the second was writing the content for the various branches. The video logging task required discernment regarding the composition of the shot, the sound quality as well as its appropriateness for particular subject areas. Composing the content text stimulated reflection regarding her content knowledge.

In response to the group discussion (c1, s8), and content organisation of the first day (c2, s7, f*), Sonya reported having high skills and little challenge, a profile consistent with channel 8, boredom. The negativity that boredom commonly engenders could explain why Kimberley reported finding it difficult to work with Sonya.

The following day, Sonya reported suffering from Monday-itis on the first day, and stated that her low energy rating would have been the same if she'd

been skydiving. However, late on the Monday she took the opportunity to explore the World Wide Web. She and Valerie found a topic related to the disappearance of the actress Michelle Pfeiffer. They typed a search query "why has Michelle...". When it was explained to them that the search-function searches for key words rather than sentences, they immediately changed their strategy. It took them barely minutes to find Brad Pitts' home page and a few minutes later amongst much laughter, they'd found several nude pictures of him. Low energy levels can clearly be banished by the right stimulus!

On the second day of the study Sonya again reported very low challenge levels although this time the differentiation with her skill level was not as great as the day before. She rated her video viewing session at c2, s5, f4. This low challenge, moderate skill profile is classified by Massimini and Carli (1988) as relaxation, or channel 5, although judging from the diplomatic comments of her peers on their ESFs, it is more likely that Sonya was bored and disgruntled.

Sonya stated on her ESF after this session, that she needed "more knowledge in area" if she was to achieve flow. She began to work with Valerie to produce the video log and at lunchtime again reported low challenge and moderate skill levels (c2, s5, f5), stating that she was "working the VCR and discussing" and that she required a "higher level task". This suggests that she was taking a passive role especially as Valerie's ratings were c6, s7, f8. Unfortunately she didn't fill out an ESF for her next session, because during her interview she stated;

Today was good. ... when we were going through the video highlights, ... once I really got into that, and ... you get to a point where you can distinguish what's good and what's bad, ... and I thought yea we can use that, no we can't use that because of the film and the angle, ... that was really good today, once I'd been at it about a half hour or an hour, just when you finally do it, you know, get involved in it.

This appears to be an excellent description of the flow state, illustrating the process of perceiving appropriate opportunities for action and developing skills to match the challenge of the task. However, Sonya's final rating for the day was again low at c0, s5, f5. This rating was given in the later afternoon when she reported being tired and that "the interview made me a bit self conscious". She had also been engaged in a fairly passive activity, looking at the CD-ROM that she had acted in the previous year.

The third day of the study again began passively for Sonya, her first ESF was filled out just before lunch after she had been “looking for a slide indicating space” and writing. On this ESF she rated her challenge at 4 and her skill at 4 and she stated “I don’t feel ‘active’. Mostly physically - as I’ve been sitting down - looking at a screen”. In the mid afternoon she emerged from this passivity after “Typing/collating” and “Printing/Watching video”. This time she stated that although the challenge was only 3, and her skill was 8, her flow was 8. This suggests that she may have been experiencing control, or channel 3, (Massimini & Carli, 1988). In response to the question whether the task was important to her, she replied “very, to organise my mind” and also that “feel better because this was active typing, collating”. This suggests that she previously became aware of her physical discomfort because she wasn’t immersed rather than that she actually needed to be physically active. A little more than an hour later, Sonya distributed her video log lists, having finished “labelling storyboards with relevant video”. This time she rated the challenge at 3 and her skills at 5, with her flow rating as 5. This contradicted my fieldnotes in which I interpreted her as “proudly” handing out her video log. This pride was nevertheless apparently confirmed in the final focus group when she stated “I didn’t feel like (we) were being productive in terms of concrete, ... producing something, until the end of the third day when I just printed all the information we’d put into the word processor”. On her ESF she merely stated that the activity “was necessary”.

On the fourth day of the study, Sonya spent much of the time composing the play-devising text directly onto the prototype screens with Kimberley. This activity proved to be at a more appropriate challenge level as her ratings that day at c6, s6 f8; c5, s7 f8; and c7, s5, f7 indicated. These three ratings appear to fit within Massimini and Carli’s (1988): flow (channel 2: high arousal, high skill); control (channel 1: moderate challenge, high skill); and arousal (channel 3: high challenge, moderate skill) channels, respectively. As she explained during the final focus group;

Doing content and actually writing onto the ... program, that felt for me like I was really doing something, cos it was there and it was mine and I’d written it. And it was now on this real software. ... Its like a sense of achievement and getting your name on an award or something. It’s like yeah! I wrote that.

Sonya's preference for seeing the product of her work created a dilemma for her. She and Kimberley were encouraged to write the content text in a word processor, but Sonya wished to work onscreen in the Authorware 2 (1995) prototype, so that she could see the colourful background and use decorative fonts, but she thereby also lost the specialised word-processing tools. This considerably hampered their progress, because the text sometimes disappeared behind other objects on the screen and a shadow layer from the previous version of the text proved confusing, and was difficult to select and delete.

Although hampered by the complexity of working in the prototype, analysis of the transcript of one of these text writing sessions revealed that Sonya and Kimberley generally worked well together, perhaps generating a shared flow. Their conversation was focused on the task, with Kimberley, who was familiar with word processing, typing and suggesting examples while Sonya worked on finding words to interpret the meaning. When Sonya found an interesting way of summarising the discussion she received ebullient praise from Kimberley.

Sonya	(Reading a longer passage back from the screen) Implementation of the programme should be as open and flexible as (the devising approach?) as open, as open and flexible. Implementation of the programme should be as open and flexible as the devising process.
-------	---

Kimberley	Ohh, that sounds good!
-----------	------------------------

This cheerful collaborative goodwill and pride pervaded their conversation and was either a generator or a product of flow. As stated earlier, flow is more difficult to generate in company, as concentration on the task is required. This illustrates one of the instances when they worked together in a very focused manner.

Csikszentmihalyi (1975) also states that the "clearest sign of flow is the merging of action and awareness" (p. 38) and that a person in flow is entirely focused on their actions. When they stop to reflect, the split in awareness interrupts flow at least momentarily. "Flow is difficult to maintain for any length of time without at least momentary interruptions" (p. 38) because the mind reflects on the effectiveness of the action. These natural breaks in flow were immediately followed by recovery of flow in task immersion. This is illustrated by the following continuation of the above dialogue.

Kimberley (typing) aghr... bloody Apple computers! Should be open and flexible as the devising process itself.... y-e-s. Where do you pull this from Sonya?

The transcript of this session in which Kimberley and Sonya are conferring about the text for the Role of the Teacher, also reveals that half of the dialogue was devoted to dealing with the vagaries of the software and how it handled text. In retrospect, instead of simply telling them, it would have been more effective to have shown them directly the advantages of editing the text in the word processor and then transferring it onto the Authorware (1995) screen and enhancing it there. This approach may well have increased their skill and productivity more quickly, by dividing the task into more manageable subgoals and thereby matching the challenge more closely to their skill level. Instead, during these sessions Sonya relied entirely on Kimberley to do the computer work. Because they were both focused on the task of producing the software, they did not use the opportunity to scaffold Sonya's fundamental computer skills such as cutting and pasting. They could have done this more easily if they had remained within the word processing environment and transferred the text to the prototype when it was complete. This approach would have provided a more natural progression from the skills Sonya had already developed within the word processing environment, and also allowed Kimberley to break the task into more discrete steps so that she could have made a clearer mental model of the processes involved. These themes are developed further in Chapter Seven. Because Sonya missed the opportunity to develop her skills, this issue arose as a problem the following day. At this stage however, the mystique of writing onto "this real software" still held primacy.

On the fifth day of the project, after a large group meeting that she perceived as very unproductive for her (c4, s2, f0), Sonya continued working with Kimberley on composing the text for the Actor/Audience branch. This time Sonya was at the keyboard, whilst Kimberley tried to coach her on how to operate the basic computing functions such as cut and paste. It is interesting that Sonya did not rate the challenge of this exercise very highly (5) whilst rating her skills at eight and her flow at 7. Perhaps this occurred because she was rating her content writing skills rather than her computing skills. Kimberley on the other hand reported experiencing much frustration at the slowness of the task and after lunch, on advice from me, left Sonya to

work alone on the computer. Left on her own, Sonya's flow level plummeted initially, as she struggled with her lack of computer literacy (c4, s4, f4). However, in the late afternoon she apparently recovered well, as she reported her challenge at 6, her skills at 5 and her flow at 8.

Sonya's final self report on the sixth day of the study rated the video rehearsal at a challenge of 4, her skills of 8 and her flow of 6. She stated that what would help to increase her experience of flow was "more time to complete tasks" and in fact, she spent every possible moment that afternoon, working on her own, writing content onto the software. She did not however, fill out an ESF for this session.

Summary of Flow Experiences

Table 9
Sonya's daily ratings for challenge, skill and flow.

	Day 1		Day 2		Day 3			Day 4			Day 5			Day 6		Mean	
Activity	dc	cp	vv	lv	vc	lv	lv	lv	cw	cw	cw	gd	cw	cw	cw	rs	
Challenge	1	2	2	2	0	4	3	3	6	5	7	4	5	4	6	4	3.6
Skill	8	7	5	5	5	4	8	5	8	7	5	2	8	4	5	8	5.9
Flow	*	*	4	5	6	*	8	5	8	8	7	0	7	4	8	6	5.8

dc=discussion, cp=content planning, vv- viewing/logging video, vc=viewing cd rom, lv=logging video, cw=content writing, gd= group discussion, rs=rehearsal * not rated

Sonya's mean for challenge was 3.6 and her mean for her skill was 5.9, whilst her mean for flow was 5.8. The 2.3 difference indicates that Sonya frequently perceived her ability to be higher than the challenge of the task and that either the tasks were too simple for here, or she did not recognise the available challenges.

Sonya reported degrees of flow of eight on four occasions out of thirteen self reports. Three of these occurred whilst writing the content. The only time that her rating for writing content dropped significantly, was on day five when Kimberley left her to operate the computer on her own, and her flow rating dropped to four due to her lack of experience with computers.

Discussion

Due to the fact that Sonya had missed the preliminary software familiarisation sessions, she lacked the broader foundations on which to build her skills. The tasks that were therefore available to her were arguably

simpler than those undertaken by the others. Her low rating for viewing the video to log it, or typing the logs into a word processed document suggest that these tasks may have been disappointing for Sonya, perhaps she had anticipated more colourful roles within the multimedia design process.

It also appears that the requirements of the video logging task had not been sufficiently explained at the outset. This was suggested by the statement during her interview that she began to find the task interesting once she recognised the discernment required to complete the task.

Sonya reported that one of the factors that disrupted her experience of flow was "not being active enough". This statement was initially interpreted to mean that she needed to take an active role in completing tasks, especially in the light of the feedback that she saw working on the word processor as more active. However, Sonya reported flow during her content writing sessions when Kimberley operated the computer and she remained physically inactive but intellectually engaged. This suggests that her need to be active was linked to an increased awareness of physical discomfort when she was not experiencing flow, rather than a need for physical activity.

It can also be argued that Sonya's reduced experience of flow was due to her inability to derive sufficient feedback from a number of the tasks that she undertook. This appears in part, to be due to her difficulty recognising the intrinsic feedback in a task or topic. This observation was prompted by her statement that she didn't feel like she was being productive until she had a product "cos it was like it was all in my head or on various bits of paper, it wasn't a product, so it's much easier if you have a product". Her teacher training had also stressed the importance of student's having a product so that they can say "this is what I know, instead of just having it all as knowledge, you have to have a product". Therefore the software prototype was particularly meaningful for Sonya. "The highlight of the fortnight has been seeing the ROM develop, cos that's real, its not just sitting around talking about what we're going to put in it, or what its going to be like. It's actually a product."

Sonya's reports that she needed the finished product of the printed video logs to experience satisfaction in the video logging task, suggests that the task of word-processing also provided her with insufficient feedback of her progress. It may be that the logs were little more than a growing body of text

on the screen for her, because the content of the logs, and the process of using the software apparently were not inherently interesting to her. It appears that Sonya's difficulty with perceiving the intrinsic feedback in a task created this need for a product, to give substance to her efforts.

During the final focus group, in the context of doing housework she stated "you work through the goals instead of thinking of the drudgery of it. Achieving the goals becomes the goal instead of the task (itself)". This contradicted her interview statement about the accessibility of immersion in any activity. It also raises the issue of whether the completion of sub-goals becomes an end in itself rather than supporting intrinsic immersion in a task, as indicated by the statement "I thought they (the task lists) were good, it helped to structure it a lot more, ...when you ticked something off it feels... like you have achieved something."

The apparent lack of intrinsically motivating pastimes, the need for a product, the lack of concern about other people's evaluation of her, as well as her apparent lack of interest in whether a task was important to others (left blank on her ESFs) or interesting in itself, her reports and frequent demeanour of discontent, as well as several hurt or uncomfortable comments from her fellow students such as "working with Sonya a little distracting", or "now I know where she's got her reputation from", suggests that Sonya may have been self-centred. This would explain why she did not experience flow very often. Csikszentmihalyi (1992) has described the detrimental effects of self-centredness and self-consciousness on a person's ability to experience flow.

Too much psychic attention is wrapped up in the self, and free attention is rigidly guided by its needs. Under these conditions it is difficult to become interested in intrinsic goals, to lose oneself in an activity that offers no rewards outside the interaction itself.

(Csikszentmihalyi , 1992, p. 84)

Although Sonya's background and intellectual understanding suggest that she was familiar with flow, in practice Sonya did not often experience the cheerfulness or involvement that would be expected from an autotelic person.

What Sonya Gained Through Participating

Sonya became familiar with multimedia design processes and how this could be realised through the use of computers. She also developed a number of computing skills through using two fairly sophisticated software packages.

Sonya also had to grapple significantly with the content of the play-devising course. This especially clarified the teacher's role for her as indicated by her final feedback sheet where she stated that she had gained "more understanding of the teaching role".

Sonya was also introduced to the concept of flow, and through her participation in the various reflective discussions, is likely to have extended her understanding of this concept.

Case Study Five - Valerie

Background

Valerie, at the time of the study, was in her early twenties and had just completed her BA (Education), majoring in Drama Education.

Valerie was attracted to participate in the study because;

It was something different and it was in the area of computers and as David said on the notice, you don't have to know anything about computers. I thought it was a good chance to learn, but I'd always put it off, ... they (computers) looked really difficult, and I always thought it would take heaps of work and I'd have to do some really long course or something.

Seeing one of the prototypes in class also interested her. "I didn't know that you could do that with equipment in the university". She was also interested in seeing how the video which had been shot during her classes would be used. Although learning computers "which I wanted to do, or, thought I should do rather than wanted to do, it was always a put off thing" presented Valerie with some ambivalence, she also stated "I always like learning something new, that's the best way to get along."

When read the description of flow during her interview, Valerie said that she experienced flow quite often in her hobbies of theatre and dance. She cited learning ballroom dancing and doing choreography, as instances when time disappeared and she became completely absorbed, especially when she has a complex new dance to learn. She also stated that she had developed an excellent memory for unusual dance patterns "I was the one who was always relied upon to remember everything, so I'd always... try my hardest to remember everything fully". She uses these patterns in her choreography "I often use steps that have struck me because they are really different or original". Having discussed the concepts relevant to flow on the first day of the project, Valerie surmised during her interview, that the reason that it was easy for her to remember complex dance patterns was because "it must have been at just that right level (for flow). ... Its not too hard, but its not simple, it makes it easy to remember as well as making it more interesting" thereby suggesting that learning new dances challenged her at an optimal level to generate flow.

Another example that Valerie gave during her interview that illustrated her experience of flow, was lecturers giving interesting lessons:

Usually you're dozing off and sometimes you come across something you haven't encountered before and they present it in an interesting way and *it really gets your full, full focus on it, your full concentration on it* and it motivates you to do things in that way (italics added for emphasis).

Other activities that motivated Valerie strongly were drama and learning foreign languages. She stated that when learning languages "it was always teaching you something new and then how to use it , ... you always moved at a really quick rate to get through everything, so that was really interesting." It appears that Valerie enjoyed high levels of challenge.

Unfortunately, no information regarding her family's influence on her learning was collected.

Project Participation

Valerie's demeanour during the project was generally cheerful, attentive and untroubled. She was happy to work on her own and always seemed to find opportunities to learn new things without prompting. Even during the preliminary software familiarisation stage, Valerie only needed to be shown the basics even though she had not used a computer since primary school. She rarely asked for assistance, appearing instead to prefer to work things out for herself, and quickly began to find her way around the Macintosh interface by exploring the menu options that the various software packages provided. When asked about this after having participated in the three preliminary sessions she said;

A lot of the things I just sort of did by accident, (laughs) how did I do that? and how can I do it again? .. I don't know if I could repeat them again... so I feel, I've learned a lot more of its capabilities and I feel a lot more comfortable with them, and with the fact that yea, I can use them, I'd probably make a lot of mistakes and that sort of thing, but I can use them.

This confidence to explore came from being reassured that she couldn't accidentally damage anything "after Debra Anne said you can't break them,... I thought yup I can't break it, I'll just fiddle around and see what happens". She was therefore happy to try things out, simply to find out what they did.

On the first morning of the workshop, during the content design discussion which drifted into lecture mode, Valerie looked interested even though she also reported on her final feedback sheet that one of her low lights was "boring instruction style talks". However, during the session she looked reasonably alert and she stated on her ESF straight after the session that "there was a lot (of content) I didn't think of which was good to know, so much is involved in (the) project." She rated the session at a challenge level of 6 and a skill level of 5. As her mean for challenge was 6.4, and skill 6.6, this was slightly lower than average, and suggests that she was feeling a little passive. This was corroborated by her rating for mood which was only slightly more alert than drowsy, although reasonably involved and excited. This was probably because she saw the activity as very important (rated at 9).

That afternoon's session proved to be less than rewarding for Valerie's group (Valerie, Sonya and Kimberley) who chose to work on prioritising the content for the CD. Valerie's lack of enthusiasm for this collaborative task may have come from some tensions within the group because Kimberley reported that working with Sonya was rather distracting. Valerie's ESF rating of the activity showed a degree of neutrality towards it (c3, s 6), as she saw it neither as particularly challenging or important.

Valerie's energy picked up later in the afternoon when she stayed back with Sonya and Kimberley to explore the computers further. She focused on experimenting with a sound editing software package and created and combined several sound tracks, after applying a variety of filters to them. After this she explored the Internet with Sonya and quickly discovered the images of Brad Pitt. No ratings were recorded for this session.

On the following morning, after the whole group video viewing/logging session, Valerie stated on her ESF that she needed a 'better idea on direction -> (to reach) goals' and that "working in smaller groups? Quicker?" would have increased her experience of flow.

After morning tea, Valerie elected to document the relevant video sequences with Sonya. They stated that this was partly because they both lacked confidence in their interface design skills. Valerie reported experiencing degrees of flow on her next two ESFs, (c 6, s7, f8) and (c8, s8, f9), stating on her second form that the factors that affected how she felt were "worked at my own pace!! more control!". Although she was ostensibly

paired with Sonya, Sonya's low rating for this session suggests that Valerie was primarily the one doing the active work.

The next day, Valerie and Sonya produced a numbered list of relevant videos and images illustrating the various subject branches. Valerie's ratings for these tasks were (c5, s6, f*) and (c6, s6, f7). These ratings which were just below her mean, and therefore, along with her report that she was generally alert, active, strong and clear, and that the importance of the activity was a 7 and 6 respectively to her, suggests that the task was of moderate interest, although not challenging enough to stimulate flow.

On the fourth day Valerie chose to develop the audio ideas for the project. Perhaps Valerie's love for dance had developed her auditory skills, because she appeared to have greater auditory acuity than the others in the group. This was evidenced by her discovery of an interesting, if slightly obscure sound sequence that no-one else had noticed, which was embedded in an unconventional CD-ROM designed in London. It is likely that the experience of hearing how sound was used on this CD, helped Valerie to choose the task of formulating the play-devising CD's sound design. Later in the day she learned how to digitise video and do simple video editing. As Kim and Sonya were engrossed in the content text and Nathan and John were working on the interface, she worked on her own quite contentedly. Her first ESF report for the day, filled in at morning tea time, indicated a reasonably high challenge 8, and skill level 7 for her tasks of "Brainstorming" and "thinking about different aspects of sound". Her next ESF indicated that she was looking for "Possible pics" to use for background screens, and that she was searching through the video footage and "recording grabs". This task proved to be very challenging (9), whilst her skills were also high (8) suggesting that her flow indicator of 8 was either a channel 1 (arousal) or channel 2 (flow) experience. Her highest rated flow event for that day however, was when she experimented with the image filters in Photoshop (Adobe, 1994) during the moments when the video she was digitising was being compressed (c9, s8, f9). This could be due to the fact that experimenting with Photoshop gave her immediate feedback in response to her own goals.

On the fifth day of the workshop, Valerie reported low ratings on her ESF of c3, s5, f4 after the lengthy group discussion which had become focused on details specific to the needs of others in the group. Once she continued to work alone on digitising video, higher challenge and skill ratings returned

(c8, s7, f8 and c8, s8, f8), testifying to her improved engagement. The long compression periods required to digitise the video, created the opportunity for her to experiment with applying interesting filters in Photoshop (Adobe, 1994) on another computer. However, the video compression computer locked up and crashed on a number of occasions, causing her to exclaim with irate frustration that she thought that they couldn't be broken. Fortunately this occurred well after her interest and confidence had been established and did not seem to significantly dampen her interest. Assisted by the ongoing crashes of the video compression computer, the Photoshop experimentation session gained dominance for the day.

Valerie did not complete any ESFs on the last day of the project, before dashing off to work, although during the final focus group she responded thoughtfully on a number of topics. She also teased Nathan in response to his clowning attempts to follow the rapid exchange between her and Sonya (see page 162) with the microphone, laughingly jibing him with "a bit late !" when he missed her remark.

Summary of Flow Experiences

Table 10
Valerie's daily ratings for challenge, skill and flow.

	Day 1		Day 2		Day 3			Day 4			Day 5				Mean
Activity	dc	cp	vv	lv	lv	lv	lv	sd	sd	lv	dv	dv	dv	dv	
											ep	ep	ep	ep	
Challenge	6	3	3	6	8	5	6	8	8	9	9	3	8	8	6.4
Skills	5	6	4	7	8	6	6	7	7	8	8	5	7	7	6.6
Flow	*	*	6	8	9		7	7	7	8	9	4	8	8	7.4

dc= discussing content, cp= content planning, vv= viewing/logging video, lv= logging video, sd= sound design, dv= digitising video ep= experimenting with Photoshop,
 * = not rated

Valerie reported a flow of eight on four occasions and a flow of nine on two occasions totalling six reports of flow out of fourteen. As mentioned previously, her mean for challenges was 6.4 and for skills was 6.6 suggesting that although she perceived the challenges to be fairly high, she also saw herself as appropriately skilful. Her mean for self-rated flow at 7.4 was the highest in the group. As the self rated flow scores indicate, other than the three occasions when she filled out a form that didn't have the flow rating scale on it, Valerie reported only two occasions where her flow was below 7.

Both these occasions were insufficiently focused group activities, which in all likelihood prevented her from experiencing flow through their lack of clear goals and feedback.

Valerie's sound design work did not rate as highly as exploring Photoshop (Adobe, 1994), possibly because she had to generate the sounds and no midi devices were available, whereas the complex effects that could be gained via the filter options in Photoshop, provided her with immediate feedback.

Discussion

On the ESF form that records her first nine for flow, Valerie wrote that she was finally "working at my own pace!" suggesting that being self-directed was very important to her.

This self-direction stood her in good stead when it came to learning how to use the computers as indicated by the preliminary software sessions and confirmed by her later work. Valerie was very comfortable and confident in learning by discovery and experimentation. This was also motivated by the creative scope of the sound and imaging software as evidenced by her comment.

It's spurred me on to stay on each day and have a play, ... I don't think that's anything I would've thought of, to come here and play with the computers in my spare time, and (now) I can understand how people get addicted to them...

It appears that combined with Valerie's easy confidence in her ability to learn, the computer provided clear goals and immediate feedback so that she did not have difficulty sustaining a balance between the challenge of the task and her skills level and she therefore had optimal conditions to generate the immersion of flow. This illustrates the "addictive" quality of flow, which in this instance served to stimulate apparently optimal levels of learning, but which Csikszentmihalyi (1992) warns, in rare extreme instances is a potentially negative aspect of the flow experience.

Valerie's reports regarding her love for and success with learning complex dances, suggests that she may have gained confidence in her ability to learn through her talent in this area. Csikszentmihalyi, Rathunde and Whalen (1993) found that although "natural endowment may not be a guarantor of personal happiness, it undoubtedly promotes early and

relatively effortless experiences of flow at relatively complex levels of performance" (p. 80), thereby preparing talented individuals to seek for the complexity that leads to flow in daily life. If Valerie's ready mastery of complex dance patterns is seen as an indicator of talent in dance, the ease with which she learned dance patterns may have provided the foundation of confidence that sustained her interest and openness to new learning.

The fact that Valerie was generally cheerful and easy going, found it easy to focus and find her own direction, sought out complexity, along with the fact that her mean scores were reasonably high and very close, and her self rated flow scale was the highest in the group, suggests that she had an autotelic personality.

What Valerie Gained Through Participating

Valerie moved from being a computer novice to feeling competent to explore a variety of software packages, and produced a number of experimental images and sound files. On her final feedback sheet Valerie stated "I'm glad that I worked on the project because it's made me want to keep exploring the world of computers" and that her greatest gains were "general ease with the software - a feeling of self-empowerment, I'm not intimidated any more". She also said that in the past she would sidle away from people who were talking about computers, whereas now she would join them, to listen and participate in their conversation.

Valerie also gained substantial insight into the processes involved in multimedia design.

When asked what she'd learned about flow, she stated that "I think it's to do with trying to work at your own pace that's the handiest to keep applying. Allowing time to run smoothly - no interruptions."

When asked what she learnt about the play-devising process however, Valerie felt that as a student completing third year, there was little left to learn about the subject and that the project primarily brought the subject matter "back into mind". Logging the video was also useful for her "watching the performances and how things that you do are perceived ...working on that actor, audience relationship."

Summary and Comparison of the Case Studies

The following section summarises the reasons the students participated in the study and the activities they focused on during the study. Their responses to the ESFs are then compared and contrasted, and the reasons for the similarities and differences of their ratings are explored. The findings to the research questions are discussed in some depth in Chapter Seven and summarised in point form in Chapter Eight.

Reasons for Participating

Two of the people who participated in the study were motivated by the desire to develop computer literacy skills in an informal, arts focused environment. Two people participated because they were strongly interested in programming and were motivated to explore innovations in software design. One person participated because she enjoyed using computers, as well as the social and collaborative aspects of the design process. She also expressed interest in seeing the subject of devising plays represented on CD ROM.

Project Participation

During the first two days of the project John and Nathan, the two people with advanced computing skills, both immersed themselves in designing the interface of the CD. On the second day they were joined in this, by Kimberley. On the fourth day of the project, John and Nathan both worked together on prototyping part of the interface in Director (Macromedia, 1995). Nathan also participated in some word processing on the last day. John attended on only three of the six days of the project stating that it was primarily social demands that precluded his attendance. On the days that he did attend, his participation was often very amenable, although he also reported being restless and both he and Nathan suffered on the fourth day from extreme tiredness. It is possible that as the overall design became finalised, John was less motivated to participate, because like Nathan, he valued the process of design more highly than the process of production. Nathan was apparently very self-conscious, as evidenced by his quiet and withdrawn manner during many of the sessions. It appears that apathy prevented him from initiating his own activities during group sessions not relevant to his interests. His demeanour changed radically on the occasions

when he became involved in discussing topics of particular interest to him. On these occasions he became animated and talkative.

Initially, Kimberley, Sonya and Valerie grouped together on content design. Kimberley then participated in some of the interface design sessions and experienced her strongest immersion during one of these sessions. Valerie and Kimberley were both mostly cheerful and interested participants within the group, whilst Sonya appeared to generate some friction on a number of occasions. This appeared to be mostly due to her dissatisfaction at being asked to participate in group activities. Friction also occurred between Kimberley and Nathan whilst storyboarding the screens. Kimberley was keen to storyboard, whilst Nathan saw the storyboarding as a waste of time. Valerie and Sonya logged the video, after which Valerie worked alone to design the audio for the CD and to digitise the video. Later during the project, Kimberley and Sonya worked closely together on developing the content text and appeared at times to develop a collaborative flow. From the afternoon of the fifth day Kimberley also worked on her own, designing a branch of the software whilst Sonya devised the content text.

Comparison of the ESFs

The following section presents four tables. The first compares and contrasts the participant's mean ratings for flow. The three that follow compare the ratings given by individuals participating in the same tasks. It is recognised that the ESF ratings are subjective, and that the utility of a comparison lies primarily in illustrating each person's range of experience rather than in being able to provide a direct numeric comparison. Nevertheless, the tables illustrate sufficient relationship to provide some confirmation of the profiles drawn in the case studies, and to suggest several further hypotheses.

Table 11
A comparison of each participant's mean for challenge, skill and flow.

	John	Kimberley	Nathan	Sonya	Valerie
Challenge	6.6	5.1	5.0	3.6	6.4
Skill	5.5	5.8	4.6	5.9	6.6
Flow	6.5	7.1	5.2	5.8	7.4

Kimberley and Valerie reported the highest engagement, whilst Nathan and Sonya reported least. John, who's flow was rated in the middle, and who appeared to augment some activities to increase their complexity, gave the highest rating for challenge. Sonya, although new to computers, recorded the second highest perceived skills rating in the group, whilst Nathan's perception of his skill was the lowest, even although he was one of the most skilled in the areas of computing, video logging and software design. Nathan's flow rating was more than two points lower than Valerie's. In contrast Valerie's challenge and skill ratings were high and the most closely matched in the group, as confirmed by her flow level which was also the highest in the group.

These ratings suggest that Nathan may have lacked confidence in his skills, whilst Sonya may have been overly confident in her skills, attitudes which could contribute to their respective experience of apathy and boredom. It could equally be argued that Sonya was faced with less challenge than Nathan however, and that these ratings provide an indication of the complexity of the task undertaken by each person. To explore the participant's attitudes more fully, further comparisons were undertaken.

Tasks that required group participation were the first to be compared. The following table (Table 12) illustrates the group discussion rated on day one and the initial video viewing/logging session rated on the morning of the second day.

Table 12
Ratings comparison for the content discussion and video viewing/logging sessions.

		John	Kimberley	Nathan	Sonya	Valerie
Concept Discussion	Challenge	6	3	0	1	6
	Skill	6	4	1	8	5
Viewing/ logging video	Challenge	8	4	1	2	3
	Skill	5	6	4	5	4

This comparison illustrates how for the same tasks, John reported degrees of challenge and engagement on both occasions, whilst Kimberley and Valerie illustrated degrees of alertness. Sonya indicated that she felt strongly under-challenged, particularly by the discussion for which she rated her skills significantly higher than her peers, whilst her video logging rating

was commensurate with her peers. Nathan's concept discussion session indicated a strong apathy profile, and he also rated his video logging skills lower than three of his peers, whilst he was the only one in reality, with actual experience with this task.

This comparison highlights the subjective nature of perception. To further understand the participant's similarities and differences, it was decided to compare and contrast ratings further.

Table 13

A comparison of Nathan's and John's ESF results for the activities they both participated in.

		Day 1		Day 2		Day 4		Mean	
Nathan	C	0	7	1	7	6	9	7	5.3
	S	1	6	4	8	6	6	4	5
	F	*	*	3	9	6	3	4	5
John	C	6	7	8	8	4	9	5	6.7
	S	6	7	5	8	5	3	4	5.4
	F	*	*	6	8	8	2	8	6.4
		dc	id	vv	id	id	pd	pd	

note: dc=discussing content, id= interface design, pd= programming director, vv=viewing/logging video, * not rated

There are many commonalities between these challenge and skill ratings, for example they both indicate a similar strong discrepancy between their perceived skill level and the challenge for programming in Director (Macromedia, 1995) after the second session on day four. The greatest differences occurred on the days that they were involved in the group discussion and video logging sessions as mentioned previously.

Smaller discrepancies occurred on the day that Nathan and John were both very tired. In the morning they worked together designing the interface for the "Play" branch of the software before trying to develop this in Director (Macromedia, 1995). Nathan rated the experience at six which was above average for him, but he did not rate the experience as a flow experience, although on the actual form he had circled from five to seven, and stated "need more sleep I'm afraid". John found the experience less challenging, but rated it as a flow of eight, apparently gaining satisfaction from seeing the job well done. Their different manner of framing experience was also illustrated by the last session on day four, when Nathan

perceived Debra Anne as taking over. His experience of challenge was higher than John’s but his flow was low, whilst John’s rating for flow suggests that despite his reported inactivity he valued the learning experience. Out of the four sessions that they worked together John reported flow on three occasions, whilst Nathan reported one instance of flow and otherwise generally recorded low flow ratings. This evidence is not conclusive but does suggest that John frames his experience in a more positive light than Nathan.

It was then decided to compare Sonya and Kimberley’s content writing because both participants found this interesting.

Table 14
A comparison of Kimberley and Sonya’s content writing ratings.

		Day 4			Day 5	Mean
Sonya	C	6	5	7	5	5.8
	S	8	7	5	8	7
	F	8	8	7	7	7.5
Kimberley	C	5	6	6	5	5.5
	S	7	7	7	6	6.8
	F	9	8	9	6	8

The comparison of Sonya and Kimberley’s ratings reveals that the earlier mentioned discrepancies decreased when they were both engaged in a task that they found meaningful and sufficiently challenging. Their means are very similar. As Kimberley was more experienced with computers this suggests that Sonya was perhaps rating her content design skills rather than her computing skills. It is noteworthy however, that on Day 5 when Sonya began to operate the computer and the pace dropped below Kimberley’s ability to sustain engagement, Sonya reported the challenge of the task to be 3 points below her perceived skill level.

Although the evidence is inconclusive, it is possible to hypothesise that Nathan’s low self esteem may have been linked to his inability to perceive his opportunities for action, therefore most commonly leading to apathy, whilst Sonya’s tendency to overestimate her skills may also be linked with her underestimation of her opportunities for action, but in her case led to boredom. John, Valerie and Kimberley each appear to have skills in perceiving relevant opportunities for action leading therefore to an appreciation for the value inherent in a broader range of experiences.

Conclusion

This chapter presented the detailed case studies of the five participants and described their reasons for participating, and how they approached their chosen tasks. A description of their day was given, along with their ESF ratings for each task they participated in. Each person's ESF ratings were then collated and the characteristic features of their experience was discussed along with what they learned from participating, along with their experience of flow. Finally a cross case summary was given of the reasons each person participated and the tasks they engaged in, and their ratings were compared to see if this might further elucidate their experience of flow. This led to some hypotheses being raised with the aim to help elucidate how their perception of the skill and challenges available related to their experience of flow.

The following chapter discusses the findings in relation to the research questions. These are then summarised in point form in Chapter Eight and presented along with the limitations of the study and the suggestions for further research.

CHAPTER SEVEN

Discussion of the Findings

This chapter begins with a collation of the findings in relation to the first research question “What learning gains are made by tertiary students from participating in the process of multimedia design?”. This is followed by a discussion of the findings in relation to the second research question “How does flow theory explain student’s natural process of engagement?”. The general factors that effected the participants’ experience of flow are summarised, some conclusions are drawn from the comparison of their processes of engagement, and the role of the study’s context in relation to flow theory is explored. Part two of the research question “How can flow theory be used to deepen students’ experience of engagement or flow, during the process of multimedia design?” is discussed in terms of the study’s implementation of Csikszentmihalyi’s (1992) “the essential steps to build flow”. Other ways that the principles might have been implemented are also considered. This is followed by a discussion of a number of other flow related themes that arose from the data. This includes a brief look at the ESF as a metacognitive tool, and at the consistency of the challenge and skill balance levels as predictors for flow. The issues of flow in relation to design and production processes, as well as the flow and antiflow implications of groupwork are discussed. This leads to an examination of the relationship between flow and the concepts of collaboration and peer scaffolding. The findings are summarised in Chapter Eight and a number of hypotheses for further testing are presented, along with suggestions for further research.

What Students Learned From the Process of Multimedia Design

The preliminary design process stimulated great visions of possibilities that were quickly discarded during the six day period of the study, when the realities of producing the design within the project constraints were faced. It appears therefore that the six preliminary design discussions (see page 67 for an example) were especially effective in triggering the deconstruction of the play-devising process. During this period they had a broad canvas on which to experiment with metaphors and representational methods, and to test, discard or extend these, in the process of finding the best ways to represent the underlying principles of the play-devising process. This therefore appears to have stimulated the participants to extend their mental models,

both in regard to the processes involved in play-devising, as well as for deconstructing the multimedia interface. That this preliminary design process was so rich, appears to be due in part to the fact that Nathan and John were so strongly motivated to explore and extend the possibilities of multi-media design beyond what they believed was the unduly restricted interface they had previously encountered.

During the 6 day study period, Nathan, Kimberley and John all at times reported an increased understanding of the complexity and interconnected nature of the play-devising process, due to their involvement in the interface navigation design. This task evidently challenged them to visualise and consider all the possible interrelationships and links.

Through writing the text for the various play-devising topics, Kimberley and Sonya were also challenged to clarify their understanding of these. The task of representing their knowledge on the computer for their peers, provided a catalyst for them to clarify their understanding through the process of reflective dialogue. As student teachers, writing the content for the topic of the teacher's role proved to be particularly useful for them, as it stimulated them to realise that there was a lot that they didn't know about this subject. This experience therefore sensitised them to the importance of the teacher's role, and they subsequently reported a new appreciation for how effectively David modelled this for them on the day of the studio rehearsal session. Valerie also reported gaining an increased understanding of the actor/audience relationship from watching the video footage.

Observations on the first day indicated that the process of representing the play-devising process conceptually, along with linking and re-categorising some of the related topics, stimulated some higher level re-organisation and clarification. This learning appeared to be quite seamless, and was therefore not recognised by the participants. Valerie however, acknowledged that the process brought the subject matter "back to mind".

Based on this evidence, it was found that the participants who worked directly with representing the contents were challenged most to clarify their knowledge of the subject. The interface designers, by being required to represent the subject of play-devising in a manner that allowed logical navigation, came to understand more deeply both the subtleties as well as the complexity of the inter-relationships of the many play-devising topics.

In the domain of computing, both Valerie and Sonya were computer novices at the start of the project. Valerie gained the most computer skills of the two, in part because the preliminary software familiarisation sessions gave her enough of an understanding of the sound and imaging software's functionalities to motivate her to explore these in every spare moment. It was also apparent however, that Valerie's playful curiosity and willingness to explore and make mistakes contributed to the rapidity with which she learned to use the computers. Sonya was initially limited to using the word processor and later to grappling with basic software processes such as copying, pasting and dealing with layers in Authorware 2 (1995). She appeared to have developed a degree of proficiency by the end of the project, after struggling to use Authorware on her own. She also appears to have gained a much clearer understanding of the functionality of computers.

Kimberley, who had some prior experience using IBM computers for word processing and games, also benefited greatly from participating in the preliminary software familiarisation sessions. She likened the process of learning the complex Director (Macromedia, 1995) animation package to playing a computer game. She focused primarily on this package, being interested to extend her skills with it. Both Kimberley and Valerie developed the confidence to learn a variety of application packages independently and appear to have understood many of the underlying principles of computer use. Nathan and John, both experienced computer users and programmers, did not attend the preliminary sessions and restricted their software use to Director (Macromedia, 1995). They both expressed a strong interest in this application, which was almost matched by their frustration with its complexity, although they did extend their skills somewhat with its use during the project. They both battled with tiredness perhaps exacerbated by the complexity of the software and their lack of automaticity with the Macintosh interface. They stated that this lack of familiarity created some resistance to their use of the computers.

All the participants became aware of the concept of flow. Nathan, apparently in part due to having to reflect on the flow process by having to fill out the ESF each day, became conscious of setting small attainable goals for himself, and reported having used the goal breakdown strategy to transform a domestic task from hackwork to a flow experience. Kimberley became aware that it is easier to enter flow with some people than others and was appreciative of the fact that this was a factor in her compatibility

with her boyfriend. Valerie reported that she learned the importance of working at her own pace and sustaining her focus.

Several discussions focused on the groupwork process. This stimulated reflection on the barriers and aids to groupwork and the role of leadership, although answers were not found. Nathan expressed appreciation for the synergy of the collaborative design process, finding an unexpected reward in working with others because it enriched his own perspectives. Kimberley also mentioned her appreciation of the enlarged perspective she gained from working with some of the others on some occasions.

Participation in the multimedia design process extended every participants' understanding of this process. Nathan, John and Kimberley, with their in-depth conversations about alternative approaches to designing multimedia, were especially challenged to reflect on the limitations of current design practice and to explore how this could be extended.

The study's findings corroborate those described in the literature. The software design process encouraged the participants to become involved in understanding the deeper structures (Harel and Papert, 1992) of both the play-devising process and the work of multimedia software design. Participating in the situated task of software design helped to recast their conceptual understanding "in a new, more densely textured form" (Brown, Collins & Duguid, 1989). Their efforts to extend their mental models of the knowledge domain was documented, as they struggled to analyse the subject and to represent it on the screen. This led to generative learning as described by Jonassen (1994).

Every participant appears to have increased their understanding of the hardware and software used, as well as the skills required to design multimedia. As John stated in relation to multimedia design, "I have it a part of me now that I can do something like that." This statement, along with Valerie's account of how she now participated in conversations about computers, suggests that struggling to implement their ideas through the use of the technology, helped at least some of the participants to enter more fully into the cultures of computing and multimedia design and to "build an increasingly rich implicit understanding of the world in which they use the tools and of the tools themselves" (Brown, Collins & Duguid, 1989).

Despite participants' protests regarding the difficulties of groupwork, the various transcripts and drawings document their process of collective problem solving as they drew out and clarified each others perceptions and misconceptions, thereby developing their groupwork skills as indicated by Brown, Collins & Duguid (1989).

In summary, a number of learning gains were noted over the period of the study. The learning by design processes afforded opportunities for the participants to deepen their understanding of the interconnected nature of the play-devising process, to clarify specific play-devising issues, to extend their understanding of multimedia interface design, and to familiarise themselves with a number of multimedia design roles, technologies and production skills. Their introduction to flow theory provided the participants with a useful model through which to understand their process of engagement, thereby stimulating some metacognition.

Factors that Influenced the Experience of Flow

The first part of the second research question sought to examine whether flow theory could provide a useful model from which to understand the participants' natural process of engagement. It was found that flow theory provided insight into each participant's natural propensity for flow through clarifying the consequences of their motivation, degrees of self-consciousness and self-perception on their engagement. This is elaborated below.

Context

Heeding Salomon's (1990) suggestion to represent the social context of a study, a description has been given in the background to the study as well as the case studies, to describe the context of the project.

It was also noted that the five categories of autotelic environments; choice, clarity, centering, commitment and challenge were represented in the study design as participants were:

- given a choice of tasks;
- provided with focus and clear support and expectations;
- shown interest in their work for its intrinsic worth;
- encouraged to be honest and unguarded; and
- scaffolded to assist them in increasing the complexity of the tasks they faced.

Flow and Personality

It was found that based on their general good humour, their apparent lack of self-consciousness or self-centredness, their ability to identify their opportunities for action and sustain their focus, and the frequency of their reported instances of flow, Valerie and Kimberley were identified as having autotelic personalities.

Nathan was identified as being self-conscious and this interfered with his ability to sustain flow. He only appeared to become socially involved when a topic was of sufficient interest to cause him to forget himself. Nathan's apathy was partly seen to be linked to his preference for the high challenge of design work. Flow theory suggests that because he did not recognise the potential challenge in most production tasks, he was not able to act on the available opportunities for action. It also appears that Nathan lacked confidence in his skills at times, which along with learned helplessness may have led to a spiral of apathy which prevented him from initiating his own tasks.

John was identified as perhaps being mildly self-conscious, but he mostly appeared to be hampered from engagement by his restlessness. This was partly seen to be due to physiological factors, but also by his proclivity to see the potential complexity of a task, leading to degrees of arousal which could easily lead to anxiety. It was recognised that John's ability to grasp this potential for complexity also made him more adept than his peers at recognising and optimising his opportunities for action. In part this was achieved through augmenting a task to balance its challenge to his skill level.

It appears that Sonya's focus on the extrinsic rewards of tasks interfered with her ability to experience the intrinsic immersion of flow. This profile was substantiated by data that indicated a degree of self-centredness, and a tendency to view her skills as higher than the available challenges. This appears to have prevented her from searching for opportunities for action within the available tasks and meant that she frequently experienced boredom.

Data was gathered to explore whether the participant's had the benefit of an autotelic family, but the evidence is inconclusive, although some support was found for Rathund's (1988) autotelic family model. Nathan and

John both described very difficult family environments, with few if any apparent autotelic characteristics. Kimberley came from a very supportive family and her parents expressed a great love for learning, suggesting that her family was autotelic. Sonya described a family that also appeared to have a number of autotelic characteristics. No data was collected about Valerie's family.

As illustrated above, the flow model clarified a number of personality related learning issues. The data corroborated Csikszentmihalyi's (1988) model of the autotelic learner. His explanation for the role of self-centredness and self-consciousness in learning (Csikszentmihalyi, 1992), was seen as particularly useful for elucidating habitual perceptions of learning.

Flow theory also afforded a useful model to study the role of perception. The contrasting studies illustrated that the self-perception of skills may not match actual skills. The data led to the hypothesis that the perceived skills/challenge imbalance associated with low-self confidence may predispose a person to apathy (low skills, moderate challenge), whilst the perception of a skills/challenge imbalance associated with over-confidence may lead to a customary experience of boredom (moderate/high skills, low challenge). Both these attitudes were seen to be linked to an inability to perceive the available opportunities for action. In contrast, the data also suggested that the facility for augmenting a task, thereby fine tuning the skills/challenge balance, can also be developed. This facility for seeing the inherent complexity of a task appears also to have links to restlessness due to the recognition of the potential challenge of a task.

Implementation of "The Essential Steps to Build Flow"

Part two of the second research question asked how flow theory could be implemented to deepen the participants' process of engagement. As explained in the theoretical framework, this study adopted the premise that engagement in a challenging task requires level of skills equal to the task. The "essential steps to build flow" described by Csikszentmihalyi (1992), were used to guide the study design in scaffolding the engagement process. A number of issues arose in relation to their implementation and use. These are described below.

Csikszentmihalyi (1992) first principle states that *to set an overall goal, and as many subgoals as are realistically feasible, encourages flow.*

The process of developing sub-goals was expedited by providing task lists for the interface design and video/content development work, on both the second and third days of the study (see Appendices F - I). These lists were formulated by myself after the first and second project days respectively, the second task list carrying over uncompleted tasks from the first. The participants were invited to choose the tasks that interested them most or that they felt most capable of performing. The limited time for the project caused the decision to be taken to present the participants with pre-written lists as this appeared to be the most efficient way to proceed. The participants were therefore only given a brief overview of the tasks and roles, before we proceeded onto developing the content scope and interface design.

In preparing the task lists it was difficult to ascertain how far a goal should be broken down because some tasks, like flowcharting, were very familiar to some people and not at all to others. It was therefore my aim to allow the participants to decide their own sequence and sub-goals, as I did not know how the task breakdown would suit their particular working style and I did not want to develop lists that was too long or appeared to be condescending.

The lists were therefore presented as broad and general tasks rather than the discerning sub-goals Csikszentmihalyi (1992) prescribes.

Two examples of the interface design tasks on day 2 were;
Flowchart the branches; and
Begin to storyboard the main content screens.

Valerie, Kimberley and John appeared happy to choose their tasks from the list and to ignore those tasks that didn't have immediate priority for them. This suggests that they were skilful at setting their own implicit goals and sub-goals as might be expected from their well developed autotelic skills. Nathan however stated that he would have preferred a short list of only a few tasks as he felt overwhelmed by the length of the list, and this may have contributed to his inertia in finding a task without prompting. Sonya however, would almost certainly have benefited from having more subgoals to follow.

On the fourth day of the study, the day that the prototype was introduced, I hadn't structured a task list for the two groups. This was primarily

prompted by feedback from two people that they felt overwhelmed by the length of the list provided on day three, even though a number of the first list's tasks were simply carried over. I then made the mistaken assumption that everyone was established in their tasks well enough to be able to continue setting their own goals and sub-goals, based on their experience with the earlier provided lists. This assumption arose because setting goals as Csikszentmihalyi (1992) states, is generally implicit in most tasks undertaken. However, I had overestimated the group's autonomy and familiarity with the required tasks. It became especially apparent on the second day that the task list was not provided, that several of the group members had been dependent on it for direction, because I was approached on a number of occasions to provide guidance on the next required task. This suggests there was insufficient understanding of the tasks and that a more thorough description of the tasks was required.

Kimberley's feedback at the end of the project that she required more "doable objectives" was probably a comment on these last days, unless it was a suggestion to have the tasks presented in the, for her as student teacher, familiar Mager (cited in Print, 1993) style format. As Marra and Jonassen (1993) point out, objectivist approaches provide clear structures and boundaries for novices in new situations, suggesting that this approach may have been entirely appropriate to adopt. Fetherston (1997) argues that constructivist learning design also needs to provide clear structure, through steps such as overtaking the desired outcomes.

In hindsight, the outcomes were left rather implicit. Even although time was restricted, it appears that the project and the participants would have been better served if the focus on the first day had been on describing and structuring tasks rather than outlining the content. Csikszentmihalyi (1992) states that where possible, it is important for people to set their own goals so that they have a sense of ownership of the work. By giving the participants explicit information about the multimedia design process, perhaps assisted by concept maps or outlines, they could have selected a significant goal and developed a breakdown appropriate to their needs. Four of the study's participants were in fact particularly well equipped for this task because they were student teachers, and would have had little difficulty translating the tasks into objectives or outcome statements. Alternately, preparation of the task list might have been approached more informally with a statement such as, "I'd like you to write down all the steps required to complete the

task, so that you will readily be able to monitor your progress whilst you are working”.

Had Nathan and Sonya written their own task lists they may have developed a clearer understanding of what was involved in a task, or simply just had stronger proof that the project was different from the more institutional settings they were used to. Having ownership of the goals would also have given them stronger motivation to become involved and would have shown them more immediately what their opportunities for action were. As Larson (1988) states “if one sees no way of making an activity challenging - boredom takes over” (p. 164).

In summary, it was found during the study that the task lists facilitated engagement for some of the groups members through providing a handy guide, but at least two of the groups’ members would have specifically benefited from an individualised list so that their opportunities for action would have been more apparent to them. It appears that participation in developing an individualised task list would have given each participant a greater sense of ownership of the work.

The second guideline (Csikszentmihalyi, 1992) to generate flow is *to find ways of measuring progress in terms of the goals chosen*.

Through their self-directedness and immersion, Valerie, Kimberley and John demonstrated that they had more intrinsic strategies for measuring their own progress and the broad goals on the task list appeared to be adequate for their needs. Nathan and Sonya both indicated however, that they required more specific lists.

The small incremental steps in the design process were frequently subtle and provided little overt evidence of progress to these two participants. Although it appeared to me at the time that the task itself would serve as adequate proof of progress, and that a list of sub-goals to tick off would provide poor feedback, Sonya in fact indicated that she lacked sufficient feedback of her progress until she had a final product in the form of the completed video log or text on a screen.

What constitutes feedback varies considerably in different activities. Some people are indifferent to things that others cannot get enough of. The *kind* of feedback we work toward is in and of itself often unimportant... what makes

this information valuable is the symbolic message it contains
'that I have succeeded in my goal'
(Csikszentmihalyi, 1992, pp. 56-57).

This suggests that by providing a step by step description of the required steps in a task, a comprehensive and individualised sub-goals list could also have given Sonya effective scaffolding for learning new tasks such as word processing. This list could have been in the form of a text document, so she could edit it to tailor it to her needs.

Although Nathan requested a very short task list, his account regarding his experience of reframing hackwork by mentally making effective sub-goals, suggests that he would benefit from devising his own strategy for making the steps in tasks explicit, and that the project's task lists were simply not focused enough for his needs.

In John's case, although he appeared to have developed skills in augmenting his activities, thereby balancing his challenge and skill levels, it appears that when it came to Director (Macromedia, 1995) he was suddenly faced with a task that was beyond his immediate skill level and required scaffolding. John did have some assistance available from Debra Anne to increase his skills. Unfortunately, she also needed to work out how to solve the problem, and thereby took control of the computer. This left John and Nathan in a passive role, which Nathan found very frustrating. This will be discussed further under the topic of peer scaffolding.

In summary, because progress is measured by individual criteria, the application of this principle suggests again that individualised task lists would have best facilitated the implementation of the second principle and that tickable items may have provided enhanced feedback for some individuals.

Csikszentmihalyi's (1992) third principle for building flow is *to keep concentrating on what one is doing, and to keep making finer and finer distinctions in the challenges involved in the activity.*

The ability to sustain attention is critical to flow, in fact Csikszentmihalyi (1992) points out that "Any lapse in concentration will erase it (flow)" (p. 54) and that for a person who is unable to control their "psychic energy" or focus on a task, "neither learning nor true enjoyment is possible" (p. 84).

Csikszentmihalyi (1992) goes as far as to say that "the shape and content of life depend on how attention has been used" (p. 33).

This principle was not emphasised in the study, although Kimberley and Nathan did both state that they wanted to stay with a task to sustain their flow and found it difficult to stop for lunch. As might be expected, all the participant's ESF indicated degrees of difficulty with concentration.

Making increasingly fine distinctions in the challenges of an activity was interpreted to mean that as skill improves, greater discernment becomes possible through understanding the range of possibilities for action. An example of this might be as simple as improving the layout of a document as the skill of word processing is learned and attention is freed from more fundamental tasks such as typing and error correction.

The need to make finer and finer distinction in the work casts light on why Nathan suggested during his interview that the process of implementing his designs was "hackwork", and also why John stated that once he'd written a story and worked out what would happen, he didn't want to go back to polish it. Both had stated that once their design had taken shape they knew what was going to happen and that refining it was therefore boring. It can be argued that this boredom might have been alleviated if they had simply made finer distinctions as they worked.

Larson (1988) described a case which appears to have similarities. He described a bored student who was writing a term paper.

He knew what he wanted to say about the draft. The process of writing it down on paper was therefore a routine exercise. He had simply not learned that writing holds challenges; hence he missed the option of becoming more personally involved.

(Larson, 1988, p. 161).

Nathan's pre-disposition towards experiencing apathy and boredom, and John's pre-disposition towards experiencing anxiety and restlessness, appears to have made it difficult for them to sustain their focus. Perhaps they mistakenly applied the goal of discovering something new, a goal appropriate to the initial design process, to a task that has a different goal, that of honing and producing. If this is true, they would benefit from extending their understanding of the editing, testing and production processes in which they already had considerable skills, by studying adept

work. This would then allow them to make finer and finer distinctions in judging the quality of their own work, and to measure their progress against appropriate sub-goals, thereby extending their opportunities for action.

This process also describes the situated practice of cognitive apprenticeship, discussed in the review of the literature, where through enculturation within an authentic environment, the learner is able to see exemplary work and therefore to aim for an increasingly high level of skill themselves. The closest expression of this model currently available to students is work-experience in a chosen profession. Although the study did aim as far as possible, to replicate an authentic environment where the various roles were undertaken, the authentic culture of practice within a commercial environment is likely to have better stimulated their understanding of the integral iterative relationship between the production and the design process. It appears that with effective opportunities to learn how to discern subtleties in the quality of professional work, John and Nathan would be able to extend the quality of their design skills. This would significantly extend their future employment prospects.

One instance during the project when this level of discernment was shown was on the fourth day when Valerie discovered the subtle and skilful use of sound on an exemplary CD-ROM. Those of us present had not noticed some of the more subtle features until Valerie pointed them out. Her discovery inspired her to pursue the sound design of the project. Unfortunately, this occurred in the absence of John and Nathan, as it may have inspired them extend themselves further too.

The occasion when Kimberley's reported deep absorption whilst storyboarding provides an example when she inherently applied the principle of discernment. In contrast to Nathan and John, her ability to sustain focus allowed her to see that despite the similarities between the screens, there were opportunities to extend each screen's design by capitalising on its unique content.

It seems that much is to be gained from including sub-goals explicitly to sustain focus, with the aim of strengthening and exercising this important faculty, as this ability is so fundamental to flow. The impulse to break focus can then be used as a signal to herald that a quick adjustment to the flow variables might return them to flow. Theoretically this could be accomplished if the participants were motivated by the understanding that

they were participating in fine-tuning their learning skills and enjoyment of learning.

To summarise, it was argued that John and Nathan's preference for the scope of design work prevented them from seeing the challenges and therefore the opportunities for action inherent in the work of producing a design. It was therefore suggested that seeing exemplary work would allow them to discern goals appropriate to the task of production.

This study found two people experienced deep immersion, but generally the participants broke their focus fairly readily. Application of flow theory suggests that it is possible on these occasions, to use this as a metacognitive signal to indicate that the challenge or skill levels may need fine tuning, through applying deeper discernment regarding the opportunities for action and thereby return to flow.

Csikszentmihalyi's (1992) fourth principle for building flow is *to develop the skills necessary to interact with the opportunities available*.

The preliminary software familiarisation sessions were very helpful for the two people who attended them. Nevertheless, the sessions only served as an introduction to the software's capabilities and provided sufficient demonstration of how the packages worked to bridge Valerie and Kimberley to explore on their own. It appears likely that John and Nathan would have been more motivated to implement their design if they had greater competency with Director (Macromedia, 1995).

As mentioned elsewhere, Sonya's lack of skills prevented her from choosing more complex tasks. Her progress in skill development was also undermined when she worked in pairs, because the more skilful person tended to take the active role.

This principle however implies that a person will recognise the available opportunities for action. This perception however, appears to be very subjective. It has been argued that when a person lacks skills they tend not to recognise the available opportunities for action and may therefore not seek opportunities to extend their skills.

In ideal circumstances, the project would have provided sufficient time and resources for the participants to develop all the required skills to a

higher level of proficiency. This would have increased every person's scope for contributing creatively.

This study confirmed that those people who had a reasonable level of skills were more likely to seek out tasks that interested them. It was also found that some of the participants did not fully utilise the available opportunities to increase their skills.

Csikszentmihalyi's (1992) final principle for building flow is to *keep raising the stakes if the activity becomes boring*.

This principle applied to those sessions for which the participants reported low challenge and moderate to high skills, for example a number of the group planning meetings, the video viewing session and for one person, the storyboarding sessions. This latter example is the one instance during the project where it could be argued that someone (Nathan) had mastery over a process and deemed it too simple. Without the opportunity for discussion with him, it is hard to know what would have raised the stakes for him unless he'd been employed to do the job.

It is acknowledged that meetings are frequently a source of boredom for people. This only highlights the fact that this issue can benefit from closer attention. Boredom seemed frequently to be related to the fact that the discussion was not relevant to everyone. The stakes in this instance could have been raised by breaking the group into smaller task groups which were required to report back to the larger group. It is also possible however, that boredom arose because the opportunities for action were not recognised due to a lack of relevant skills. In this case the stakes could have been raised with the expectation that all group members take turns to be group facilitators, and to explicitly develop the required skills. Through the explication of these processes, each meeting could be utilised as an opportunity to further refine their skills. On the other hand, if it appeared that group leadership skills or group process were not an issue, it may have been equally appropriate for those who were not involved in the discussion to simply leave the group and to continue with their chosen tasks.

The fifth principle of raising the stakes when appropriate, had limited application in the current project, because most of the required skills had not yet been mastered.

In summary, the five essential steps to build flow are to:

- set overall goals and subgoals;
- find ways of measuring progress through feedback;
- sustain focus and discern challenges;
- develop the required skills; and
- raise the stakes when the task becomes boring.

These principles provided very useful guidelines for implementing flow theory and later for analysing this process.

It was found that the more autotelic people readily worked with broad and general task lists. These people appeared to develop their own implicit sub-goals and gained their feedback through their progress in their chosen task. The two people who had greater difficulty seeing their opportunities for action and therefore more frequently experienced apathy or boredom, also would have benefited most from individualised sub-goals to gain optimal feedback. It appears that one person would have benefited from a comprehensive list of tickable sub-goals which could also have scaffolded her work. This might have been provided in the form of an editable list as she lacked the experience to write this list without assistance. In contrast, another person felt overwhelmed by the longer list and required a short and clear sequence of tasks. It appears that this person especially, would have experienced more ownership of the work and therefore experienced less apathy, if he had developed his own task list.

It was also found that focus was generally easily broken unless flow was active. It was argued that the ability to focus could be deliberately fostered as a metacognitive signal to check the skill and challenge balance, and perhaps even scaffolded through the use of a task list.

Development of discernment was also seen to have been somewhat neglected during the project, it was suggested that an introduction to more masterly work and, in the case of meeting facilitation, strategies and underlying principles, would have lessened the tendencies to boredom.

Not all people availed themselves of the opportunity to develop their skills. Those who did were seen to extend their opportunities for action.

The principle of raising the stakes was not implemented but suggested some strategies for challenging participants to extend their skills in areas otherwise seen as mundane.

Additional Themes Arising from the Study

The themes that follow arose from the study and are brought together here because they warranted more discussion than the individual case studies afforded or did not fit under the previous headings. Each theme further explores the relationship of flow theory to the process of learning by designing.

The Role of the ESF and Metacognition

Filling out the ESF proved to be very useful for stimulating metacognition for some of the participants. As Nathan commented during the final focus group “normally you don’t talk about *how* you’re learning, it’s learn or work or whatever, and you’re not really interested in how you’re learning or whether you can learn better in a lot of cases but... in this case because we had to stop, fill out the forms... it was really put up right in front of us”. This comment shows that Nathan clearly associated the experience of flow with the process of learning, particularly in response to the invitation to suggest how their flow could be increased. It also appeared that writing provided a degree of confidentiality and neutrality that is missing from oral communication, because the commentary section of the ESF gave Nathan in particular, and to a lesser degree Kimberley, opportunities for providing feedback regarding their experience of the workshop. This therefore allowed the workshop to be adjusted somewhat to their needs.

Variations in the Flow Profile

Csikszentmihalyi (1992) and his colleagues have gathered thousands of ESFs during their research, but they do not report having collected data regarding people's own ratings of their flow experience. In the current study the opportunity was taken to ask people to do this.

For the purpose of analysis, ratings of eight or above were taken to be signifiers of flow, because cross-analysis with the mood ratings found that the eight rating was more consistently confirmed to be a flow experience by generally elevated mood patterns, than the rating of seven. It became evident from the data, that there were a number of instances when people reported experiencing flow when their challenge and skill ratio did not fit within Csikszentmihalyi’s (1992) flow profile of an above average balance of challenge and skill levels. For example Nathan reported a flow of nine after

the final focus group, with challenge of five and a skill level of 4, these were on his mean. Kimberley also reported three instances of flow where her challenge and skill levels were separated by at least two points.

Because these discrepancies were strongly evident, and yet the mood ratings corroborated that flow was present, it suggests that variables other than challenge and skill match can trigger the flow experience. For example, the elevation of mood Kimberley reported whilst storyboarding (c4, s6, f9) appears to have been associated with doing a job well even although the challenge was fairly low. Alternately, it also appears that undertaking the challenging task of working in Director (Macromedia, 1995) did not stop Kimberley from being immersed, even although she was aware of a skill gap. In John's case, on the day that Debra Anne took the active role using the keyboard he still experienced immersion (c5, s4, f8) although the challenge and skill were below his mean, apparently because he was learning how to programme Director. Sonya, on the third day, recorded a discrepancy of five points between her skill level of 8 and the challenge level of 3 whilst preparing the video log, yet she reported an experience of flow at 8, apparently because she was beginning to discern her opportunities for action, although not sufficiently to realise the actual complexity of the task.

This points again to the subjectivity of perception and suggests that either the definitions of flow varied or that the experience of flow may be more complex than Csikszentmihalyi, M. and Csikszentmihalyi, I. S. (1988a) have indicated.

Designing and Producing as Flow Activities

Csikszentmihalyi, M. and Csikszentmihalyi, I. S. (1988b) state that "designing or discovering something new"... appears to be a unique experience, different from the others; this item represents a creative dimension" (pp. 27-28). They also found that "the underlying similarity that cuts across... autotelic activities, regardless of their formal differences, is that they all give participants a sense of discovery, exploration, problem solution - in other words, a feeling of novelty and challenge" (p. 30).

These statements shows how closely designing and problem solving are related to the autotelic experience. This study corroborated this claim, as all design sessions rated degrees of flow of eight or higher by a least one or

more of the participants. For the purpose of their analysis however, Csikszentmihalyi, M. and Csikszentmihalyi, I. S. (1988b) categorised design separately from problem solving. Harel and Papert (1992) argue however, that design “promotes the active and creative use of knowledge by the learner” (p. 67), which suggests that problem solving is integral to design. Examples of tasks in the current study which overlap design and problem solving to various degrees include; storyboarding, the writing of the content screens, the exploration of the capabilities of the software and the solving of navigation issues whilst designing the interface. These activities also generated reports of flow of eight or above.

The data suggests that the design discussions indeed stimulated the most creative and generative thought. This is apparently the reason that John and Nathan spurned the apparently to them, lesser or “hack” work of production. It appears however that the production of a design provides immediate feedback and builds increased discernment through requiring iterative cycles of problem solving as increasingly subtle problems surface during the implementation process. The cycle of designing and producing therefore seems to offer an optimal balance between the mastery of knowledge and the mastery of skills. It is therefore argued here that it may be a mistake to separate the two unnecessarily.

Task Allocation and Peer Scaffolding

It became quickly apparent during the study that task selection generally occurred along skill and gender lines. The latter was highlighted by graduating student Valerie’s comment that she hadn’t worked with boys before. “Buddy” pairings could have increased opportunities for skills development for Sonya and Valerie whilst providing Nathan with a context for exercising his communication skills. It also became apparent, as illustrated by the number of instances when the more skilful person of a pair took control of the computer, that pairing did not ensure scaffolding. This suggests that for scaffolding to be effective, it requires some form of preperation or scaffolding itself.

Flow theory suggests that the principle of setting appropriate goals and measuring progress might also be applied to the scaffolding process itself. This will be explored further in the section on collaborative flow.

Project Outcomes

The learning by designing approach must inevitably balance the requirements of learning against the requirements of producing a product. As discussed previously, the learner might need scaffolding and skills development, whilst in the commercial world, production requirements may forego both of the former for efficiency. It was found however that the production of an effective educational product was a significant motivator for the participants. Although more emphasis on process could have heightened learning gains, it also appears that it would have been counterproductive to abandon the goal of designing an authentic product.

Perhaps a balance can be struck between these two potentially disparate goals. One approach would be to overtly focus on skills development in the areas of peer scaffolding, group process, and in writing effective personal task lists, in advance of the project work. Another would be to incorporate the required skills into a individually tailored task list which could then scaffold the learning of the required skills.

Groupwork, Flow and Anti-flow

The factor that appeared to generate most flow and most anti-flow was groupwork. For example, Nathan was excited by the support he received during group design discussions. Sonya however, made it clear from the very first day that working in groups did not appeal to her, with a statement to the effect that there was no point to do things in large groups (five people) when small groups (three people) could do better. And indeed, Sonya only recorded flow on her ESF after paired sessions or working alone. Nathan on the other hand appeared to experience flow during all of his small-group design meetings as well as after the last day's focus group.

The subject of groupwork arose spontaneously during the last day's focus group.

Sonya	I hate groupwork
Valerie	I don't like groupwork
Sonya	It's just impossible to make decisions in groups, ... I feel anyway
Valerie	I like pairs,

- | | |
|---------|--|
| Sonya | pairs are good |
| Valerie | pairs are good or by yourself, as long as you've got someone you can |
| Sonya | discuss things with |
| Valerie | bounce things off when you need to , yeah... |
| Sonya | I think groups are ridiculous because people are too scared of stepping on each other's feet and I think because |
| Valerie | Trying to cater for the other... |
| Sonya | We've had to do so many bloody group assignments and no-one is really happy with the outcome but you know that if you get bogged down in what you want to do or you have an idea then there's so many people to discuss it with ... its like you know, who wants to do this, who likes it, who doesn't. |
| Nathan | I prefer groups, if you're working in a group you know, larger than two or three people, then I like to have a leader... to delegate responsibility because... if you get a group of five or six people and they've all got equal power and control then,... no one wants to put out, nobody wants to give up. |
| Valerie | or certain people do take over when you don't want them to, ... you've just got something you want to work on and they take over and say you can't do that. It's better in smaller groups. |

John also spoke about his difficulties with groupwork during his interview. He stated that he preferred working in pairs because a group generated too many ideas and that he was arrogant enough to think that his ideas were better. He also expressed frustration with too much planning and discussion "Talking then doing, not continuous talk, that leads only to more great ideas".

These comments suggest that Sonya, Valerie and to a lesser degree John, found groupwork unproductive and potentially fraught with conflict. Nevertheless, Kimberley reported her strongest flow experience after a group collaborative session. It appears that the collaborative discussion about links had helped her to visualise the complexity of the play-devising process much more clearly. This propensity for finding flow in groups is

also true of Nathan as reported in his case study. Nathan found that groupwork provided him with opportunities for extending his ideas collaboratively, thereby stimulating unusual degrees of fluency for him.

The dialogue reported above, illustrates some moments of fluency. It appears that Sonya and Valerie were continuing each others' stream of thought, apparently generating a flow-in-dialogue. Sonya and Kimberley also generated a cheerful collaborative spirit as the following excerpt from their work transcript illustrates.

Kimberley All right. (repeating Sonya's words as she's typing)
 "boundaries and clarity for the students." Ohhh, we
 should be put into the hall of fame!

Sonya Pulitzer prize !

The occurrence of a number of instances of apparent collaborative flow stimulated a search through the data to see if the small group design process might have shown a relationship to flow. Several instances of small group flow were found. The preliminary design phase frequently generated deep discussions whilst individuals tried to integrate the strengths and limitations of the technology into the requirement of representing the play-devising subject domain. These discussions were often imaginative, free ranging, and complex (see page 67) and along with the congenial atmosphere and dinners were sufficiently engaging to motivate continued participation in people's free time, during the six weeks of the preliminary design period.

The study period itself, although more production oriented, also led to numbers of documented instances of collaborative flow. These were:

Nathan's reference to the phenomenon described by Cleese as "shared creation" (cited in Schrage, 1995, p. 33, and explored in Nathan's case study on page 116);

his report of experiencing flow after the last day's lively group discussion;

the collaborative good-will between Kimberley and Sonya as they worked on the content screens; and

the instances reported above of flow-in-dialogue.

Two instances of undocumented collaborative flow were also observed during the first and second day's interface design groups. It appears that flow is generated through effective collaborative dialogue as well as through

the design process itself. Every interface design session was conducted in small groups, and each of these sessions generated reports of flow whether orally or written, from most or all of the people involved. People working alone on designing reported flow, as well as those working on problem solving, whether they worked alone or in pairs. The question that arose was therefore not whether design and problem solving were conducive to generating flow, but whether there was also a link between collaboration and flow.

Schrage (1995) states that there is a dearth of literature about the collaborative process, because the outcomes of successful collaboration are generally the focus of study, rather than the process itself. He found that collaboration as a state of communication is fairly rare and differs from co-operation by its products, which are of significantly greater quality than those that result from co-operation. This suggests that collaboration, like flow, is integrally related to the development and utilisation of complexity.

Although Csikszentmihalyi (1992) freely acknowledges that people are often happiest when they are participating in social activities, in part because company distracts them from their fears which frequently surface in solitude, he also suggests that solitude is required for a person to be able to experience and sustain the concentration that leads to the deeper states of flow. No mention of flow in relation to groupwork was found in his writings. As stated in Kimberley's case study, Massimini and Carli (1988) do describe a student named Carlo, who reported flow through experiencing consistently high and equal challenge and skill levels, in the company of a friend.

Neither Csikszentmihalyi (1992) writing on flow or Schrage (1995) writing on collaboration, link these two, and yet it appears that flow can be experienced during effective collaboration or alternately may be an indicator of effective collaboration.

Collaborative Flow

Research at IBM (Schrage, 1995) found that design groups using collaborative technology such as electronic whiteboards, increased their productivity by up to ninety percent compared to their previous projects. This suggests that solitude is not a prerequisite for immersion in a complex task, although the willingness of the group to actively focus must play a key

role. Additional to the autotelic context of choice, clarity, centering, commitment and challenge which appears to be inherent to this approach, there also appears to be the factor of a shared commitment to a project which coheres these groups. The fact that sustained absorption is required to allow participants to engage in increasing levels of complexity, suggests that flow may be inherent to the collaborative process. In fact, it raises the question whether it is the experience of flow that distinguishes collaboration from co-operation and shifts co-operation to become collaboration. As the products of collaboration are documented (Schrage, 1995) to be substantially increased over those of co-operative groupwork, it is suggested that the study of the conditions which lead to flow in groups is warranted.

Flow theory suggests that well matched skill and challenge levels between the individuals in a group may be an indicator for collaborative compatibility. This would appear to be enhanced if each partner had complimentary but different skills.

The participants in the study shared a close skills match in a number of areas. Alongside their shared practical experience and theoretical understanding of the play-devising process, Nathan and John augmented each others programming and software design skills whilst Kimberley and Sonya complemented each others computing and grammatical abilities.

The design group members also appeared to have complimentary skills and levels of experience, which may have contributed to their fluency and coherence. Nathan and Kimberley both reported flowing after these design groups, and Nathan also after the final focus group. The cheerful goodwill and humour, as well as the excited discovery process generated during design group sessions, again point to the likelihood that flow may be intimately connected with effective collaboration.

Strategies for Building Group Flow

Reflection on how to increase engagement with the much less stimulating group meetings, raises the question "what sub-goals and measures of progress can be built into group communication so that flow can be built and maintained?". Hooper (1992) states that conscious use of communication and group facilitation skills is required if groups are to succeed at effective co-operation. This suggests that skills such as, turn

taking, effective listening, group agenda creation, group facilitation, consensus decision making, and conflict resolution, can be overt and monitored to allow members to consciously develop group flow. Conflict can also be reframed as an opportunity to develop skills because as Schrage (1995) suggests, argument when used as “the craft of explicitness” (p. 31) promotes creative collaboration through challenging people to clarify their personal positions, unstated assumptions, and unstated criteria.

Flow theory (Csikszentmihalyi, 1992) also suggests that flow is enhanced if the members of the group are autotelic by nature. This corroborates the findings of Meredith-Belbin (1993) who states that *stable extroverts*, that is, people who are motivated and sociable and are willing to fulfil various group roles as needed, allow for easiest group functioning. In all the pairs and small groups, at least one member was identified as autotelic and their goodwill and cheerfulness was observed to contribute to the unself-consciousness concomitant with the flow experience for the other members of the group. Varan also reminds us that “team members need to learn to transcend self, understanding how the needs of the project and of the team outweigh their personal ambitions” (1996, p. 26) thereby describing the intrinsic motivation inherent to the autotelic experience.

This study found evidence to suggest that flow theory can be used to enhance collaboration through a careful match between the participant’s skills as well as with the challenge of the task. It was also suggested that the relationship between flow and collaboration warranted further research, and it was hypothesised that autotelic motivation, explicit group skills development, and shared goals and sub goals, might be optimised to enhance collaborative flow.

Peer Scaffolding and Collaborative Flow

The need for optimising peer scaffolding has been mentioned during this discussion. This section looks briefly at the implications of the concept of collaborative flow for peer scaffolding as well as for the wider concept of Vygotsky’s (1986) Zone of Proximal Development. It was decided to treat this issue separately from the group collaboration discussion for reasons of coherence, although many of the same issues apply.

Vygotsky (1986) states “thus the notion of a zone of proximal development enables us to propound a new formula, namely that the only

'good learning' is that which is in advance of development" (1978, p.89 cited in Bruner, 1986, p.73). This statement implies a one way learning relationship where the scaffolder gives to the novice. The concept of collaborative flow extends the concept of the ZPD (Vygotsky, 1986) by suggesting that flow might motivate optimal forms of mutual scaffolding.

To build flow in pairs, the skills and challenge match would again be sought, and the question "what sub-goals and measures of progress can be built into peer communication so that flow can be built and maintained?" again utilised. This question could stimulate the development of a task list written by the participants that could include and thereby scaffold, the sub-goals required to develop their peer scaffolding skills. These skills might include taking turns to fulfil the active role, listening effectively, thinking aloud (Nist & Kirby, 1986; Rosenshine & Meister, 1992) whilst performing a task to explain procedural strategies, restraining the impulse to actively intervene in the other's efforts, and instead, relying on the use of verbal prompts. Flow skills such as applying discernment and sustaining focus could also be included in this list. It is expected of course that these skills would become second nature and that groupwork and scaffolding would then more readily generate collaborative flow.

In summary, it was found that the flow experiences reported in the group did not always match the above average challenge and skill match profile. It was therefore hypothesised that other variables than skill and challenge match can influence flow, or that greater differentiation between the elevation of mood and flow may need to be made. It is also possible that the flow profile is more complex than initially indicated.

It was also argued that although learners may wish to separate the design and the production process these processes are valuable when implemented together to provide effective feedback and to develop discernment in the learner. Arguably, the discernment stimulated by the iterative process of honing a design is difficult to replicate without the process of producing it.

It was suggested that task lists could be developed for classroom use. This tool could be used for a number of metacognitive and scaffolding purposes, for example, to remind the learner who was experiencing boredom or anxiety that this was a signal indicating that they needed to apply the principles of flow.

Groupwork was identified as perhaps one of the strongest sources of both flow and anti-flow. This was seen to be significant because, in its positive form, groupwork is a pre-requisite to group collaboration. It was argued that effective collaboration is qualitatively different from co-operation in that it allows a group to work effectively at highly complex levels and thereby to develop something that they could not otherwise have created.

Furthermore, it was hypothesised that it is flow that allows people to make this shift through providing the necessary immersion to allow them to sustain the necessary focus to engage with complexity. For this reason, issues relevant to the implementation of flow theory were discussed. The participants stated that they found it easiest to work in triads, and it is possible that a groups' skills and challenges might quickly become very difficult to balance with larger numbers. It was also argued however that flow theory might still be fruitfully applied in larger groupwork environments through the clear specification of sub-goals as well as attention to skills matching, and through overtaking cooperative communication practises and including these in the groups' sub-goals.

Furthermore, it was suggested that collaborative flow could optimise peer scaffolding. This might be accomplished through ensuring an appropriate skills match between the learners, as well as by scaffolding the scaffolding process itself, through the use of a task list which listed the appropriate sub-goals.

It was also noted that there were tensions between the outcomes for the project, as the requirements for learning at times diverged from those of producing a product. With emphasis on the former, time would be spent ensuring optimal peer scaffolding and metacognition. With emphasis on the latter, these skills would be easily forfeited to optimise design, budgetary and time-line demands. However, it became apparent that developing an authentic product provided strong motivation for participation. This indicates that a balance between these two outcomes needs to be struck.

Conclusion to the Discussion

This chapter discussed what the participants learned during the multimedia design process, and applied flow theory to provide an explanation for the participants' individual approaches to learning. The study's implementation of flow theory was discussed and a number of

additional themes that arose during the study were presented. The following chapter summarises the findings to the research questions. This section therefore only attempts to give a summation of the findings.

It was found that the participants increased their understanding of the subject matter in the areas of their focus, which meant that the interface designers increased their understanding of the scope and interlinking of play-devising, whilst the content designers deepened their understanding of the specific subjects they wrote about. Furthermore, all the participants reported increasing their understanding of flow and the multimedia design process, as well as increasing their understanding and use of multimedia design software and hardware. Several people also extended their understanding of their own learning process, stimulated metacognitively through the use of the ESF.

Flow theory provided a useful theoretical framework for clarifying and explaining the variations in the participants' process of engagement. Perception and attitude were seen to play a critical part in this. Flow theory also provided useful guidelines for increasing flow, primarily through developing sub-goals that maintained the balance between the learner's challenge level and skill level. Although in the immediacy of the moment it was not always apparent how the theory should best be applied, the data analysis process provided the opportunity to reflect on how the principles might be better implemented in future. This led to a number of suggestions being made.

The primary suggestion which has come from the study, is to extend the utility of the task list. The task sub-goals would ideally be developed by each individual. It would also be interesting however, to see whether a pre-written list might be edited by the participants to match their requirements. These lists could include goals aimed at developing relevant process skills such as sustaining focus and increasing discernment, as well as peer-scaffolding and/or groupwork skills. It is hypothesised that such a list could stimulate metacognition regarding the individual's flow, learning, and collaborative processes.

The study also explored the link between collaboration and flow and the suggestion was made that it might be flow that distinguishes co-operation from the qualitatively more productive collaboration, through providing optimal conditions for sustaining engagement with complexity.

CHAPTER EIGHT

Summary of the Findings, Limitations, Hypothesis for Further Research and Conclusions to the Study

This chapter summarises the findings to each of the research questions. Next, the limitations of the study and the effect of the evaluator are explored. This is followed by the implications of the findings for educational research, and in conclusion a summary is provided of the links between the study findings and the literature.

Introduction

The statements that initiated the focus of this study were;

The only people who significantly benefit from the design process and the use of those tools were the designers, not the learners.

(Perkins, 1986, cited in Jonassen, 1994)

and

Therefore, I shall argue that we should take the tools away from the instructional designers and give them to the learners, as tools for knowledge construction rather than media of conveyance and knowledge acquisition.

(Jonassen, 1994)

The Findings for the First Research Question

What learning gains are to be made by tertiary students from participating in the process of multimedia design?

It is now possible to answer this question.

The study found the following:

Learning about the subject matter

The preliminary design workshops were found to be particularly useful for stimulating the deconstruction of the play-devising process, because appropriate over-arching metaphors were sought, tested and discarded.

The task of writing the contents stimulated two participants to engage in reflective dialogue, thereby clarifying and deepening their understanding of the subject matter. They became aware of the gaps in their knowledge, especially in the area of teaching, and also became aware of the implicit modelling provided by their lecturer.

The process of designing the navigation assisted the people engaged in this task, to understand the complexity and interconnected nature of the play-devising process.

One person reported an increased sensitivity to how the actor was viewed by the audience from watching the video footage of their class work.

Some learning was transparent to the participants and was therefore not identified by them, although it was evident to the researcher. This occurred on the first day of the study, through the processes of categorising and re-categorising, as well as changing the links between the play-devising topics which indicated higher level processing.

The findings therefore support those reported in the literature by indicating that the process of designing multimedia software with computers as mind tools made the participants aware of the scope and limitations of their knowledge, stimulated generative learning, and extended the participant's mental models of the play-devising process and of multi-media design.

Learning about computers

All of the participants advanced their knowledge and use of computers.

Through adequate scaffolding, and an autotelic approach, one of the computer novices was able to establish good skills with a number of professional software packages.

This person stated that she was beginning to participate in the culture of computing due to the fact that she was starting to understand and seek out the more technical conversations about computers which she had previously avoided.

The other novice, with less opportunities for acquiring skills, developed an understanding of basic computer operations and processes. She also gained basic competency with two complex software packages.

A third participant who had some initial experience with word processing and computer games developed skills in animation with a complex software package. She learned that this work could be as engaging as playing computer games.

The two advanced computer users experienced some resistance to generalising their skills from one computing environment (IBM compatible) to another (Macintosh), because they were uncomfortable with the loss of their automaticity with general computing functions. They did however succeed in advancing their skills in programming the Lingo (Macromedia, 1995) environment sufficiently to create rough interactive prototype screens for one branch of their design.

All participants gained experience with the use of multimedia production software.

Learning about flow

All of the participants were introduced to the concept of flow.

One person reported learning to apply the flow principle of breaking a task into small attainable goals, and was thereby able to transform his experience of hackwork into a flow experience.

One person reported understanding the importance of flow in interpersonal relationships.

One person reported understanding the importance of working at her own pace and sustaining her focus.

Learning about multimedia design

All of the participants significantly increased their understanding of the multimedia design process, as well as their understanding of the culture of multimedia design. The novices also became able to identify the roles and skills required in the process, and the software and hardware required for the task.

Three people substantially increased their understanding of interface design limitations and potentialities, and of navigation principles and processes.

One person reported having learned enough to now be able to design and develop his own multimedia software.

All participants learned some of the following related ancillary skills, including graphic imaging, sound and video digitising, video logging and text design.

Learning about collaboration and groupwork

All of the participants participated in reflective discussions about the groupwork process, and extended their skills in collective problem solving and in clarifying each others perceptions and misconceptions.

The impact and role of leadership was discussed by the group, as well as hindrances to effective groupwork.

Two participants reported genuine appreciation for the rewards of effective collaboration.

Learning about learning

All members were able to understand the relationship between flow and learning.

One person reported that the process of filling out the ESF had stimulated him to reflect on his learning process, and he therefore applied his understanding of flow theory to his learning process.

The Findings for the Second Research Question

How does flow theory inform the process of engagement or “flow”, during the process of multimedia design?

This question translated specifically into two more questions, the first of which was:

i. How does flow theory explain the participants’ natural process of engagement?

The study found that flow theory provided an effective model for understanding the factors that influenced the individual participant's experience of flow, in the manner described below. Suggestions arising from the findings are elaborated in the section on the implications for practice.

Two participants were identified to be autotelic, as indicated by their cheerfulness, motivation to learn, ability to sustain focus and find tasks, and the frequency of their reports of flow.

One participant was identified as being strongly self-conscious which disrupted his experience of flow. This person also had a tendency to underestimate his skills and had difficulty identifying his opportunities for action. This appears to be linked to his more frequent experience of apathy.

One participant was identified to be somewhat self-centred which also disrupted her experience of flow. She appeared to overestimate her skills and had difficulty identifying her opportunities for action. This seemed to link to her more frequent experience of boredom.

It is hypothesised that these polarities may be aligned with low and exaggerated self esteem respectively.

One person showed an unusual aptitude for seeing opportunities for action in tasks seen by the others as too simple. He found ways of augmenting activities which helped to make tasks more complex.

This person also had difficulty recognising flow, apparently due to the strong restlessness he experienced, which appeared to have been due to a combination of factors, including a fast metabolism, the disruptive and irritant effect of his dependence on smoking and coffee drinking, as well as the arousal and anxiety stimulated by his recognition of the complexity potential within tasks.

Because the two participants with more advanced software design skills had not learned to discern the more subtle elements in refining and implementing their designs, they were unable to recognise their opportunities for action in this domain.

The participant's reports regarding their family's learning support was inconclusive but was generally confirmed by their flow profile.

The next flow question asked;

ii: How can flow theory be used to deepen students' experience of engagement or "flow", during the process of multimedia design?

The students participated in the process of monitoring their own flow. This was accomplished through the explication of the theory, the regular use of the ESF and the application of the five "Essential steps to build flow".

The specific findings are outlined below.

The first principle of building flow is that an overall goal and as many subgoals as realistically feasible should be set. It was found that:

Task lists were very useful for providing a structure for the participants to work within.

Three of the participants appeared to be satisfied with the general nature of the list and implicitly created their own sub-goals;

One person found that there were too many tasks on the list;

One person required more discernment within each task to provide sufficient feedback of progress; and

The findings therefore indicate that participants would benefit from being supported to develop their own individualised task lists.

The second principle required finding ways of measuring progress in terms of the goals chosen. It was found that:

Feedback requirements are very specific to individuals;

People measured their progress either by the product of their work, or through intrinsic involvement with the work;

Some tasks, such as word processing, did not appear to provide sufficient direct feedback; and

One person transformed the concept of hackwork by developing a series of goals appropriate to the specific task.

The third principle was to keep concentrating on a task and to make finer and finer distinctions in the work. It was found that:

All members of the group reported degrees of difficulty with sustaining concentration;

Two participants reported deeper states of absorption; and

Two participants reported thinking that the implementation of their designs was boring. This was identified as being due to the fact that they were unable to discern the finer opportunities for action within the task.

The application of the fourth principle, to develop the necessary skills to interact with the available opportunities was implemented through the provision of initial skill development sessions. It was found:

That the provision of formal opportunities for developing skills provided a significant foundation for those people who availed themselves of the experience;

Two people chose not to use this opportunity apparently because they already had considerable software skills and expected not to extend them significantly in this session;

The more skilful person tended to take the active role and scaffolding was therefore not implicit to paired work; and

Therefore, for peer scaffolding to be optimised explicit skills development is required.

The fifth principle was to keep raising the stakes if the activity became boring. The study found that;

Mostly skills weren't high enough for this principle to apply;

Boredom based on mastery of a skill appeared to be an issue on only one occasion; and

In the instances when boredom was experienced during meetings it was hypothesised that the stakes could be raised by challenging the participants to learn group facilitation skills.

The essential steps to build flow provided a useful conceptual framework both for organising the project and also for the analysis of the data. The analysis process also provided insights about the process of engagement to arise. These will be discussed in more depth in the section on implications for practice and suggestions for further research.

In the nature of qualitative research, a number of findings arose from the study that were peripheral but relevant to the research questions. These were:

The ESF provided unexpected utility for metacognition as it served as a consistent reminder that flow and therefore learning, was in fact a goal of the design activities;

Some of the participants used the ESF as a non-confrontational vehicle for giving feedback to the facilitator regarding their learning and workshop process, and what would increase their experience of flow;

Discrepancies occurred in the flow profile in a number of the reported instances of flow. It was expected that flow required a balance between skill and challenge levels above the person's mean. This suggested that the relationship of these variables to flow may be more complex than previous research has indicated. Although skill and challenge ratings above the mean do appear to be an effective index of flow, it also appears that instances of flow occur when this balance above the mean is not present. This suggests that other factors are involved; and

Groupwork was a major source of flow as well as anti-flow. The former was due to the fact that collaboration sparked a synergy of skills that stimulated flow. The latter was due to the fact that the meetings were not inclusive of all member's needs, and the participants lacked skill in group process and facilitation.

Limitations of the Study

The conclusions drawn from this study are limited by the context, time period, and sample for the study. The limitations can be described as follows:

The learning by designing project was extra-curricular and occurred at the beginning of the holiday period and therefore does not provide a direct match with conventional educational settings. As opportunities do not currently exist to integrate learning by designing multimedia software into the tertiary drama curriculum, the workshop was held over two and a half weeks beginning the end of November. The restricted time span did not allow any longitudinal development and removed maturation effects. As explained in the case studies, end of semester is a time generally regarded by students to be for relaxation and socialising. The requirements of a fixed schedule weighed heavily on several of the participants who would rather have started their day around lunchtime. This had a strong effect on their energy level and motivation and in one case, on attendance. All these factors affected the generalisability of the study. Furthermore, as stated in the chapter on data collection, it was not possible to validate the analysis with the participants using the procedure called member checking, due to the fact that by the time thesis was written, the participants had graduated and departed from the university. Also, as mentioned in the discussion, there was some conflict between the requirements for the project to design and produce an effective multimedia CD Rom for teachers, and the learning requirements of the participants. Time pressure directed the focus quickly over a general introduction of the design roles onto content development, and prevented the participative development of task lists. This suggests that the requirements of project management may have hindered the reflectiveness required for the most effective integration of the learning by design and flow theories.

As stated in the introduction, this study was conducted in the spirit of Salomon's (1994) corollary which states that the most useful contribution educational research can make is in designing new and innovative learning environments guided by theory.

It is therefore the aim of this study to provide some insights and "a fruitful source of new ideas and hypotheses" (Salomon, 1994, p. 23) thereby contributing to the "ongoing cycle of hypothesis testing through design and hypothesis generation through observations of the resultant learning environments" (p. 23). It is also aimed to further "extrapolate" (Cronbach et al, 1980, cited in Patton, 1990) the findings to other settings and future applications, as is addressed in the sections which follow.

Evaluator Effect

Patton (1990) speaks about the effect of the evaluator/observer on the data collected. Although he considers the evaluator effect of an observer to be overrated, he advises that it is appropriate to observe for reactivity and to inquire overtly about it.

My role was very active and central to the study. When I asked the participants during the final focus group, to what degree their relationship with me might have effected their responses, Valerie stated;

I think it was because you told us that it was for your research, so trying to make it as honest as possible, and if I was feeling bored, I wrote it down, feeling tired or whatever, I wrote it down ... a couple of times that happened, ... it made me want to be as honest as possible because I knew it was going to be part of your research, you're not marking us, it for you.

Nathan said;

The only way I was really affected was ... when I was writing things down I was pretty blunt when I was feeling stuff, but other times, when I was tired or something like that,... I took that into account ... So I wrote down I liked what I did, I didn't write down that I was tired anyway, unless I was tired because what I was doing was boring me, then I actually wrote down so,... because a couple of times I was just dead and it had nothing to do with this.

There is little doubt that at times, people attended out of loyalty to me and my research. As Kimberley stated in answer to the above question "it had an influence on making the decision to do this... I didn't want to let you down because you're (play acting) 'cool' ".

Hypotheses for Further Research

Salomon's statement is reiterated here for clarity.

The attempt to employ theories to guide the design of new learning environments, novel classroom practices, or extracurricular settings can be seen to accomplish a crystallising role. On the one hand it integrates a variety of considerations, principles, pedagogical hunches, and hypotheses to create a new composite entity, while on the other it tries to break new ground thus creating a totally new entity. ... The study of novel and complex designs becomes a

fruitful source of new ideas and hypotheses, thereby establishing an ongoing cycle of hypothesis testing through design and hypothesis generation through observations of the resultant learning environments.

(Salomon, 1994, pp. 22-23)

As explained in the introduction, this study aimed to create such a learning environment, and to explore the implications of both learning by designing and flow in an extracurricular setting. There are a number of hypotheses regarding engagement and learning by designing that have arisen from the study, which might be adapted to curricular educational settings.

With the aim of providing an extrapolation for general educational contexts, the following hypothesis are offered for further testing.

The findings from the application of flow theory suggest that:

Learners will gain insight regarding their individual learning styles and needs, through being introduced to flow theory;

Understanding the relevance of autotelic skills such as, searching for opportunities for action, being less self-conscious, sustaining focus, will provide them with motivation to develop these;

Sustaining focus is an important learning skill to overt so that it may be integrated and applied;

An understanding of the debilitating effects of self-consciousness and self-centredness may reduce name calling, and challenge these habitual behaviours;

The characteristics of choice, clarity, centering, commitment and challenge may be implemented to encourage autotelic learning in the classroom;

If students report boredom or apathy they can be encouraged to read this as a signal so discern greater levels of complexity in a task;

If students experience restlessness they can check to see if they are feeling anxious. If this is confirmed, they can learn to simplify the task by breaking it into smaller steps;

Students can gain an increased sense of ownership in their participation by developing or editing their own task lists;

Participating in the design and use of this task list will increase their understanding of their own learning style and needs;

Novice learners or those who report experiencing insufficient feedback may benefit from a detailed task list that can be ticked off;

A detailed task list can provide novices with the overt steps otherwise generally implicit in a task and thereby provide them with a degree of scaffolding; and

The process of scaffolding needs to be taught explicitly.

The findings regarding groupwork and collaboration suggest the hypothesis that for co-operation to become collaboration, flow is required. This has relevance to the ZPD and peer scaffolding.

It is argued that flow will be assisted by:

Seeking a skills match between individuals as well as to the challenge of the task;

Using smaller groups to reduce the complexity of sustaining this match;

Groups developing their own goals and task lists so that they have clear and appropriate measures for progress; and

Encouraging autotelic motivation by emphasising the group goal over individual goals.

It is also hypothesised that group communication, leadership and scaffolding skills require explicit development and that group skills include:

Agenda setting, listening skills, conflict resolution skills, group facilitation skills, turn taking, valuing the group goal over the individual goal.

Peer scaffolding skills include:

Turn taking, active listening, thinking aloud, avoiding physical intervention but using verbal prompts instead.

The following hypothesis might be tested in relation to the development of collaborative flow.

That the group or pair members participate in developing a task list which included explicit group or scaffolding skills. This list would aim to optimise participation and provide effective feedback to assist students to consciously build and sustain collaborative flow.

The findings from the application of the learning by designing principles suggest the hypotheses that:

The design of multimedia or World Wide Web pages provides computer shy students with an authentic context for developing their computing skills;

For students to optimise their learning about a subject they will need to participate in both the content and interface design of the software;

Where time and support are minimal, simple authoring tools should be used;

The reward of seeing their work develop onscreen as a product can provide novice learners with strong motivation to engage with the complex task of extending their computer skills; and

Those students who have higher skills levels can be provided with more professional software to sustain balance between the challenge of the task and their skills.

The primary hypothesis for further testing might be summarised as:

task lists might be used to scaffold and support immersion in not only practical tasks, but also in metacognitive skills such as flow and groupwork skills development; and

co-operation might be transformed to collaboration through flow.

Furthermore, results from this study warrant further investigation into the areas of learning by designing and the implementation of flow theory in educational settings.

The learning by designing approach deserves to be researched across a variety of settings, especially in contexts where motivation to learn about the subject matter and/or computing is desirable.

The explicit teaching of flow theory also deserves further study, to see how it might affect aspects such as student's self-attributions for example.

Another area with great relevance, not only to education but also to industry, is that of collaborative flow. Research efforts to determine if in fact flow distinguishes collaboration from co-operation could provide a wealth of strategies for developing group and peer scaffolding effectiveness.

All these areas of research can be framed within the iterative cycle of hypothesis testing, reflection and design suggested by Salomon (1994), with the aim of informing further developments in educational theory and in the implementation of the learning by designing strategy.

Conclusion to the Study

The theoretical framework of this study was founded on constructivist and flow theories, and the study focused on the processes of engagement and learning by designing. The learning by designing work was situated in the context of multimedia software design and computers were used as mind tools. The requirement of representing their knowledge for their peers stimulated the participants to negotiate, collaborate, and reflect on the play-devising and multimedia design processes. This mixture was found to stimulate a rich context for learning.

This study set out to establish what five students learned from designing multimedia software, and whether flow theory could provide an explanation for their processes of engagement, as well as assist in deepening it.

It was found that the participants deepened their understanding of the subject domain and the multimedia design process, in so far as they focused on specific subsets of these. They also all learned a number of computing and multimedia software design skills, and some gained insight into their own processes of engagement and learning.

Flow theory proved to be a useful model for illuminating the influences that effected students' normal processes of engagement.

Through applying the principles for building flow, insight was gained into the requirements of individual students to deepen their engagement, and a number of strategies were suggested for future implementation and refinement. The strategy of introducing students to the concept of flow and working explicitly with them to develop their metacognitive understanding of their own flow, was found to be the most optimal approach to implementing the flow model and led to the hypothesis that students could also be involved in designing their own task lists. It was also hypothesised that task lists could be used as tools for generating collaborative flow in groupwork and peer scaffolding contexts.

It is recognised that the study was limited by a number of factors, primarily the restrictions on the length of the study and therefore also on the reflective implementation process, the influence of holiday distractions on the commitment of the participants, and the lack of opportunity to check the findings with the participants. Nevertheless, this report has sought to provide an accessible, reflective and descriptive account, thereby seeking resonance with educational professionals so that the findings might be extrapolated to other educational setting, thereby informing further developments in the implementation of the learning by designing approach and the application of flow theory to education.

References

- Adelman, C., Jenkins, D., & Kemmis, S. (1976). Re-thinking case study: notes from the second Cambridge Conference. *Cambridge Journal of Education*, 6(3), 139-149.
- Allison, M. T., & Duncan, M. C. (1988). Women, work, and flow. In M. Csikszentmihalyi & I. S. Csikszentmihalyi (Eds.), *Optimal experience: Psychological studies of flow in consciousness* (pp. 118 - 137). NY: Cambridge University Press.
- Ault, C. R. (1985). Concept Mapping as a Study Strategy in Earth Science. *Journal of College Science Teaching*, 15, 38-44.
- Australian Education Council. (1994). *Statement on technology for Australian schools*. Carlton, Vic.: Curriculum Corporation.
- Australian Education Council. (1994). *The Arts: A curriculum profile for Australian schools*. Carlton, Vic.: Curriculum Corporation.
- Ausubel, D. P. (1968). *The Psychology of Meaningful Verbal Learning* (2nd ed.). New York: Grune & Stratton.
- Authorware Professional 2. [Computer Program]. (1993) Macromedia Inc USA.
- Balestri, D. P., Ehrmann, S. C., & Ferguson, D. L. (Eds.). (1992). *Learning to design: Designing to learn; Using technology to transform the curriculum*. Washington: Taylor & Francis.
- Biehler, R. F., & Snowman, J. (1990). *Psychology applied to teaching* (6th ed.). Boston: Houghton Mifflin Company.
- Biggs, J. B., & Moore, P. J. (1993). *The Process of Learning* (3rd ed.). Sydney: Prentice Hall.
- Bork, A. (1991). Computers and educational systems. *Australian educational computing*, Sept, 31-34.
- Bransford, J. D., Sherwood, R. D., Hasselbring, T. S., Kinzer, C. K., & Williams, S. M. (1990). Anchored instruction: Why we need it and how technology can help. In R. Spiro & D. Nix (Eds.), *Cognition, Education and Multimedia. Exploring ideas in high technology* Hillsdale, NJ: Lawrence Erlbaum.
- Brown, J. S., Collins, A., & Duguid, P. (1989). *Situated Cognition and the Culture of Learning*. Available WWW:

<http://www.ilt.columbia.edu/ilt/papers/JohnBrown.html> [last updated 29-Nov-95].

Bruner, J. (1971). *Towards a theory of instruction*. Oxford University Press.

Bruner, J. (1986). *Actual minds, possible worlds*. Cambridge: Harvard University Press.

Buzan, T., & Buzan, B. (1993). *The Mind Map Book*. London: BBC Books.

Csikszentmihalyi, M., Rathunde, K., & Whalen, S. (1993). *Talented teenagers: The roots of success and failure*. Cambridge: Cambridge University press.

Csikszentmihalyi, M. (1975). *Beyond boredom and anxiety: The experience of play in work and games*. San Francisco: Jossey-Bass.

Csikszentmihalyi, M. (1992). *Flow: The psychology of happiness*. London: Rider.

Csikszentmihalyi, M., & Csikszentmihalyi, I. S. (1988a). The measurement of flow in everyday life: Introduction to part IV. In M. Csikszentmihalyi & I. S. Csikszentmihalyi (Eds.), *Optimal experience: Psychological studies of flow in consciousness* (pp. 251-265). NY: Cambridge University Press.

Csikszentmihalyi, M., & Csikszentmihalyi, I. S. (Eds.). (1988b). *Optimal experience: Psychological studies of flow in consciousness*. NY: Cambridge University Press.

CTGV - Cognition and Technology Group of Vanderbilt (1993). Anchored Instruction and Situated Cognition Revisited. *Educational Technology* (March), 52-70.

Dansereau, D. F. (1987). Technical learning strategies. *Engineering education* (Feb), 280-284.

Delclos, V. R., & Hartman, A. (1993). The Impact of an Interactive Multimedia System on the Quality of Learning in Educational Psychology: An Exploratory Study. *Journal of Research on Computing in Education*, 26(1), 83-93.

Dick, W. (1995). Instructional design and creativity: a response to the critics. *Educational Technology* (July-August), 5-11.

Director 4. [Computer Program] (1995). Macromedia Corp USA.

- Fetherston, T. (1997). *Designing cognitivist and constructivist educational, interactive, multimedia*, Edith Cowan University, Perth.
- Flavell, J.H. (1985) *Cognitive Development*, (2nd ed.) Englewood Cliffs, NJ: Prenticehall, 1985.
- Fosnot, C. T. (1996a). Constructivism: A psychological theory of learning. In *Constructivism: Theory, perspectives, and practice* (pp. pp. 8-33). New York: Teachers' College Press.
- Fosnot, C. T. (Eds.). (1996b). *Constructivism: Theory, perspectives, and practice*. New York: Teachers' College Press.
- Gage, N. L., & Berliner, D. C. (1992). *Educational Psychology* (5th ed.). Boston: Houghton Mifflin Company.
- Gagné, R. M. (1966). *The Conditions of Learning*. New York: Holt, Rinehart and Winston Inc.
- Gagné, R. M. (1974). *Essentials of learning for instruction*. Hinsdale, Illinois: The Dyden Press.
- Hancock, A., & Ramondt, L. (1996). Drama on CD: The Playbuilding CD Rom project. *Media International Australia*, 81(August), 41-48.
- Hannafin, R. D., & Savenye, W. C. (1993). Technology in the Classroom: The Teacher's New Role and Resistance to It. *Educational Technology*, June, 26-31.
- Harel, I., & Papert, S. (1992). Software design as a learning environment. In D. P. Balestri, S. C. Ehrmann, & D. L. Ferguson (Eds.), *Learning to design, Designing to learn; Using technology to transform the curriculum* (pp. 35-70). Washington, DC: Taylor & Francis.
- Hill, W. F. (1977). *Learning: a survey of psychological interpretations* (3rd ed.). New York: Thomas Crowell Company.
- Hooper, S. (1992). Cooperative Learning and Computer-Based Instruction. *Educational Technology and Research*, 40(3), 21-38.
- Hopkins, D. (1993). *The teacher's guide to classroom research* (2nd ed.). Buckingham: Open University Press.
- Jih, H., J., & Reeves, T. C. (1992). Mental Models: A Research Focus for Interactive Learning Systems. *Educational Technology and Research*, 40(3), 39-53.

- Jonassen, D. (1994). Technology As Cognitive Tools: Learners As Designers. In ITFORUM [listserv discussion paper] Available WWW: <http://itech1.coe.uga.edu/itforum/paper1/paper1.html> [published 1994, May 4].
- Jonassen, D. H. (1995). Supporting communities of learners with technology: A vision for integrating technology with learning in schools. *Educational technology* (July-August), 60-63.
- Jonassen, D. H., Campbell, J. P., & Davidson, M. E. (1994). Learning with media: Restructuring the debate. *Educational Technology and Research* 42(2), 31-39.
- Jonassen, D. H., Wilson, B. G., Wang, S., & Grabinger, R. S. (1993). Constructivist Uses of Expert Systems to Support Learning. *Journal of Computer Based Instruction*, 20(3), 86-94.
- Kember, D., & Murphy, D. (1990). Alternative directions for instructional design. *Educational Technology*, 30(8), 42-47.
- Kemmis, S., & McTaggart, R. (1990). *The action research planner* (3rd ed.). Melbourne: Deakin University Press.
- Kozma, R. B. (1994). Will media influence learning? Reframing the debate. *ETR&D*, 42(2), 7-19.
- Larson, R. (1988). Flow and writing. In M. Csikszentmihalyi & I. S. Csikszentmihalyi (Eds.) *Optimal experience: Psychological studies of flow in consciousness* (pp. 150 - 171). NY: Cambridge University Press.
- Laurillard, D. (1994). Multimedia and the changing experience of the learner. Paper presented at the APITITE, conference, Brisbane:
- Le Compte, M. D., & Goetz, J. P. (1982). Problems of reliability and validity in ethnographic research. *Review of Educational Research*, 52(1), 31-60.
- LeFrancois, G. R. (1982). *Psychology for teaching: A bear always, usually, sometimes, rarely faces the front*. (4th ed.). Belmont, California: Wadsworth Publishing Company.
- Levine, H. G. (1990). Models of qualitative data use in the assessment of classroom-based microcomputer education programs. *Journal of Educational Computing Research*, 6(4), 461-77.
- Lincoln, Y. S., & Guba, E. G. (1990). Judging the quality of case study reports. *Qualitative studies in education*, 3(1), 55-59.

- Marra, R. M., & Jonassen, D. H. (1993). Whither constructivism. In *Educational Media and Technology - Yearbook 1993* (pp. 56-77). Englewood, Colorado: Libraries unlimited.
- Marton, F., Dall'alba, G., & Beaty, E. (1993). Conceptions of Learning. *Journal of Educational Research*, 19, 277-300.
- Marton, F., & Saljo, R. (1976). On Qualitative Differences in Learning; I - Outcome and Process. *British Journal of Educational Psychology*, 46, 4-11.
- Maslow, A. H. (1968). *Toward a Psychology of Being* (2nd ed.). Princeton, NJ: Van Nostrand.
- Massimini, F., & Carli, M. (1988). The systematic assessment of flow in daily experience. In M. Csikszentmihalyi & I. S. Csikszentmihalyi (Eds.), *Optimal experience: Psychological studies of flow in consciousness* (pp. 266- 287). NY: Cambridge University Press.
- Meredith-Belbin, R. (1993). *Management Teams: Why they succeed or fail* (13th ed.). Oxford: Butterworth-Heinemann Ltd.
- Merrill, M. D. (1990a). Introduction to Special Issue: Computer-Based Tools for Instructional Design. *Educational Technology*, March, 5-6.
- Merrill, M. D., Li, Z., & Jones, M. K. (1990b). Limitations of First Generation Instructional Design. *Educational Technology*, Jan, 7-10.
- McInerney, D., & McInerney, V. (1994). *Educational Psychology: Constructing learning*. Sydney: Prentice Hall.
- McMurray, A. (1994). Researching rural health: The qualitative approach. *The Australian Journal of Rural Health*, 2(4), 17-24.
- McNiff, J. (1994). *Action Research: Principles and practice*. London: Routledge.
- Miles, M. B., & Huberman, A. M. (1994). *An expanded sourcebook: Qualitative data analysis* (2nd ed.). Thousand oaks, California: Sage Publications Inc.
- Nist, S. L., & Kirby, K. (1986). Teaching Comprehension and Study Strategies Through Modelling and Thinking Aloud. *Reading research and instruction*, 25, 254-264.
- Nowakowski, A. (1994). Reengineering education at Anderson Consulting. *Educational Technology* (Nov-Dec), 3-20.

- Papert, S. (1993a). *The Children's machine; rethinking school in the age of the computer*. NY: Basic Books.
- Papert, S. (1993b). *Mindstorms: Children, computers and powerful ideas* (2nd ed.) New York: Basic Books.
- Patton, M. (1990). *Qualitative evaluation and research methods* (2nd ed.) Newbury Park: Sage.
- Pavlov, I.V, (1927) *Conditioned reflexes*, London: Oxford University Press.
- Perkins, D. N. (1986). *Knowledge as design*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Perkins, D. N., Goodrich, H., Tishman, S., & Owen, J. M. (1994). *Thinking Connections: Learning to think & thinking to learn*. Menlo Park: Addison Wesley Publishing Company.
- Photoshop 3.0. [Computer Program]. (1994). Adobe Systems Incorporated. USA
- Piaget, J. (1952). *The origins of intelligence in children* New York: International Universities Press.
- Piaget, J. (1977). *Equilibration of cognitive structures*. New York: Viking.
- Preece, J., Rogers, Y. et. al (1994). *Human Computer Interaction*. London: Wokingham, England, Addison-Wesley Pub. Co.
- Print, M. (1993). *Curriculum Development and Design*. Sydney: Allen & Unwin.
- Rathunde, K. (1988). Optimal experience and the family context. In M. Csikszentmihalyi & I. S. Csikszentmihalyi (Eds.) *Optimal experience: Psychological studies of flow in consciousness* (pp. 342-363). NY: Cambridge University Press.
- Reeves, T. C. (1992). Evaluating Interactive Multimedia. *Educational Technology* (May), 47-53.
- Reeves, T. C. (1993). Reeves' Pedagogical Dimensions. In *Educational Computing Australia - Western Australia* (pp. 1-10). Bunbury: ECAWA
- Rieber, L. P. (1996). Seriously considering play: Designing interactive learning environments based on the blending of microworlds,

- simulations, and games. *Educational Technology Research & Development* 44(2), 43-58
- Rieber, L. P., Luke, N., & Smith, J. (1998). Project Kid Designer: Constructivism at work through play. *Meridian*, [online serial] 1(1) Available WWW: http://www.ncsu.edu/meridian/feat_1/kiddesigner.html [accessed 1998, February 25]
- Rogers, C. R. (1969). *Freedom to Learn*. Columbia, Ohio: Merrill.
- Rosenshine, B., & Meister, C. (1992). The Use of Scaffolds for Teaching Higher-Level Cognitive Strategies. *Educational Leadership* (April), 26-33.
- Rowland, G., Fixl, A., & Yung, K. (1992). Educating the Reflective Designer. *Educational Technology*(Dec), 36-44.
- Salomon, G., Perkins, D., & Globerson (1991). Partners in cognition: Extending human intelligence with intelligent technologies. *Educational Researcher*, 20(3), 2-9.
- Salomon, G. (1994). Whole individuals in complex settings: Educational research re examined. In *Annual Meeting of the Australian Association for Research in Education*, (pp. 1-32). Newcastle, NSW.
- Schrage, M. (1995). *No more teams! Mastering the dynamics of creative collaboration* (2nd ed.) . New York: Doubleday.
- Schwandt, T. (1994). Constructivist, interpretivist approaches to human inquiry. In Denzin, N.K. & Lincoln, Y.S. (Eds.)*Handbook of Qualitative Research*, Thousand Oaks : Sage Publications
- Shore, L., Erickson, M. J., Garik, P., & Hickman, P. et. al. (1992). Learning Fractals by "Doing Science": Applying Cognitive Apprenticeship Strategies to Curriculum Design and Instruction. *Interactive Learning Environments*, 2(3 & 4), 205-226.
- Skinner, B.F. (1938) *The behavior of organisms: An experimental analysis*. New York: Appleton-Century.
- Stake, R. E. (1988). Case study methods in educational research: seeking sweet water. In Jaeger, Richard M. (Ed.), *Complementary methods for research in education* (pp.253-265). USA: American Educational Research Association.
- Stake, R. (1995). *The art of case study research*. Thousand Oaks: Sage Publications.

- Strauss, A., & Corbin, J. (1990). *Basics of Qualitative Research - Grounded theory procedures and techniques*. Newbury Park: Sage Publications.
- The Concise Oxford Dictionary of Current English (1995). (Eds Fowler, H.W., Thompson, D. & Fowler, F.G.) London: Oxford University Press.
- Tobias, S. (1991). An eclectic examination of some issues in the constructivist-ISD controversy. *Educational technology, Sept*, 41-43.
- Varan, D. (1996). *Connecting with the user* Seminar paper. Perth: Imago.
- von Glaserfeld, E. (1996). Introduction: Aspects of Constructivism. In *Constructivism: Theory, perspectives, and practice* (pp. 8-33). New York: Teachers' College Press.
- Vygotsky, L. S. (1986). *Thought and language*. Cambridge, Mass: Harvard University Press. (Original work published in 1934, foreword to the 1986 edition by A. Kozulin).
- Watson, J.B. (1913) Psychology as the behaviorist views it. *Psychological review*, 20, 158-177.
- Weininger, D. (1995) The Frankfurt school. Book review published in Boston Book Review : Wiggershaus, R. (1995)*The Frankfurt School: Its History, Theories, and Political Significance*. translated by Robertson, M., MIT, Available at <http://www.bookwire.com/bbr/politics/frankfurt-school.html>
- Yin, R. (1989). *Case studies research: Design and methods*. Newbury Park: Sage.
- Yin, R. K. (1993). *Applications of case study research*. Newbury Park: Sage.

List of Appendices

Appendix	Title	Page
Appendix A	Letter of notification	195
Appendix B	Letter of consent	196
Appendix C	Flow Poster	197
Appendix D	Flow Interview Questions	198
Appendix E	Final Questionnaire	199
Appendix F	Day Two Activities Video	201
Appendix G	Day Two Activities Content	202
Appendix H	Day Three Activities Video	203
Appendix I	Day Three Activities Content	204
Appendix J	Case Study Summary Matrix	205

Appendix A- Letter of notification

Home Address

Hi,

Thanks for participating in the design of the play-devising CD. As you know this project will be providing me with the data for my Masters in Education thesis research. As I've explained, I'm hoping to test whether participating in the design process increases your understanding of the play-devising subject area, and whether your level of enjoyment is at its optimum when your skills are equal to the required task.

To collect data, I'll be interviewing you, and if necessary leaving a video camera running in the corner of the room to capture an overview of what is happening. I will also ask you to fill out a questionnaire about devising plays before and after the project as well as asking you to fill out a "Flow sampling" questionnaire after you've been engaged in a task. The latter will only take a minute or two but will happen four times each day. As well as all that, I'll be taping our afternoon discussion sessions on audio tape if it relates to my study.

In the new year, I'd like to get everyone together to show you progress on the CD and to find out how everybody sees the design experience with the wisdom of hindsight.

I trust that there will be benefits to you from participating in the research namely learning some useful flow and design strategies.

I also hope that the research findings will contribute to the teaching and instructional design professions by casting light on these issues.

Of course, participating or not in the research will in no part prejudice or effect your course at (this university). If you would like to participate in the design process without participating in the research, or if you have any problem with my recording you or have any questions at all about the process, please don't hesitate to call me.

Your participation is totally voluntary and your choice to withdraw from the project at any time will be protected and respected.

Sincerely,

Leonie Ramondt phone number email address

Appendix B - Letter of Consent

Name

Address

Telephone

I have read the attached information and any questions I have asked have been answered to my satisfaction. I agree to participate in the research on flow and learning by designing, with the understanding that I may withdraw at any time.

I agree that the research data gathered for this study may be published provided I am not identifiable.

Participant

Date

Investigator

Date

Flowbuilding

The essential steps to build Flow are:

(a) to set an overall goal, and as many subgoals as are realistically feasible;

(b) to find ways of measuring progress in terms of the goals chosen;

(c) to keep concentrating on what one is doing, and to keep making finer and finer distinctions in the challenges involved in the activity;

(d) to develop the skills necessary to interact with the opportunities available; and

(e) to keep raising the stakes if the activity becomes boring.

Appendix D - Flow Interview Questions

Flow

I am going to read you a description of a state of mind. After I read it I would like to ask you to what degree you experience it and some other questions about it.

When I stop to think about it I realise that an important part of this state of mind is enjoyment. I get so involved in what I'm doing, I almost forget about time. When I experience this state of mind, I feel really free from boredom and worry. I feel like I am being challenged or that I am very much in control of my action and my world. I feel like I am growing and using my best talents and skills: I am master of my situation.

To what degree do you experience this?

(prompt if necessary) Which activities are most likely to be associated with this experience?

What attracts you to participate in the software design project?

Final focus group

What was your experience of Flow during the project?

If you were to enhance your experience of flow in future, how might you go about this?

In what ways do you think that participation in the design project might have influenced your understanding of devising plays?

Appendix E - Final Questionnaire

Name:

1. The highlight(s) of this fortnight has been;
2. Lowlight(s)?;
3. Overall, what has been most useful to me is;
4. In terms of organisation, what I found most useful was;
5. What has been least useful was;
6. Changes in my attitudes/feelings/understanding/skill with computers;

7. Some things I've learned about flow that I'm likely to apply in my life/career.

8. New understandings/ connections perceptions on play-devising.

9. Insights and comments

Appendix F - Day Two Activities Video

Some Video goals, subgoals and considerations.

	Scan through the shot lists and video looking for illustrative bits, mark these on the shot list (clarify text on the shot lists for later editing.)
	Work out where the video sequences fit into the program
	Establish from (lecturer) which exercises were not filmed. Verify there are no other omissions.
	Work out which footage is essential
	Develop a shot list for the studio shoot.
	Dub (devised production) to svhs, shot list and record which images are particularly illustrative.
	Can we already tell which of the play-devising documentary sections are most useful for inclusion?
	What sort of commentary might be most useful for the documentary sections? Who do we need to interview for these?
	Grab pics from video to illustrate relevant sections.
	Compress relevant video
	Edit with interesting effects in Premiere.
	Mock up sequences and using either video or the quick take camera, digitise the images for experimentation eg the movement variables.

Appendix G - Day Two Activities Content

Some Interface design goals, subgoals and considerations.

	Read up the (very little) info we have on what teachers say they want from this package
	Device some scenarios eg Hilary has been teaching drama for 12 years, she has a big class of boisterous year nines, what would be most useful for her on the CD? or John and Francesca are new theatre ed students learning about play-devising , what would they like to find on the CD ?
	Is there a theme or metaphor which can be applied throughout the interface? (simplicity and unity are more readily powerful)
	Brainstorm strategies to link the nodes eg students or (lecturer) talking to the user as links,
	Flow chart the branches.
	Begin to story board the main content screens (may need to depend on what video is available ?)
	Scan through the shot lists and work out which images/scenes might be used for the intro interface, and the main nodes,
	Brainstorm navigation conventions eg just click directly, help, map, how do you go back a screen (on the interface), exit
	Work out which images/scenes might be used for the intro interface.
	Digitise the relevant material (screen captures from video?)
	Design/devise the prototype main screen(s) (photoshop/director)
	Where do the play-devising exercise demo video sequences fit into the program ?
	Brainstorm how and where the documentary pieces might be integrated into the program
	Photograph relevant images with the quick take camera.
	Mock up sequences and using either video or the quick take camera, digitise the images for experimentation eg the movement variables.

Appendix H - Day Three Activities Video

Day 3 Video activities

	View and shotlist relevant images in final performances
	View and shotlist relevant images in (devised production)
	View current (devised production) pics using jpeg and select relevant images
	Compress selected video sequences
	Grab pics from video.
	Edit with interesting effects in Premiere.
	Develop a shot list for the studio shoot.
	At some stage dub (a devised production) onto svhs.
	Can we already tell which of the play-devising documentary sections are most useful for inclusion?
	What sort of commentary might be most useful for the documentary sections? Who do we need to interview for these?
	Mock up sequences and using either video or the quick take camera, digitise the images for experimentation eg the movement variables.

Appendix I - Day Three Activities Content

Day 3 Interface design goals etc

	Brainstorm navigation conventions eg just click directly, help, map, how do you go back a screen (on the interface), exit
	Brainstorm strategies to link the nodes eg students or (lecturer) talking to the user as links,
	Where does the documentary and play-devising info fit ?
	Complete storyboarding
	Show off the storyboards and discuss progress so far with the whole group, discuss what video is available to illustrate.
	Scan through the play-devising picts to see if any of those can be used for the main contents screens.
	View and digitise video if necessary.
	Play with photoshop to enhance the content screen picts .
	Mock up the first main content screen in photoshop/ director (not the intro or main menu yet, one of the topic screens)
	Get feedback from group re first screen, begin mocking up next main screens.
	Scan through the shot lists and work out which images/scenes might be used for the intro interface, and the main nodes,
	Digitise the relevant material (screen captures from video?) as appropriate (might be being done by video group)
	Photograph relevant images with the quick take camera if experimental mockup are required eg the movement variables.
	Is there a theme or metaphor for the whole interface emerging yet ?

Appendix J - Case Study Summary Matrix

	John	Kimberley	Nathan	Sonya	Valerie
new to computers				*	*
some experience		*			
experienced	*		*		
learned to use new packages	*	*	*	*	*
autotelic		*			*
self conscious	?		*		
self centred				*	
sought complexity		*	*		*
augmented complexity	*				
sustained immersion		*	*		?
restless	*			*	
bored			?*	*	
apathetic			*		
tired	*		*	*	
designed	*	*	*		*
preferred pairs	*	?	*	*	*
preferred working alone					?
liked groups	*	*	*		
stated strong preference for design work	*		*		
stayed behind to work		*		*	*
initiated activities	*	*		?	*