Bournemouth University
The Media School
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Critical Computer Animation:
An Examination of "Practice as Research"
&
its Reflection and Review processes

This thesis is submitted for the degree of Doctor of Philosophy

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Critical Computer Animation -

An Examination of "Practice as Research" & its reflection and review processes

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Abstract

My doctoral study investigated the "Practice as Research" model for critical 3D computer animation. I designed a structure for the model using mixed research methods and a critical process, and applied this proposed methodology first into a pilot study to examine some selected methods and identify other required techniques for this research model. The refined "Practice as Research" model was then applied into different fields of animation - a game development project, a narrative, and experimental animation for detailed analysis and improvement of its flexibility.

The study examined a variety of practices and procedures used by animators and studios and identified processes for the analysis and evaluation of computer animation. Within the created research space in both commercial project and experimental works, I demonstrated that there were effective and different procedures, depending on the application and its target qualities. Also, I clarified some of the basic differences between traditional animation techniques and 3D skills; hence, explained and modified some of the well-established animation practices to best suit 3D animation development.

The "Practice as Research" model encouraged critical research methods and attitudes into industrial settings to expand the receptiveness of experiences and knowledge, shifting away from the common creative product-oriented view. The model naturally led a practitioner to intervene one's perspective and previous ways of doing. It showed that the "Practice as Research" approach could increase creativity in a product while maintaining control in time management and encourage animators to welcome other perspectives. The research concluded that if "Practice as Research" model was used properly, it could be an effective and efficient method to satisfy both commercial qualities and personal development.

The most interesting part of the research was perhaps the search for an animator's mindset, personal qualities, preconceptions and preferences that could influence practices and qualities. With those additional information, I refined the proposed "Practice as Research" model that allowed animators to modify their previous way of working and thinking during the process, and encouraged continuous development to aim for a higher quality of work.

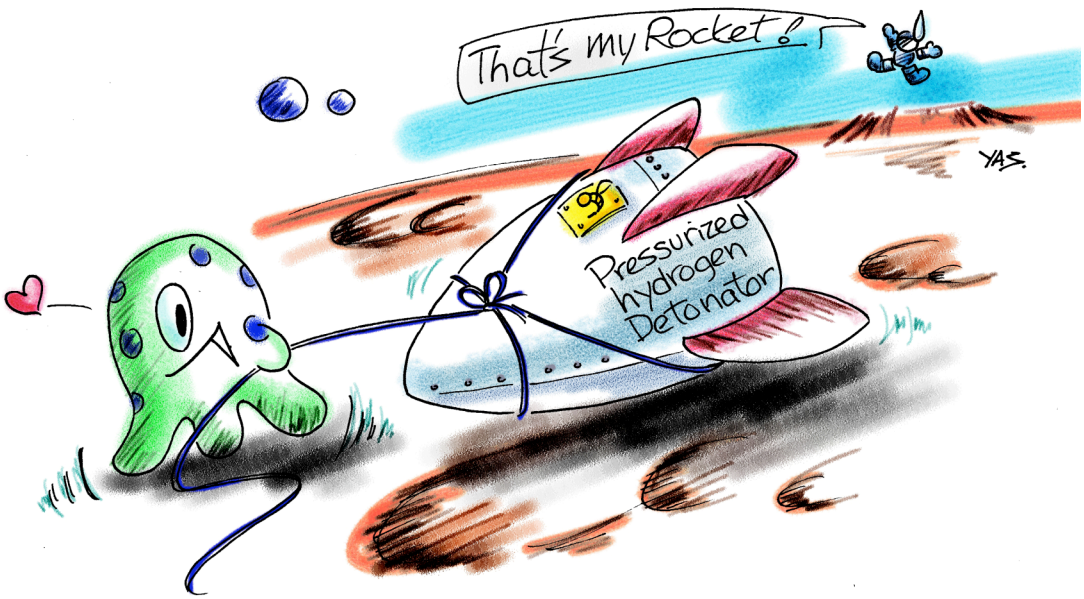
Foreword

"If we knew what it was we were doing, it would not be called research, would it?"

"It would be possible to describe everything scientifically, but it would make no sense; it would be without meaning, as if you described a Beethoven symphony as a variation of wave pressure."

-- Albert Einstein

Miko is a little alien who tries to study other aliens' cultures using Einstein's suggestions. This alien finds that science is interesting. It explains what it sees on Earth and the wider relationship to the Universe and its home planet – Mars. Engineering is good for creating tools for the alien to use; Art is therapeutic, in that the alien can understand human and the (so far) unexplained. Little alien hates to see things being put into little boxes and wasting away. It refuses to see the dividing lines that humanity imposes on their cultures, societies, education, and even themselves because this slows their progress and delays the moment when a race sees the real Universe where the Martian *does* exist.



Acknowledgements

I would like to express my gratitude to Bournemouth University for funding this unconventional research topic using controversial methods and King Records for the permission of "Yoma Kazoeuta" used in the research. Thanks must also go to Dr Steve Bell for his effort in initiating such a novel research idea. His trusting attitude allowed me the freedom to explore and toy with many different ideas, methods and experiments. Within the supervising team, Susan Sloan always provided me useful opportunities for discussion, particularly in the areas of practitioners' reflections and her own interests in animators' mindsets. I also appreciated Steven Harper's presence as an animator in the team. The organisation of funding and administrative work are very important to a research though sometimes, we may easily overlook the contributions; here, I would like to thank Barry Richards, Jan Lewis and Daniel Cox of the Media School.

There are a few characters who indirectly contributed tremendously to this research because they have set good examples for me over the years. Professor Chris Harris taught me the correct attitudes to approach research in my degree study. His idea of providing just "enough" direction and allowing me to find my own course during my final year project, trained me to become a person who can approach any problem on my own. His teachings helped me as an engineer for over ten years and never seemed to be out-dated. He gave me advice that I should attempt computer animation, in an era when classical animation dominated and computer graphics was still under research. Also, I have to thank Prof. Harris for offering his time to read the early stage of the work and providing me with valuable suggestions.

I was extremely fortunate to have met Al Morrison who guided me into the world of Animation. As a professional photographer, independent filmmaker and a person with many different artistic backgrounds, he welcomed diversity and had passion for many subjects. He welcomed me as an independent animation student at Westminster University. Because of his fascination for computer animation, he introduced me to a 3D world instead of focusing only on hand-drawn animation. His teachings became my daily mottoes in the industry and set the groundwork for this PhD. It was very unfortunate that he passed away a few years ago or else he would be amused by how much animation studies had progressed since he was a keen promoter for higher educational study in animation.

Bip – Dr James Garry was the rocket fuel behind this research since without his encouragement, I would not have taken up the Bursary when I was at the height of my career in the industry. I appreciate his understanding that I have a strange hobby of gluing myself to the Mac and ignoring communication; watching anime; talking to myself; drifting off to fantasyland any

moment and falling asleep within 9s. The invention of animated coffee-cups and loaves of bread were ideal means to distract me from the Mac to have lunch or a break, and brought laughter between the glue moments. My life is filled with animated creatures, imagination and possibilities, all because of him. The whole process of the PhD is full of fun and enjoyment that no one had told me about before. I am extremely grateful that Bip can walk the road with Me. ;p Also, I have to mention that Mushroom's wise words and Waps Van Delft's frantic character kept me in balance during these three years too.

Because of the nature of this research, I had to involve many individuals for interviews and the review process. Thanks must go to Triumph Studios and Lennart Sas in supporting my idea of performing research on an industrial project and also conducting interviews with different professionals in the studio that interrupted their work for a day. I am grateful for the studios staff – Len Sas, Roel Grevendonck, Remco Moll, Peter Kortenhoeven, Joost Blatter and Sandy Brand for accommodating my interviews. Many animators/academic also contributed their time and experience to this research and here, I want to express my gratitude to Steven Harper, Sebastian Read, Andy Joule, Claudia Moore, Paul Hilton, Richard Smith, Sandra Guarda, Iain Hastell, Aysha Madina, Andy Davis and Ross Stanton. To conduct animation reviews, I asked peers and individuals to aid the process and I would like to thank Wendy Wong (filmmaker), Merijn Vogelsang (game designer), Roel Grevendonck (lead artist), Remco Moll and Peter Kortenhoeven (both senior animators), Alyce Wai, Winnie Lo, and Michiyo Kitazono (independent viewers), and my three research supervisors – Steve Bell, Susan Sloan and Steve Harper.

Finally, I have to mention the spiritual support from Mind – a character whose existence directly fuels my desire to continue to create. Without him, probably I would still be an engineer and would have missed my chance to develop my other talents in a professional manner.

Declaration

Some parts of the thesis have been presented in conferences and during an invited visit to Sheffield University. Material, mainly from the case studies on game development, was presented at SAS conference 2008 as a poster and a paper presentation was given at Postgraduate Researcher conference 2008 on "An Approach to Visual and Practice-based research for computer animation". A paper presentation was given at Image2.0 Digital Media Futures 2009 on "Self-Reflection process forming a part of 'Practice as Research' method" which is one of the major focuses in this research.

The author was invited to give two talks at Sheffield University in 2010, dealing with techniques and practices for the transition between traditional animation and computer animation; and the impact on character animation design and production. The two presentations included part of the conclusions from the research interviews and the findings from some of the animation experiments in this thesis.

A paper about the "Practice as Research" model for computer animation and the conclusion from the pilot study of this research is currently under review by the SAGE Journal: Animation.

A demonstration on Hypertext presentation for animation research and reflection process, has been accepted at the 2010 Sydney International Animation Festival. The public has been able to access the research website, which contains a significant portion of the results from this research, for over half a year and Google analytic reports show sustained public interest (see Section 3.3.2.2 for access details).

The resulting animations and the game play demonstration from two of the principal research experiments were incorporated into a game project developed by Triumph Studios and published by Codemasters UK (en.wikipedia.org/wiki/Overlord_II). The author acknowledges Triumph Studios' support in providing some of the initial research materials, reviewing the work, and integrating the character animations into their project.

The above submitted work and conference materials can be obtained from the research website:
www.yas-studio.net/PhD via download menu
Or
Located on the CD submitted with this thesis, Please locate and launch filename:
PhD_DocumentStore.html

A Guide for the reader

This thesis is divided into four parts.

1. A Review
2. The Pilot Study
3. The Principal Research
4. Animation experiments and Hypertext presentation

The first three parts are in this printed thesis while the fourth part is written as hypertext and is held on the enclosed CD and can also be accessed via the Internet. The CD should be auto-run upon insertion into the optical drive. The reader can also run the Hypertext Filename - Miko_PhD.html - directly from the CD.

Internet access URL is: www.yas-studio.net/PhD
Password: Miko_PhD

The first part of the thesis, the Literature Review, is a stand-alone document. The second and third parts, the Pilot Study and the Principal Research are closely related to animation experiments and other contents on the CD or are displayed at the Internet URL address. For quick assessment, the reader is advised to have the Hypertext materials to hand while reading the thesis.

The Hypertext presentation is an illustration of the research journey. It was written at different stages of the research to reflect the immediacy of the practice and employed a casual dialogue approach. It includes extensive materials on the practical and technical sides of computer animation; in-progress reflections; and visual research materials and initial concepts, which are relevant but not necessarily fit into a formal PhD thesis.

Parts of the thesis printed in *Italic* distinguish personal experiences, internal dialogues and reflections, or insights from external resources from the formal thesis. Those contents are relevant for subjective argument of the practice and may be of interest to practising animators.

Words marked with an asterisk (*) are described in the Glossary and in some situations, footnotes are also recorded in the Glossary.

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CD bound to the inside of the front cover

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1 Introduction

Computer technology has opened new opportunities for animation to be used in industries and different forms of entertainment, and in doing so computer animation has changed traditional concepts and approaches to animation production. Such change is not unique in any sense. Throughout history, whenever there was a leap in technology, changes would occur in both industries and public understanding. For example, the development of photography modified traditional ideas about creating pictures, a shift comparable to the changes brought about by computer technology. However, unlike the shift from painting to photography, which still relied on materials and physical tools, the use of computer technology in animation has liberated the art from the material world. Concepts and techniques have been developed that would be nearly impossible for a traditional animator to achieve, testament to the research conducted in this field. Much of the research in computer animation seeks to develop the computational technology and is conducted mainly by technical researchers. However, computer animation is not only used in engineering but is also used widely in the field of entertainment and many of the personnel in that field are animators or creative individuals who are rarely exposed to research environments.

My research addresses a similar concern to that in other practical subjects, such as the fine arts and design, architecture, or medical professions, namely whether practitioners need to conduct research in their practices and what research methods (Frayling, 1993 and 1997) are applicable. For a subject like computer animation that currently sits between art and technology, we ask how can an animator conduct research that may yield different knowledge when compared to mainstream technological research. What research methodologies and methods are appropriate for animators?

In the animation industry, techniques used in computer animation are often compared with those in traditional animation, especially 2D hand-drawn animation. A widely discussed aspect of character computer animations is that people often find them to be less "warm" and that they lack vitality (Sakaguchi, 2001). Some researchers have attempted to resolve this problem by parameterizing full-body movement and the expression of human emotions, or by generating algorithms to animate characters, for example the work of Fang and Pollard (2003). Other researchers have focussed on developing alternative tools to improve production qualities or to aid animators, such as the interface tool introduced by Terra and Metoyer (2004). I speculate that this apparent problem can stem from many other factors, for example, inappropriate use of (computer) animation techniques, a lack of understanding of animation and its practices, rather than a shortfall in the technology or training. However, there is insufficient peer-reviewed research outside the technological area to frame a balanced study of such problems and make a significant contribution to our understanding.

Because animation is a visual art, we will find that animators' prime concern is their artistry, and that they generally have little interest in performing academic research. Even the pioneering work of Lasseter (1987 and 1994) that dealt with computer animation from a practitioner's point of view, has not been continued. The suggestion by Ward (2006) of the need for critical thinkers and practitioners in animation studies in the time of transition from material to virtual media, has not been followed up by other researchers. In 2007, Darley noted that there was a lack of research in many aspects of animation. These observations strongly suggest that research and research methods have not been fully developed for animators in the field.

My study investigates a possible practice research model for animators to conduct critical studies in computer animation. Frayling's suggested art research model (1993) – "research *for* art and design", "research *into* art and design" and "research *through* art and design", and Borgdorff's discussion about art practices (2005) concerning a wider impact to the 'original contribution to knowledge', are concepts used by my research to enable the design of a critical structure for a practice research model. Creating a research space centred on the animator-researcher to carry out experimental works, can allow the proposed model and other required research techniques to be examined and evaluated. One of the aims is to structure different research methods and evaluate their application to the proposed methodology (see Figure 1) for computer animation. Using different animation experiments, I can experience the process, perform reflection and conduct reviews. Practical experiments also allow me to create different scenarios to examine the application of the model in different fields of animation. In the course of conducting experiments, I can study particular research questions or aspects of the practices. In this research, the understanding from each experiment can modify the research method and enable new animation experiments to be carried out for further analysis.

The pilot study in this research examines the initial proposed methodology - "Practice as Research" as termed by Borgdorff (2005). Selected research methods that build up the model are examined:

1. Case studies to explore computer animation practices and previous experiences.
2. Interviews with animators to collect field data and assist reviews.
3. Animation experiments to create research space.
4. Visual research to aid production and examine research outcomes.
5. Reflection and review processes to evaluate the research model, methods and other related animation questions.

Findings and conclusions on the application of those research methods to computer animation will be presented. The pilot study aims to demonstrate how animators can structure different research

methods to conduct their research. The pilot study also helps the practitioner to understand, criticise, and refine the proposed methodology.

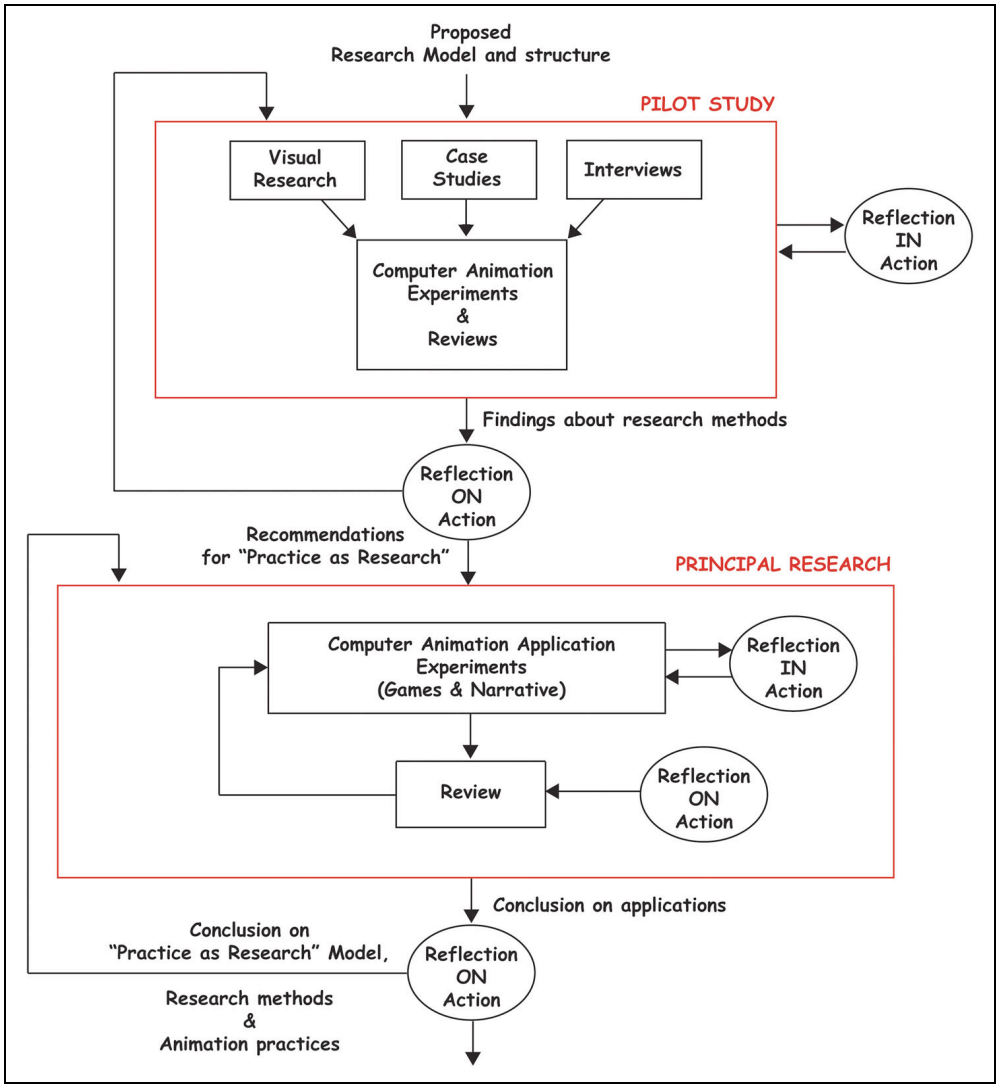


Figure 1. The proposed overall plan for this research

My principal research - the application of the refined "Practice as Research" model into game development, narrative film production and experimental work, uses animation experiments as the research platform. Animation has been used as a research tool in many areas successfully and a relevant summary is given by Power (2008). According to Gauntlett (2005), the conventional approach of studying media is by *making* media and this approach also forms the common model for practise-based research. By applying a refined version of the "Practice as Research" model and its research methods to the principal animation experiments, the model and its flexibility for critical study can be further examined in the light of different applications.

Certain animation questions revealed by the case studies or interviews with animators will be explored during the pilot study and the principal investigation. For example, what is critical animation practice for a computer animator or how does an animator design (computer) character

animation? These questions are used to set the context of an animation experiment in which the "Practice as Research" model, its research methods or the related research questions can be examined separately. Although my research is not focused on answering those secondary questions, I anticipate that such findings would provide new insights into animation practices and aesthetics, and would be of interest to other animators-researchers.

This research aims to draw animators' attention to critical thinking and practice, research processes and self-development that can turn experiences into possible knowledge. It will provide a framework for animators to engage with academic research and open new research directions for the current computer animation community and industrial applications.

1.1 Research aims

The following points will guide my research.

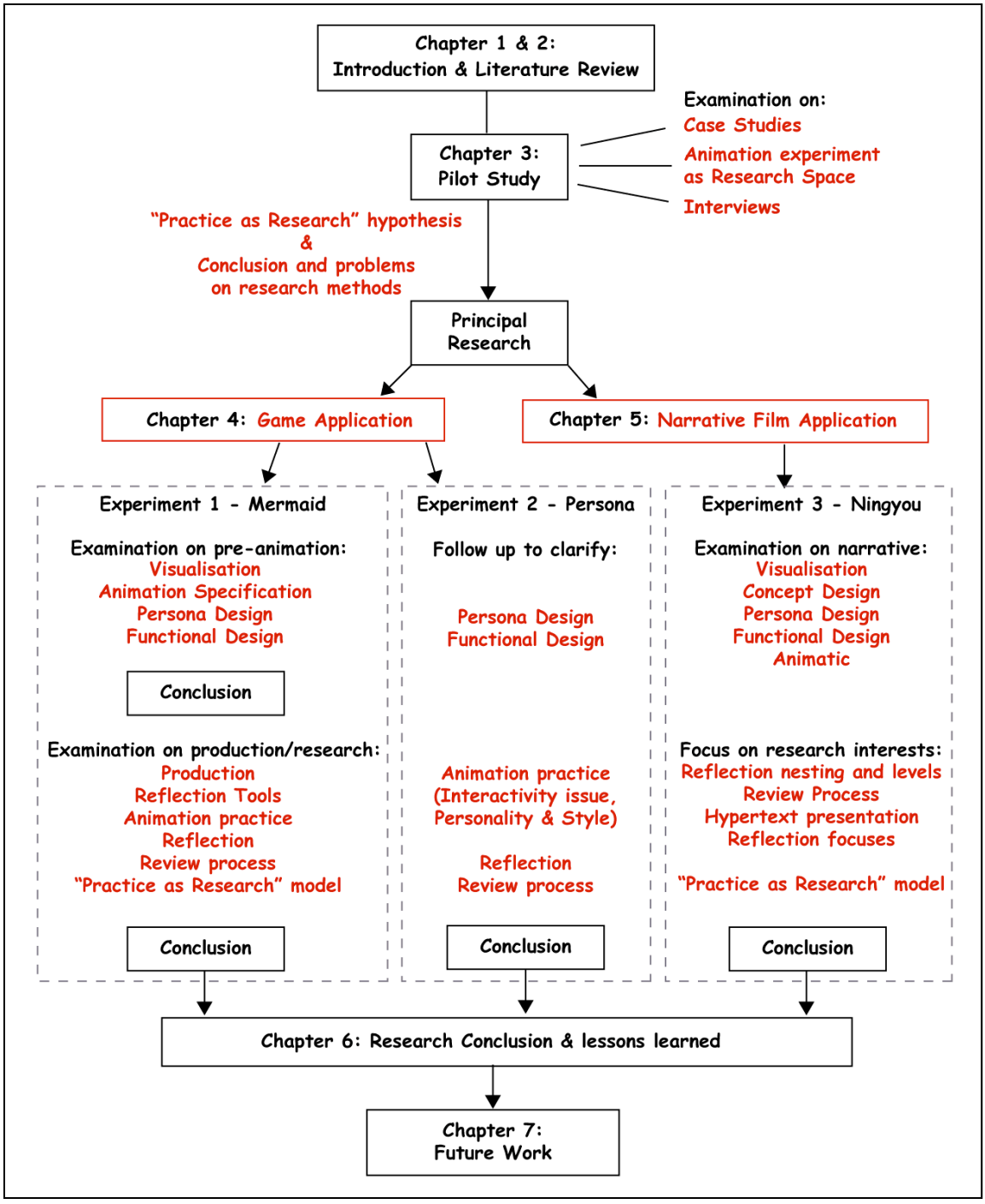
Principal aims :

1. Identify a "Practice as Research" model for practitioners to conduct critical academic research.
2. Create a research space to examine the research methodology and its research methods for application to computer animation.
3. Apply the proposed "Practice as Research" model and its structure to computer game development, and to narrative and experimental computer animation.

Secondary questions (to initiate animation experiments):

1. What are the critical practices for an (computer) animator?
2. How does an (computer) animator deal with character animation in production?

1.2 Thesis Structure Map



Due to the complexity of the proposed plan in Figure 1, the above structure map of the thesis may provide a clearer concept of how the results of the research would be presented in the thesis.

2 Literature Review

Computer animation has much in common with traditional animation, and draws on the practical knowledge of a production and the principles of Animation[1]. Thus, the literature review will examine traditional animation techniques and studies, and current research in computer animation. To broaden the general appreciation of Animation, I propose to examine pertinent aspects of human perception and psychology to explore the thought processes of animators and how they engage with their work and their audiences. Although these secondary topics are not directly relevant to my research, I hope that the information can clarify animators' underlying skills, assist self-study and eliminate preconceptions about animation studies and research. Figure 2 shows a subjective network of domains related to computer animation. Some topics such as computer technology and animation studies will be the main focuses of my literature review.

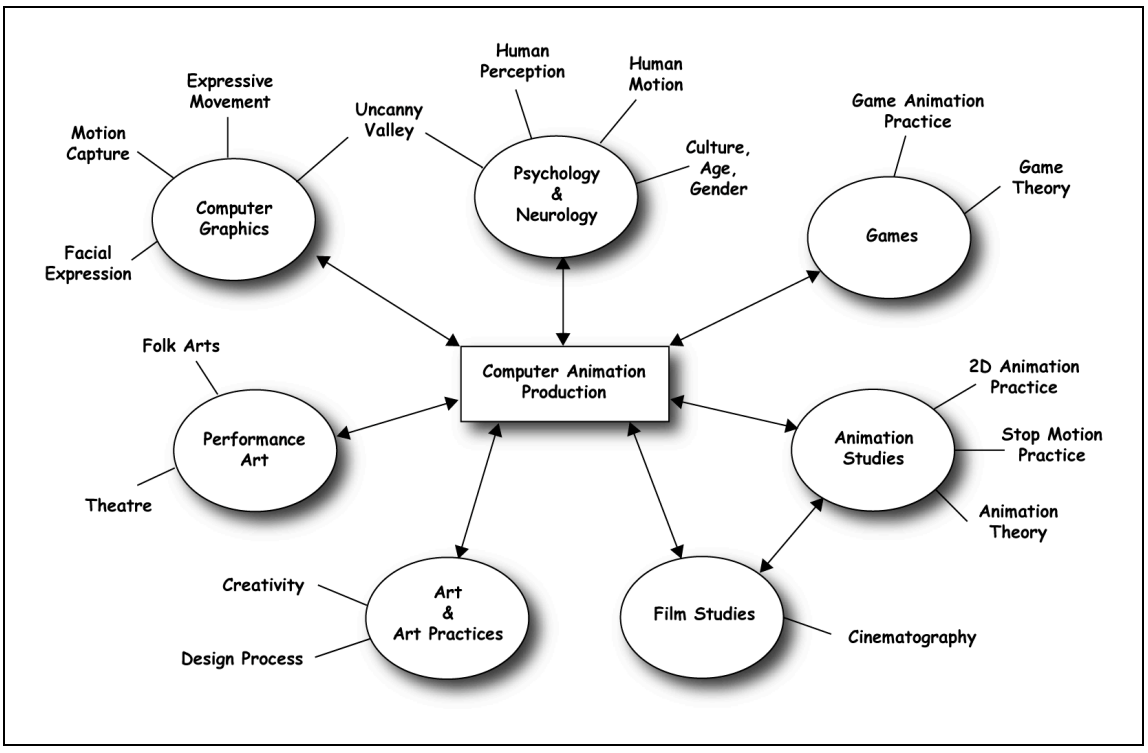


Figure 2. An initial map showing computer animation and related studies.

[1] Animation (capitalized) embraces the concept of anima - from the Latin "to breathe"; from which 'animal' and 'animation' arise. Anima is used to refer to a representation of a living soul or spirit, therefore Animation ranges from folk arts that show nature, mimicking beings and the world, puppetry, mime performance through to more recent hand-drawn animation, stop motion and computer animation.

Overview

This chapter presents the following points:

- A brief history of animation studies and animation productions
- Concepts of animation theories and formal research
- Traditional animation techniques and computer animation application

2.1 Animation studies

The modern study of animation is scattered among academic fields. Art courses may introduce animation, film courses often discuss animation as a filmmaking technique, and media studies may address aspects of animation. After the explosion of mass media in the early 20th century, filmmaking took on an important role in entertainment and animation became widely used as a production technique. Filmmakers value animations to this day and in the review by Wood (2006), the author praised the flexibility of creating cinematic space with animation rather than using live-action. However, the academic study of animation was not institutionalised in the early years of film, as pointed out by Furniss (1998), therefore, animation has not been developed as a body of knowledge independently of the business.

The relative novelty of animation as an art form in the early 20th Century, meant that animators were often trained but were rarely taught (Thomas and Johnston, 1989). The Disney Studio provided practical training for their animators and at a time, it was seen as a direct route to become an animator. Apart from specialist art schools or film studios, there was little formal education on the subject (Furniss, 1998). According to Furniss, animation studies and production were limited to a specific style in order to fit into a studio's production concept and also to suit their economic business model. Other independent practitioners developed their own style of animation and continued to experiment and refine animation techniques (Halas and Manvell, 1970) but unfortunately, few of their documented practices are available for study. Books written on experimental animators tend to focus on their unique style and output, for example, the anthology of animators produced by Russett and Starr (1988). Halas' book (1987) on filmmakers and animators also provides a good collection. However, crucially the practitioners' views about their own experiences are seldom the main focus of the text. Practical knowledge and experiences were either not thought to be as important as explicit knowledge or they were somehow too difficult to record and pass on.

The absence of information about animation studies and animator's experiences has been noted in the literature. Darley (2007) found that there was a lack of research in animation histories, techniques, style and production and few informative papers on animation studies or practices were found in the course of my literature search. Ward (2006) suggested that the community had to

broaden animation studies with critical thinking and practice, and to take on an interdisciplinary view. This would involve integrating the old and the new, and should exchange knowledge and expertise with other disciplines. In Dewey's book "Art as Experience" (1980), he had a much stronger opinion about how to deal with changes. He said "The junction of the new and old is not a mere composition of forces, but is a recreation in which the present impulsion gets form and solidity while the old, the 'stored' material is literally revived, given new life and soul through having to meet a new situation." However, animation literature seldom described how an animator could approach changes or what research methods were available for (computer) animation studies. Power (2008) examined the use of animation in other research fields such as neuroscience and applied psychology. His review confirmed that animation as a medium could assist in understanding a topic and that animation was a valuable tool for research. Indeed, computer graphics and animations were used in simulation and engineering long before their use in entertainment: according to Furniss (1989) one of the first computer animations was made in 1963 to study satellite positions in space. Scientific researchers and engineers in different fields had clearly been using animations to test and verify their hypotheses and designs. But within the animation community, we seldom see animation being presented or made to demonstrate an argument or to illustrate a problem in its study. Instead, we have reviews *after* a production, for example, Sakaguchi (2001) and Adamson *et al.* (2001) whose works deal with photorealistic[2] animated characters. Similarly, Desowitz's (2003) article written about emotion handling in "Finding Nemo" also occurs after production. Crucially, their suggestions and arguments were not followed up by further investigations. Those animations were not produced for research nor were investigated further by critical reviews; thus their analyses may lack rigor. However, some animators had taken a more focused approach. For example, Lasseter's work in 1987 was based on his own experience in applying traditional animation principles to 3D computer animation. He followed up the work in 1994 to provide some useful suggestions to computer animators. However, his visual works and the details of his practice that led him to draw those conclusions were not presented in his publications. More importantly, no other researcher has continued his research.

The lack of literature and evident research may not be a problem specific to animation studies. The creditability of art studies and practice-based research is long debated in academia as noted by Frayling (1993) and Prophet (2004). According to Borgdorff (2005), practice-based degree programmes only received significant impetus after the University reforms of the 1990s in the United Kingdom and Scandinavia. For example, Art and Design, and Nursing degree courses only became widely available in British Universities around the mid 1990s. According to Borgdorff (2005), such reforms happened much later in other European countries. This surely contributed to

[2] The kind of realism which resembles photographic quality.

the delay in animation degree studies and the late development in its research. We will explore practice research in detail and its creditability in the later chapter 2.3.

In summary, we (animators) have yet to learn what the other research communities have already known – the value of producing animation to aid research and the strength that comes with integration of different methods from different fields.

2.1.1 Animation theory

Like the definition of Animation, animation theory also has different meanings for different people. If animation is seen as a component of mass media, its theory should share common ground with film studies; hence it may include cinematography, script writing, directing, etc. However, the institutional study of animation rarely includes film theory. If animation is a stand-alone subject, what is animation theory? Where can we learn this theory?

I turned to historians and critics in the animation field for an answer. Among them, Furniss presented some pertinent work - "Art in Motion: Animation Aesthetics" (1989) wherein she demonstrated a more formal analysis of animation and its history. Regrettably, animation theory and its developmental history were not included in her well-documented text. Many other scholars chose to write essays on animation rather than establishing a "theory". Alan Cholodenko's "Illusion of life" (1991) is such an example where he discussed animation outside particular disciplines. Some readers might have mistaken his book with "The illusion of life: Disney Animation" by Thomas and Johnston (1989) - which focused on animation making and the principles of animation - and felt dissatisfied by the absence of practical information about making animation. This leads to my argument that the general perception of animation studies is readily confused with the study of animation production techniques. The skills and ideas of an animator are easily mistaken as principles of animation or even, indeed, the "theory" of animation.

I have no intention of arguing against the use of certain words. I merely want to point out the problem in the scattered field of animation studies - the study of animation was not "institutionalised" early enough (Furniss, 1989) nor reformed successfully in the 90s for higher degree and practice research, comparing to other subjects in art and design. Perhaps this transference is the reason why very few practitioners actually perform academic research. The absence of research models for practitioners and the rapid advance of technology make it almost impossible to perform a coherent literature search for computer animation. In the industry, I have heard the keyframe technique being described loosely as one of the 3D *theories*. At universities, students claim their interest in animation theories. There is a need to re-address what is meant by animation theory and to reassess some of the terminologies used across animation disciplines to

incorporate the changes led by computer animation. Along with this assessment of language, there is a need for academics and practitioners to work together and re-establish the fundamentals taking into account the new knowledge from computer animation. Critical academic research to draw-up new standards for animation studies and practices should be encouraged.

For this research, there should be no preconceptions about what is animation theory since 'theory' was found to be not defined clearly. A theory, in scientific circles, is a model built from an ensemble of explanatory facts; it is repeatable, falsifiable[3], and universal within its domain of application. Animation techniques and styles, or the 'principles of animation' (Thomas and Johnston, 1989) that animators use to produce animation, therefore, may not be considered as theories. They are personal methods that may or may not have wider applicability. Practical techniques are implicit knowledge* and differ among individuals in different eras and situations; hence they are not falsifiable. The history of animation and the development of production processes and experimental techniques do not *automatically* reveal the presence of any theory. From the techniques used in a specific style of animation, an animator may acquire tacit* knowledge or unique intuition but these are not theories either. However, using a practice and research techniques, and posing assumptions to conduct an experiment may allow a hypothesis to be tested - the first step in forming a theory.

Hence, I propose to study animation as a "concept" and "practice" instead of using "theory". Here, "concepts" are simply ideas, knowledge and modes of thought. The "practice" includes not only the artistry of an animator but also (research) methods, processes and experiences that can assist the understanding of animation or problems leading to a body of knowledge. Analysis and verification of the "practice" are important to evaluate validity and qualities critically. The resulting meta-*method should be portable and have applicability to different animation fields.

The lack of research and critical language creates difficulties in both describing and analysing animation and its practices rigorously. This is perhaps one of the reasons why animators cannot fully embrace the knowledge and techniques developed in traditional animation and apply those concepts to computer animation. Ward (2006) used the word "Recontextualization" meaning that certain skills needed to be addressed differently in different positions and for different purposes. Critical thinkers are needed for integrating both old and new knowledge and are concerned with the process of integration (Ward, 2006). Critical practitioners described by Wayne (2001) are those who can identify and consider when and where "Recontextualization" is needed. Since computer animation sits in between traditional animation studies and computer technology, both critical thinkers and critical practitioners are needed when "Recontextualization" is required. We might ask, how might one be a critical thinker and a critical practitioner for computer animation in the

[3] It must be possible to create a test that would show a given theory to be false.

field of animation studies? Unfortunately, apart from Ward's paper, no other documentation addresses "Recontextualization" in detail nor has any research within the animation community demonstrated its need. Therefore, these absences become the pointers for the direction of my research.

2.1.2 Animation techniques

The book, "The illusion of life: Disney Animation" by Thomas and Johnston (1989) is often recommended to animation students. It describes many fundamental principles of classical animation[4] and successfully documents techniques used by Disney animators. In "The Animator's Survival Kit", Williams (2001) also describes in detail several animation techniques such as "pose to pose", "straight ahead", "squash and stretch", "double bounce", etc. These have become widely used tools for many (computer) animators. However, the thought processes of an animator, their practices and style of animation can be very different when using different media. If we examine stop motion animation[5], for example, only the "straight ahead" technique can be considered applicable, given the irreversible nature of recording and real-time practices. Techniques for model making and principles of sculpting, often used in stop motion animation (Shaw, 2003; Brierton, 2002) are not useful for classical animators. Other skills, involving the use of cameras and lights, as described by Brierton (2006) for stop motion, are also not directly portable to classical drawn animation, when those objects are often not present physically. However, this knowledge can be useful for computer animation where similar objects, cameras and lights do exist virtually.

Given the constraints of the commercial world, few animators have had exposure to experimental animation or research. Similarly, the pressure of work precludes many animators in the industry from documenting their techniques and animation studies. These discussions surfaced frequently during my interviews with animators in different fields (see Section 3.3.4). Animation books tend to be written for students of animation history or they address techniques of specific animation styles. All too often the detailed practices and thought processes of a practitioner are not addressed clearly, not even in books that purport to describe individual animators, for example Russett and Starr (1988). When I began my study on computer animation in the late 1990s, I discovered that the new medium allowed animators to exploit many techniques from both classical and stop motion animation. However, I failed to find useful guidance on how to transfer that well-established knowledge into the field of computer animation production.

[4] Classical animation here refers to hand-drawn 2D animation, in particular the Disney style, a specific technique in traditional animation.
[5] Stop motion animation is a technique where a physical object or puppet is posed and photographed so that when a series of those images is shown fast enough, the object appears to move.

It is widely thought that techniques for computer animation are essentially software-oriented, a belief similar to the perception that classical animation is about drawing. This view is evident because the majority of the published texts on computer animation focus on the description of the software and *how* to produce animation. In this sense, they are no different from traditional animation texts that centre on production techniques which are limited to a particular medium. Granted, the computer is now replacing our pens and camera in animation production and yet we need to learn the fundamental skills. However, there is much more to (computer) animation than merely a set of techniques or instruction manuals. With the knowledge we have accumulated from animation studies and traditional production, we should be able to produce much more thought-provoking or research-oriented texts. In recent years, many authors (such as Roberts, 2004; Webster, 2005; White, 2006) have tried to reintroduce traditional animation techniques to students of 3D computer animation. These texts promote the use of hand-drawn animation techniques and reveal tricks or shortcuts for animators. On one hand, I am happy to see these traditional techniques being clearly documented, but on the other, I ask what exactly is the new knowledge that is being added to the topic? With a written description of traditional techniques and a few exercises using a 3D environment, it is difficult to see why people are convinced that such ideas would improve their computer animation. Other disciplines have also been directed to the area of animation - one contemporary author (Hooks, 2000) stressed the importance of acting in animation; indeed some academics had also referred to Laban analysis[6], a widely used approach in the field of acting. However, there is little documentation about animators using acting or other formal analyses. In my research interviews, some animators admitted that they were too shy to act (see Section 3.3.4.5). Another animator used the phrase "wounded actor"[7] (Lloyd, 2006) to describe why they enjoyed animation work rather than acting in front of people. Despite different attempts to improve skills for producing animation, current literature show that there is still a distinct gap between those who study and write about animation, and those who produce animation but who do not document their findings and problems.

Computer animation all too easily allows the user to create without necessarily thinking and planning. For example interpolation[8] between key frames or particles simulation is essentially an automatic process. Hence animation practices can become loose and animators can lose focus easily. There is a tendency to generate motion for motion's sake when the technology allows animators to manipulate a character endlessly until an action looks correct. This ease in production may allow bad habits to arise and encourages an animator to do instead of to plan. Improvements in technology have given rise to new animation techniques, such as, motion capture, procedural animation, and dynamic animation. These techniques allow great scope in animation production but can easily distract an animator's focus. A novice animator, for example, is often first

[6] Movement analysis for actors or dancers, created by the dancer Rudolf von Laban (1879-1958).
[7] A concept evolved from Swiss psychologist Alice Miller's idea of the 'psychologically wounded' self.
[8] A process of generating intermediate frames between two images, also known as 'in-betweening'.

introduced to the bouncing ball and the walk-cycle. But once the technology allows us to trivially copy and generate realistic movement without an animator's intervention, it is hard for the inexperienced animator to understand the benefit of such lessons. Very few animation texts capture the thought processes and critical practices of an animator, or introduce animation as a concept instead of as a series of techniques for production. According to Boden (1997), expertise is essential to the extension of a body of knowledge - we need skilful animators who are masters of their artistry. However, to be able to extend knowledge, we need to understand our own way of thinking and learn to modify the domain to allow new possibilities (Boden, 1997), this is where (computer) animation studies *should* stand at the moment.

Many scholars would agree that animation should be treated as an art form. Therefore, the study should incorporate textural and perceptual analyses that are commonly found in other art studies as Bloomer (1990) has suggested. Apart from the techniques of making animation, our view should expand to include concepts of studying animation in order to integrate knowledge and practice. Ward's (2006) suggestion of "Recontextualization" is perhaps relevant for computer animation to integrate with animation studies and our previous knowledge. Studying animation as a "concept" and as a "practice" rather than a collection of "techniques of production" will free a practitioner from the limitations of the medium; therefore may yield new experiences and possibilities. Hence, there is a need for formal research to be conducted by expert practitioners in the field of animation who can articulate both knowledge and practices. By modifying the previous modes of working and thinking, we may be able to integrate and extend knowledge, and introduce new possibilities in the field of computer animation.

2.1.3 Summary

The study of animation is a relatively new academic field. Early 20th century animators were trained primarily through commercial work and, to a lesser extent through experimental projects. To be successful, a studio had to generate animation with a constant style and therefore, the chances for animators to explore animation studies or be concerned about personal advancement were limited. Animation was thus treated as a craft by the industry and was not recognised as an academic domain until relatively recently and as argued in this chapter, animation studies are still in their infancy. Animation research is frequently conducted by scholars or media experts but less often by animation practitioners due to the recognition of practice degree programmes and research only rising after the University reforms of the 1990s.

In the last twenty years the emergence of computer animation has had an impact not only on production techniques but has also raised questions about how to integrate knowledge and techniques between different fields of animation. As computers replace the animator's pen and

camera, the initial focus of the subject has become dominated by the technology and the manipulation of software. Although computer animation is now widely accepted as an academic study, it is still limited to the study of techniques and technology. There is an invisible barrier to the integration of computer animation into animation studies. When addressing this new medium, many scholars and animators have suggested the application of traditional animation principles to computer animation. Such pronouncements carry little weight as we have discussed, there is a lack of peer-reviewed research into Animation and its practices, and not enough critical analyses in different animation disciplines.

As discussed in this chapter, I consistently found that research or higher degree study on Animation lagged behind other art subjects. Although there are many Ph.D. theses under the banner of animation studies, most of them examined animation from the historical, cultural, social and aesthetic points of view. The thesis summaries of Gan (2008) and Cooper-Chen (1999) are such examples. Other scholars would study a particular film-maker or animation style, for example Ruddell's work on anime (2008). The research methods used are often traditional in style, such as historical and semiotic analysis. The near-total lack of practice-related research in the field of animation is notable, especially when compared to Art and Design studies. It leads to my argument that we have not yet studied animation as a concept and practice, but have only categorized it as a collection of techniques. Thus, we poorly understand an animator's thinking processes and practices, leading to difficulties in integrating knowledge from animation studies with computer animation. As artists and practitioners, we should attempt to make implicit knowledge *explicit* by exploring and preparing to assess qualitative issues in our subject of study. As scholars and practitioners, we should have the noble ambition of questioning and extending knowledge and artistry by modifying restrictive ways of thinking, and evaluating new ideas.

In the following chapter, we will explore computer animation research and discuss concepts of practice research.

2.2 Computer animation

Overview

This chapter presents the following points:

- Arguments for practitioners to conduct computer animation research
- The current research in computer animation
- Apparent problems in computer animation and its related research

Computer technology has provided a fast and economic way to generate animation by automating repetitive tasks such as tracing and painting, and eliminating the use of physical materials such as models, paints, and acetate. Its flexibility has excited both artists and scientists. The reducing costs of hardware, coupled with rising processing speed, exemplified by Moore's Law[9] (Moore, 1965), has led to an increased use of animation in different industries, not only in films but also in gaming and mass media. Some traditional animators adapted principles from classical animation to fit this new medium. For example, Lasseter (1987) had some success in transplanting older skills into this new field. However, because the technology changed both the animator's workflow and their approach to animation production (Lasseter, 1994), the valuable skills and intuitions gained through traditional animation were challenged. Depending on the final application of computer animation, its practice and production process could be very different. In the work of Tomlinson (2005), there is a description of the differences between computer animation used for linear storytelling (film) and interactive content (internet and gaming). Tomlinson also claimed that the ability to reuse animations in modified forms was one of the strengths of computer animation. I would counter that this flexibility encourages animators and the industry to focus on the *quantity* of work produced, instead of its quality. For example, some computer animators casually reuse animations in games or exploit shortcuts in the software by using the latest or most fashionable plug-ins. Such attitudes may result in a drop in quality. When I began my literature research, I was surprised to find that many technology researchers also applauded the reusability of computer animation. Indeed, a good deal of research focuses on the development of technology such as motion capture which could aid animators and simplify production by having stock animations and increasing reusability. The technology modifies animation production but can also limit animation studies and practices – a situation that resembles Furniss' (1989) observation of the impact on the mode of production and economy. I claim that the fast advance of technology and the delayed study of computer animation and its practices, has caused a schism in the transition from traditional animation to computer animation, and in the integration of knowledge and practices.

[9] Moore's law describes a long-term trend in the history of computing hardware, its improvement and relative pricing.

The future of computer animation is not a trivial matter to speculate about. The work by Hegron *et al.* (1989) suggested that computer animation would progressively move away from using the familiar techniques of traditional animation. However, in the past twenty years, many animators have claimed to employ traditional techniques in computer animation successfully. Many animation textbooks also emphasise the application of traditional animation techniques to create the missing vitality in computer animation. However, we have already discussed in Chapter 2.2 that there are too few critical studies or practical research about the application of animation techniques to make those claims significant. A recent article by Darley (2007) stated that a digital approach would neither automatically free the animator's imagination, nor would it directly make computer animation superior to other media. Quality issues noticed by computer animators, and different arguments of how to improve vitality in computer animation such as in Adamson *et al.* (2001), led me to think of an analogy to Darley's argument. The direct application of traditional animation techniques would not free computer animation from its qualitative issues nor would it assist animators to understand the new challenge. If one can argue that the use of technology does not necessarily lead to *better* results, then the unthinking use of *any* technology is certain to lead to inferior products. I claim that the unthinking application of any animation technique and the absence of critical assessment, is bound to lead to false insights for computer animators.

2.2.1 Computer animation research on character animation

Advanced technology and the flexibility of 3D software offer great possibilities for computer animation. With new tools, animators can create photorealistic[10] humans and natural movements - activities that used to be difficult and time-consuming in traditional hand-drawn animation. Motion capture (Mocap[11]) techniques can record live movements of an actor and have found much commercial success in recent years. More complex techniques are used for generating realistic character animation, for example IK*, dynamics and constraints (kinematics, physics, time, space, etc). Indeed, the use of physics constraints and optimization to create realistic and complex human motion has been demonstrated to a satisfactory level without any human intervention (Fang and Pollard, 2003). However, such techniques have been studied solely for the purpose of yielding realistic movement without consideration of the concept or reason of Animation.

Despite the technological progress, common complaints about photorealistic animation and character are: its lacks in vitality (Sakaguchi, 2001) and the phenomenon of eeriness (Adamson *et al.*, 2001) – nebulous but perceived deficiencies. For example, Mocap tools allow animators to make global adjustments to the animation (changing a character's scale or stride for example) and permit modifications to individual key frames. The fact that extra vitality or pleasing animation

[10] The kind of realism which resembles photography quality.
[11] Mocap is a widely used abbreviation for motion capture technique in the industry.

can apparently be injected into the captured human motion by an animator is a curious but long-standing question. In the past, filmmakers could produce animation by tracing live-action footage (Furniss, 1998; Canemaker, 2001). The technique, known as rotoscoping, is still sometimes used for experimental works or because of a director's choice, such as both the Ralph Bakshi and Peter Jackson versions of "Lord of the Rings". Animators in Disney's studio were among the first to find that traced copies of a live-action sequence did not translate well into hand-drawn animation (Thomas and Johnson, 1989). The mystery of why an audience would accept live-action from actors but not the same live-action sequence as shown by an animated character has never been critically researched.

There are frequent debates about Mocap technology versus an animator's innate skills in the animation community, for example, in the panel discussion described in Cameron *et al.* (1997). But there is as yet no conclusion. The ability of an animator to inject life into a character is akin to magic - I wonder what essential ingredient is being added that is missing from the Mocap technique? If we want to answer this question, it is not enough to pursue the goal of generating natural character animation using algorithms or technology alone. Understanding animators and identifying those qualities that they can inject into character animation may, in time, allow us to capture that expertise. At the moment, research in computer animation is still focussed on technology development and I have yet to find research led by animators who seek to bring their knowledge to a wider community.

2.2.2 Computer animation research on emotions

Many researchers acknowledge the perceived lack of vitality in computer animation and have sought to identify elements that an animator can add to a character in order to create believable and expressive animation. Facial expressions are widely seen as a clue to emotional states. Much effort has been spent on generating photorealistic expressions using motion capture, such as the work of Maddock *et al*. (2005). However, within the animation community, little research examines the qualities of that approach. I question whether people have to notice detailed movement of the facial muscles before they can correctly perceive a person's emotions. Outside (computer) animation research, Sato and Yoshikawa (2007) demonstrated that the dynamics of facial expressions, rather than spatial detail alone, could induce a high arousal rating in observers and enhance the overall emotional experience. An interesting study had tested the effect of behavioural cues (facial expressions and character posture) on conveying emotional state (Vinayagamoorthy *et al*., 2006) with the result that posture appeared to play a more significant role than facial expression in communication. Maddock *et al*. (2005) also suggested that the overall character behaviour might contribute more important cues than facial movement.

Many computer scientists had been aware of the need for an emotional dimension in animation (Bates, 1994) and had investigated different methods for generating emotional data. Studies had focused on generating motion and emotion, ranging from the use of signal processing techniques (Ayama *et al.*, 1996) to the use of Fourier transformations (Kraus, 2004) to generate velocity and spatial amplitude components. Those calculated values were applied to existing animated motion or were used to modify Mocap data to produce animation with *supposedly* enhanced emotional quality – in reality the effects were noted somewhat simplistic and lack subtlety.

Other researchers had separated motion data into components that they called styles (Shapiro *et al.*, 2006). For example, they obtained a 'sad component' from an existing character animation of a sad individual and then applied this component to an animated run to produce a sad run. This approach favoured reusability of motion data and allowed interactive editing for the animator. However, the results seemed to lack credibility and could appear lifeless.

The work of Neff (2005) examined the difficult task of creating expressive animated character. To help animators, he created a tool that allegedly allowed direct control of the aesthetics and meaning of the motion via editing and motion scripts at different technical levels. A dynamics and kinematics simulator executed the animation, but animators then had to continually modify the work to give convincing results. This method reverses the traditional workflow and thought processes of an animator. To some extent, it encourages animator to use a "Trial and Error" approach without an overall plan.

From examining present research, one can see that studies in computer animation have not diversified into qualitative research. Even on the subject of emotion where there are clear qualitative elements, research is still biased towards the technological aspect. Studies that seek to fine-tune animations to yield expressive results or to parameterize emotions, may be seen by an animator as approaching the topic from the wrong direction. Good animators would consider qualitative elements such as emotion, personality, and style of a character as a priority and these suggestions can be found from different animators in Canemaker's book (2001). As an aside, an interesting observation by Bates (1994) described a programming bug that caused an AI character to behave in an odd way but people found the character interesting and alive. This fact echoes a truism known by animators in classical animation - characters need to show individuality, care for and interact with their world, or else they are merely abstracts of action. Copying reality would not increase the believability of a character and Bates (1994) encouraged AI researchers to modify their idealised views and recognise that artistic insights were also important in building emotional characters.

The discussion so far has shown that animators may have a different focus from that of computer scientists when aiming to create believable animations. Indeed, if more animators were to

participate in research, we may see greater diversity in computer animation. With the migration of computer animation into other fields such as entertainment and the Internet, more diverse research should also follow. In this way, researchers can broaden their concepts and through integration of different perspectives, they can examine the same problems and gain different insights.

2.2.3 Problems in computer animation research

In this chapter, we described some major research areas and noted that the goal of creating realistic animation might have led some researchers to take a path that drove computer animation further away from an art form. *Good* character animators do not encourage the use of tracing live-action footage or of animating exact human movement (Thomas and Johnson, 1989). A strict reproduction of reality is not a necessary goal, as described by many classical animators in Canemaker's book (2001). Instead, the emphasis is surely on capturing the essence of the world and the sense of realism. We thus see that an animator's priority may differ from the current aim of computer technology research.

If we take the example of animating a walk cycle, many animation texts describe very few approaches. Clearly, an infinite number of variants exist – the work of Williams (2001) illustrated some of the more thought-provoking examples. Some of the walk cycles in his book are definitely abnormal if one judges them by human physiology and biological movement. Mathematical algorithms that model natural human activities mentioned in the previous section would have eliminated those *abnormal* walk cycles. Why would an animator choose to break the rules? It is regrettable that Williams' analysis did not continue to study the implication of those different walk cycles and his personal selection methods. The flexibility of computer animation readily allows animators to explore these questions because animations can be easily made and reused (Tomlinson, 2005). However, the scant research in this area shows that computer animation is still hindered by the culture of its predecessor - animation production is the goal and near-human movement is an achievement. Computer animators do not appear to realise the alternative benefits of using technology and the importance of research to assist the understanding of animation concepts or problems.

Lasseter (1987) successfully applied his knowledge of traditional animation to computer animation to create believable characters, deliver emotions, gain empathy from the audience and perform convincing motions. Later, in 1994, Lasseter wrote about a specific technique, the 'layered keyframe'[12] approach for computer animators. It was because Lasseter noticed that he was unable to create the expected result by using traditional approaches and therefore, he had to re-think and

[12] Controls for some parts of a character may need fewer keyframes than other parts so keyframes can be thought of as being on different layers in a hierarchy.

modify his workflow. His finding was specific to production and it was unclear whether such changes in animation workflow would also influence animators' thought processes. It is disappointing that few animators have continued the investigation after Lasseter or further explored this new medium from the animator's position.

Despite such refinements to the process of animation, in my experience the use of a computer seems to cause a disconnection between the animator and the animated. The rendering speed and the temptation to "do more" encourage animators to jump into production without thinking. There may be a tendency to focus on fine details at an early stage of the production and to obsess about seeing results quickly. For example, animators can be quite casual about animating a certain joint without thinking about the bigger picture of what the action is trying to convey. They are also keen to employ the "Trial and Error" strategy and render unfinished work frequently for viewing. Indeed, "Trial and Error" and constant rendering are features for computer animators to use that exceed the flexibility of the older medium. However, they also readily allow loose practices to develop. Computers let animators view a character as an assemblage of parts and may obscure a more holistic view of a performance. This type of workflow, I argue, can damage the engagement between the character and its creator. More importantly, this focussed working style and the desire for quick results may reduce the chances for an animator to question and to think.

Finally, current research in computer animation has identified itself with the technology it uses, but it does so without regard to its impact on the practices and creativity in animation. There is evidence of an imbalance within research disciplines addressing computer animation. I have confidence that it will change, because it needs to.

2.2.4 Summary

Current computer animation research is found to be primarily technology-driven and focused on the development of tools or techniques that simplify production, cut production time and perhaps, reduce animators' workload. I have discussed some limitations of known current research from a practitioner's point of view and have explained my view on the need for animators to participate in research. I feel that (computer science) researchers have poorly explored qualitative elements in computer animation.

Many animators may not be aware of the full potential of computer animation and they may feel unable to contribute to research in this newer medium. Many animators exploit the flexibility of computer animation in directions where the older media had limitations, for example in photorealistic character animations and large-scale works. We have failed to see the potential of computer animation outside of its production or entertainment values. This has led to a failure in exploiting its advantages in assisting animation studies and research.

The central reasons why computer animation research still lies dormant between the technology and traditional animation studies among animators likely arise from our narrow view of Animation (see footnote 1) and a lack of research concepts and rigour. Many animators have encouraged the application of traditional animation principles to computer animation but mastering our artistry via unthinking application is not going to yield new knowledge. In fact, in my opinion, a lack of evaluation or research will delay the natural development of a subject. However, there are not enough animators participating in research to either balance the technological research or to examine the effectiveness of any crossover work and to make a significant contribution to animation studies.

Computer animation research is not a new topic in the field of technology but it is a novel topic for the academic animation community to integrate into their studies. This research hopes to pose new views and open up new opportunities for computer animation study. Practitioners should no longer use a piece of technology blindly and use it to bludgeon through their traditional way of working and thinking. Researchers who aim to develop tools and improve the technology cannot overlook the processes of the end users that could allow them to fully utilise the new technology to exploit their creativity. Therefore, information about critical computer animation practices, and rigorously clear thinking from the animator would benefit not only the art world but also the future development of technology and tools.

In the following chapter, we will explore how animators and practitioners can perform academic research and conduct research of a practical subject critically.

2.3 Practice Research

In Chapter 2.2, I described some of the reasons for a lack of academic research and practice literature in animation studies. Similar gaps have been seen in other practice-related subjects such as in fine arts, design, architecture, and the nursing profession. Before examining in details how animation practitioners can conduct research in the field of computer animation, it is useful to explore how others have approached research in other practical fields.

Overview

This chapter presents the following points:

- A brief overview of art practices outside animation studies
- Possible research models for practitioners to use in computer animation
- Techniques and tools for practice research

2.3.1 Models of Art-Practice research

It had been argued that recent models of art and design teaching and postgraduate study over-emphasized on professionalism at the expense of the individual's artistic development (Biggs and Wood, 2004). As a counter to that argument, some authors had noted the use of student-centred learning models, for example in Aldrich's work (2004). Biggs (1993) had long promoted his 'Therapeutic' model that emphasised the development and sustainability between practices and the sense of self of the practitioner. The model in a manner was similar to that explained by Dewey (1980), in which personal values and experiences are paramount.

Much of the research in art and design has used historical or semiotic* methods (Stewart, 2007), which are not directly applicable for practitioners who may want to focus on the practical knowledge of making. Indeed Baxandall (1998) had suggested "Immediacy and spontaneity is not shared between observers and practitioners". If we explore his concept, we would conclude that practitioners may require different methods to conduct their study. However, appropriate research methods for practitioners are not well established in the animation research field.

Studio practitioners have long claimed that their practice *is* research but often do not articulate or record the processes they use (Stewart, 2007). Whilst observations may provide a record of a studio practitioner's work, how is one to observe thoughts? One approach, described in Dallow (2005), is the use of introspection* by which practitioners can understand the way that they engage with their physical, cultural, and psychic raw materials. However, Stewart (2007)

pointed out that many artists, regrettably, avoid writing. Writing is fundamental to documenting ideas and their practices, and more importantly, it creates a record of introspection. Documenting introspection allows art and design research addressing not just the product, but also the process of artistry and creativity, in which we learn something we did not know we knew (Dallow, 2003). I will add to Dallow's argument and say that art/practice research is also about *re*-learning something we *thought* we knew, attempting to make implicit knowledge become explicit, and evaluating our work and our experiences. Such mode of thinking may lead to a clearer understanding of both the self and personal practice.

In 'Art as Experience', Dewey (1980) said, "Things are experienced but not in such a way that they are composed into an experience". Scholars and practitioners have long been asking "what is experience?" and "how can we turn experience into knowledge?". To clarify experiences, many educators have promoted critical thinking such as Brookfield (1987), introspection and (self-) reflection, as described by Dallow (2003) and Aldrich (2004) and a "Therapeutic" model by Biggs and Wood (2004). Dewey (1980) suggested that, "Experience is limited by all the causes which interfere with perception of the relationship between undergoing and doing". His idea of "undergoing" refers to receptivity and examples of the past, "doing" simply refers to current action. Thus, the quality of an experience depends on how receptive one is to past experiences, and how one integrates it with the current experience.

For such a fusion to work, we are left again with concepts and models but no explicit working methods. In 1987, Schön encouraged the use of reflection in teaching. He defined both reflection "on practice" and "in practice" strategies that were similar to Dewey's suggestions of "undergoing" and "doing". When Boostrom (1996) described a close relationship between creative and critical thinking, he also emphasized the use of reflection in understanding our thinking process. He discussed different aspects of reflection that could challenge our preconceptions and develop new ways of thinking. These different models of thought can be argued as being useful methods for studying a practical topic and evaluate our experiences to search for possible knowledge. However, I have found no examples about how these models of thought are applied in research.

Frayling (1993) described three models of research in art and design. "Research *for* art" allowed making art to be a process of research but he questioned whether the resulting art might demonstrate a doctoral research level. However, he pointed out that "Research *into* art" using traditional and historical research approaches had demonstrated 'original contribution of knowledge'. "Research *through* art" as Frayling also suggested, qualified for doctoral research, in that the research would often be interdisciplinary, demonstrating a new concept to a new process by the use of an artistic medium. In examining current art-practices, I also noticed that the term "practice-based research" being widely used by researchers in different fields along with other

terms such as “practice-led” or “practice-oriented” that sometimes, are also used for a similar context. According to Candy (2006), the difference between practice-based research and practice-led research is that the former concerns a creative artifact that can contribute to knowledge and the latter concerns the understanding of a practice. Candy also defined practice-based PhD to include the submission of creative outcomes from the research process together with a thesis, while practice-led PhD might result only in a document and would not necessarily focus on a finished piece of art.

Another useful analysis of the different research models available to a practitioner was given by Borgdorff (2005) who discussed research in diverse fields including performance art, theatre, music, and the visual arts, similar to Frayling’s work in 1993. He presented three possible categories. In his terms, “research on the art” focused on creative outcomes and processes that shared close similarity to practice-based research. His term “research for the art” focused on insights, instruments, and services of a practice similar to the description of practice-led research. The third category presented by Borgdorff was termed “practice as research” that involved mingling research and practice with no separation between the practitioners, the practice and the creative outcomes. In Borgdorff’s description, such a controversial research model sought to articulate a body of knowledge through processes and experimentations.

Practice-based research can be ontological*; a researcher can take on aesthetic, hermeneutic* or emotive viewpoints to study art objects and their processes of making. Practice-led research is epistemological* where a researcher can purely focus on techniques, methods or instruments that contribute to the making of art or its practice. “Practice as research”, as Borgdorff termed it, centers the research on experimentation, participation and interpretation and is performed by practitioners. This form of research envisages a broader-ranging impact than the development of the practitioner’s own artistry (Borgdorff, 2005). Regrettably, little evidence of the use of this third model of research has been found. I suggest that “practice as research” exists alongside the other two better-known practice-based and practice-led models, but with less recognition. Following Borgdorff’s vision, and keen to employ a research model with the broadest possible impact, I proposed to design a comprehensive model of “Practice as Research” for this project. I also suggested that a doctoral submission of “Practice as Research” *should* require writing, experimenting and producing artwork to clarify one’s expert knowledge of the subject, and the interrelation between thinking, practical skills, and creations. Since I did not found any predecessor who used Borgdorff’s model in computer animation research, I felt that there was a need for a pilot study to formulate my “Practice as Research” model, and later, used critical and industrial applications to refine and assess such model.

Researchers may have different views about the necessity of applications of research. For example Saikaly (2005), had been concerned with the evolution of research and its relationship with industry. Robert Duchamp[13] was quoted as saying "Our research candidates can't make a PhD if there's no practical application to their research project." What he described is similar to some applied research in the scientific disciplines or industrial research where the research outcomes can directly contribute to the industry. However, George Stiny[14] had an opposing view to such industry-based research. He said, "The most successful students are the ones who worked on their own and did their own things and were motivated in terms of what they were interested in.". This view encourages freedom and exploration in research independent of industry and prioritizes the student's personal goal. These two different views are used to expand "Practice as Research" into a more comprehensive model that embraces both application and exploration. Hence, the "Practice as Research" model *should* focus the research on experimentation (application and exploration), participation, interpretation and verification, performed by practitioners. If such model is used for PhD research, then the researcher *should* also focus on contribution to original knowledge.

2.3.2 Techniques and Tools to acquire knowledge in a practice

Knowledge in a practical subject reminds me of instructions and how-to manuals. We use car manuals to understand or fix our vehicles in a step-by-step manner but obviously we do not want our surgeon to operate on us by reading directly from a manual. Practical knowledge is hidden within people who know, do, experience and think, not just within a single discipline but also using a lifetime accumulation of "common knowledge"[15]. Most of the time, practical knowledge is implicit; unrecognized even by the practitioner; unable to be explicitly communicated and different from person to person. According to Epstein (1999), to capture such knowledge within a practical discipline, for example in surgical practice, we need extensive knowledge on explicit intellectual knowledge, the know-how of the working procedures, accumulated experience on actual applications, self-analysis, mindful* thinking and practice. Such tacit knowledge* as Epstein described, can only be acquired by the integration of different ideas and experiences with some level of evaluation. Knowledge in a practice is itself organic and is acquired by a continuous process of accumulation and reflection.

In the following sections, I will explore some basic techniques that were discussed or found useful by practitioners to understand or acquire knowledge in a practice.

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[13] The founding professor of the Laboratory Conception de Produits Nouveaux et Innovation, Ecole Nationale Supérieure des Arts et Métiers, ENSAM Paris.
[14] The professor and the coordinator of the PhD programme in Design Computation, Massachusetts Institute of Technology.
[15] Knowledge being applied in various fields where its strengths or weaknesses are known. Note: common sense is not common knowledge.

2.3.2.1 Critical Thinking and Practice

In the keynote address of the 27th Annual International Conference on Critical Thinking in 2007, Richard Paul addressed the model of a critical thinker by questioning different interpretations of the term "critical thinking" Glaser (1941) and looking into deeper problems of our education systems and students' attitudes of learning. He emphasised the need for thoughts that analyzed, assessed, *de*constructed and *re*constructed thinking, and an attitude to always challenge our old ways of thinking.

Some scholars in animation studies had identified the importance of being a critical thinker (Ward, 2006) and critical practitioner (Power, 2008) in the changing fields of animation. The question to ask is not as simple as *how* to be a critical thinker and/or practitioner, but a more fundamental question - *what* is critical thinking and/or practice? On reflection, even the meaning of 'critical' is not clear in literature I have examined.

'Critical' means to offer critique - reasoned judgement or analysis, observation and interpretation. It is derived from the Latin *criticus*, meaning, "inclined to criticize severely and unfavourably" which comes from Greek *kritikós* (κριτικός), meaning "able to discern" which in turn derives from *krités* (κριτής), meaning 'a judge'. Thus judgement is at the root of critical thought.

In Brookfield's discussion (2006) on definitions, 'critical' was variously taken to mean, yielding clarity, research and analysis of the object of study, examining ideas and actions fairly, and so on. Richard Paul's discussion (2007) on critical thinking used the word 'critical' as a way to transform thinking into a regular, systematic, comprehensive and analytic manner at a higher-than-average level. In his model, he was concerned with the quality of thinking and suggested aspects of clarity, accuracy, precision, relevance, depth, breadth, logic, and fairness in thinking. These categorizations and indeed the act of categorizing may be unfamiliar to many. But, both Richard Paul and Linda Elder (2009) suggested that a critical thinker needed to be able to breakdown thinking into its component parts and assess the use of those different parts of thought. However, Brookfield (1987) suggested that critical thinking involved much more than just logical analysis. As important as intellect, Brookfield's idea of critique (2006) also included the understanding of personal emotions towards a topic and an analysis of one's preconceptions before trying to evaluate thinking or a practice. He suggested that negative and positive appraisals were equally important in assisting critical thinking and he allowed those inputs to be multi-layered and contradictory.

Brookfield (2006) described the first phase of critical thinking as the process we used to uncover our explicit and implicit assumptions that led us to make our decisions and actions. The second

phase was research - the process of checking the accuracy of those assumptions by exploring as many different perspectives, viewpoints and sources as possible. Finally, the third phase was to apply our analysis to our decisions and observe the outcome. Boostrom (1996) linked creative and critical thinking together and suggested that thinking about thinking was a form of reflection that needed to be constantly active and well controlled. To him, critical thinking was a continuous process, not necessarily to generate new ideas but more importantly, to re-work old ideas. Being creative is to encourage us to think in ways that cannot be predicted and so invent new possibilities for the thinking cycle. De Bono (1973) had long suggested different ways to encourage creative thinking; he coined the lateral thinking process where one was encouraged to use reasoning that was not immediate obvious and indirect/creative approach to solve problem, different from the traditional step-by-step logic.

In summary, critical thinking and practice are processes that evaluate thoughts and actions - a cycle that continuously assesses thinking, it can modify the mode of thinking and encourage changes in the original pattern of thoughts; hence also modifies actions. It embraces intellectual and emotional assessments of thinking and provides both positive and negative appraisals. Within the critical thinking process, there are standards for assessment as suggested by Paul (2007) such as clarity, precision, fairness, etc. Critical practice can be used to intervene and evaluate our day-to-day actions or practices. A critical practitioner is one who engages with critical thinking and reflection, attempts to unfold implicit knowledge in their actions - they know what it is that they do, how they come to do it and how to assess their thoughts and actions critically afterward.

Although various authors had identified the concepts and process of critical thinking, I found that there were some equally important qualities scattered among the texts that had not been clearly identified, for example, personal qualities or cultural influences. Since the nature of thinking is elusive and thought can be implicit and transient, it takes a firm attitude within a person to attempt critical thinking and, like any task, takes time to master. I offer a partial list of character traits that may assist in developing this - the willingness to expose one's inner psyche, a curiosity about life and the world, skepticism and open-mindedness about anything in general even one's views, patience and persistency, an ability to empathize, a willingness to embrace insecurity, inconsistency and mistakes. These human qualities that came through strongly in exploring texts on critical thinking, also led me to explore Epstein's reference to 'mindfulness' (1999) in which introspection and self-reflection played an important role in understanding one's character.

2.3.2.2 Mindfulness and Mindful practice

Mindfulness is a teaching in Buddhism that includes the practice of mediation, awareness of self and consciousness. Practitioner's believe it to be the path to enlightenment and self-liberation. In

the field of cognitive psychology, Langer (1989) suggested that mindfulness occurred at the height of involvement and wakefulness. Epstein (1999 & 2003) also spoke of mindfulness as an active degree of attentiveness and curiosity in the present; a technique that encourages a person to become intentionally aware of their thoughts and actions. Mindfulness is not a cold cognitive process. Langer and Moldoveanu (2000) suggested that the individual was completely involved and emotionally engaged when sufficiently mindful.

Rather than simply labelling a process, it is useful here to quote at length from a practitioner of mindfulness. Kurtz[16] in the 1970s introduced a body-centred experiential method to assist with self-study. He said "If you can observe your own experience with a minimum of interference, and if you don't try to control what you experience, if you simply allow things to happen and you observe them, then you will be able to discover things about yourself that you did not know before. You can discover little pieces of the inner structures of your mind, the very things that make you who you are." Kurtz put his emphasis on the person and *pure* experiences to release the mind, instead of using the logical and systematic approach suggested for critical thinking. Kurtz's suggested concept of mindfulness anchors thinking with the 'self', emotions and the present. Kabat-Zinn[17] (1990) suggested that "the present is the only time that any of us have to be alive - to know anything - to perceive - to learn - to act - to change - to heal". His teaching emphasized the importance of awareness and knowing at the present because he believes that the divisions between body, mind and spirit are not absolute, and self-learning at "no time like the present" is the basic step to understanding the body-mind relationship. Langer and Moldoveanu (2000), pointed out that the process of self-discovery could lead to greater sensitivity towards oneself and the environment, openness to new information, creation of new categories for structuring perception and enhanced awareness of multiple perspectives, which to me, are also the qualities needed for a critical thinker.

Researchers in the fields such as healthcare, art and design had promoted mindful practices (Epstein, 1999, Stewart, 2007) to aid the learner-practitioner-researcher. Stewart suggested that mindful practice could transform the creative individual into a reflective practitioner and knowledge worker, and Epstein added that mindfulness was a logical extension of the concept of reflective practice. Stewart argued that arts could be improved by critical exercise as a mindful practice and that mindful practitioners might be more articulate in that they aimed to create and model best practice by consciously constructing knowledge. Similarly, Epstein suggested that mindful practitioners should attend to physical and mental processes in a non-judgmental manner. Though mindful practice was fundamentally personal and subjective, Epstein stressed that both explicit and implicit knowledge in a practice were equally important. Implicit knowledge, in particular, is often acquired by continuous learning through observation, practice and thinking; and

[16] Ron Kurtz is the founder of Hakomi therapy and the author of Body-Centred Psychotherapy.
[17] Jon Kabat-Zinn - Professor of Medicine Emeritus and founding director of the Stress Reduction Clinic and the Center for Mindfulness in Medicine

requires a constant process of critical reflection depending on the presence of mindfulness. Epstein said, "Knowledge, then, doesn't exist independently but rather in relationship to the one observing and using it."

Since 1989 Langer has been encouraging the use of mindfulness in education and learning. Langer's (1993) suggestion is that traditional education focuses on a passive and static concept of information, and normally emphasizes objective views and the use of absolute language. Mindfulness challenges that traditional way of learning by encouraging involvement and awareness. By introducing information in conditional states (Langer, 1993), variations and multiple perspectives are enabled, and can improve a learner-practitioner-researcher's attention, memory and critical ability. Langer claimed that the process could be effective and that mindful practice was also enjoyable. Such claims were not isolated, since Epstein (2003) also suggested that mindful practice was beneficial to the practitioner's well being as well as their practices. In his article, he proposed the following methods to aid practitioners:

1. Priming - setting the expectation of self-observation
2. Availability - creating physical and mental space for exchange
3. Reflective questions to open up possibilities and invite curiosity
4. Active engagement - direct observation and exchange
5. Modelling while "thinking out loud" to make mental processes more transparent
6. Practicing attentiveness, curiosity, and presence
7. Praxis - consolidation of learning by experience
8. Assessment and confirmation

I summarize that mindfulness is a discipline and an attitude of mind which is possible to apply to daily living and any form of study; it can be treated as a cognitive habit. Recognition of one's own limitations and failings can be source of de-motivation for practitioners, even if they are skilled in their fields and intellectual discipline. To counteract that tendency for lone workers to become dispirited, some authors have suggested the need for a mentor or independent observer to aid the process. In this research context, learning and practicing to embrace insecurity and the unknown, admitting that nothing and nobody is perfect and the Buddha's nature of "No-self" can be seen as the fundamentals of mindfulness. It can be said that mindful practice enlightens a learner-practitioner-researcher to become more aware of themselves and their surroundings, and would sometimes lead to surprising insights (Langer and Moldoveanu, 2000).

2.3.2.3 Reflexive and Reflective Studies

The definitions of reflexive and reflective study are often confused in the literature that I have examined. Depending on the field of research, they sometimes could be given similar or different meanings. Ross (2004) also mentioned that "reflexive" studies inherited confusing definitions and usage; he explicitly discussed reflexivity and identified its different aspects. He considered that "reflex" actions, with all their connotations of a reversed journey, included restudy and retrospection. Ross concluded that reflexivity required a degree of reflection and was not simply re-visiting an issue or unconsciously reacting to new information. Reflexive study deals with the passage of time and reviews knowledge with new perspectives or with new information, in an attempt to recognise our previous biases. Some of those attributes of reflexivity may be found scattering among self-study or critical reflection. For example, Schön (1983, 1987) encouraged reflective study in education to improve learning and teaching skills. Dallow (2003) used reflexivity in introspection – the ability and method for practitioners to gain self-awareness and self-analysis. Different to Ross' interpretation, Ward (2006) described a reflexive practitioner as someone who studied in response to a situation but might not be able to elevate their doing and thinking to a critical practitioner's level.

Although classified in different ways, the reflexive process has been widely used by artists for introspection. Halas (1987) and Pintoff (1999) showed that some animators injected their own experiences and emotions into their works and in turn, they could study themselves spontaneously via their creations. Ward (2006) also suggested that many practitioners used reflexive study in the production process and when using new technology in animation. Though reflexive study has its merit, Ward wished that practitioners would take the concept further to include critical reflection. Boyd and Fales (1983) had long conceptualised reflective learning as a process of internal examination and exploration, triggered by an experience, which could create and clarify meanings. Such a view shares much with descriptions of introspection, suggesting an overlap between reflective and reflexive studies.

It is important for me to clarify the terms *reflexive* and *reflective* explicitly for this research because as an animator-practitioner-researcher, both techniques offer potential for computer animation research. A process is said to be *reflexive* when it deals with spontaneous responses to the present and may involve the 'self' and the unconscious in its study. This process encourages freedom of expression disregarding any intellectual considerations, welcomes preconceptions, and embraces both positive and negative experiences equally. The situation can be re-examined in the light of new information or simply, due to the passing of time. With this view, art-practice researchers can take into accounts their own psyche, background, feelings and preferences. For an artist, their

artwork can act as a mirror to their emotions or subconscious, leading to a deeper understanding of the creation and its creator.

A process can be considered as *reflective* when it adopts a deeper thinking style and uses both critical approaches and mindfulness, usually triggered by an experience or by personal will. Hence, *reflective* study is explicit, intellectual and continuous. Kolb's experiential learning (1984) used the practitioner as the principal agent and he/she could be the sole participant in the *reflective* process. Schön's presentation (1987) pointed out that *reflective* practice involved active engagement in reflection and might benefit from a "coaching process". Coaching required a mentor or observer working with the practitioner as a guide and reflective debates throughout the process. Experiential learning with reflection may result in "Perceptive Transformation" (Mezirow 1981 and 1990), which focused on the function of reflectivity and reification of experiences. Mezirow's study encouraged analysing different reflections to allow a learner to gain new understanding and insights and so modify their initial views. Reflection can turn experience into learning (Boud *et al.*, 1985); he said "Reflection is an important human activity in which people recapture their experience, think about it, mull it over and evaluate it." Biggs (1999) added that, "Reflection in professional practice gives us back not what is, but what might be, an improvement on the original."

Both *reflexive* and *reflective* studies can be viewed as self-referencing, in that the practitioner studies 'self' or an experience; hence the validity of such studies can be challenged. Merton (1948) suggested the idea of inner states as influencing the outside world, by defining the notion of a self-fulfilling prophecy. Here, a presumption of some kind can alter the analysis of the outcome such that the initial bias is confirmed. This notion poses problems in justifying findings that revolve around a person or an experience. To an extent, this problem is also found in the field of applied science, as we cannot completely disregard the presence of an observer and their assumptions. A scientific approach would require that experiments be critical, repeatable, and falsifiable* to claim a degree of credibility. However, in art-practice research or psychology when some of the studies cannot be falsifiable, or the study subject can be a person or an experience, it is more difficult to avoid the peril of a self-fulfilling prophecy. However, according to Merton (1948), within a social context, self-referencing can possess relevance. Boud (2001) suggested the use of journal writing to reveal the internal dialogues and intellectual thoughts of the practitioner. In Moon's handbook for reflective and experiential learning (2004), writing was treated as an important tool for reflection. This form of exercise records materials, such as our assumptions and reflections, approaches to learning and the practice, for revisits and critiques. Once there is better transparency of the work, others can then assess the validity of the self-referencing materials. Although this approach cannot falsify the experiment and any observation, the process is critical and repeatable,

and if applied properly, it may increase the degree of confidence in any argument using self-referencing method.

Keeping a log, similar to the use of sketchbook or notebook in art and design, is a valuable habit for learning and many educators have been promoting the importance of self-education (Mezirow, 1981; Schön 1983 & 1987; Kolb, 1984; Boud *et al.*, 1985) where reflective practice is used. These authors encourage learning within a practice and allow for changes and improvement. This resembles Action research as devised by Lewin (1946) that was first described as a tool to change society and improve knowledge. Recently the concept was adopted by teachers and health care professionals into their practices, for example, by Dadds (1985) and Freshwater's chapter in the work by Holloway (2005). The action research concept included, "putting action into the perspective of the practitioner" and "applying study/action in view of changes" or even "intervention of the current practice". Other techniques to encourage reflexivity and reflection have been summarised in various texts that addressed thoughts that catered for change: scenario/crisis simulation or analysis, storytelling; experience audits and critical writing (Brookfield, 1987; Boostrom, 1996; Gray, 2007).

As long as we understand the uncertainties present in *reflexive* and *reflective* approaches and employ different measures or methods in their analysis, self-referencing can be useful. It can generate information about the self, one's preconceptions, experiences, values and implicit knowledge for further learning in parallel with intellectual knowledge. When the practitioner-researcher is sceptical towards any analysis and outcome, he/she is naturally led to continue experimentation and verification that will lead to a more robust study.

2.3.2.4 Different views on Mind map

Numerous techniques and tools may assist researchers in learning from their art-practices. Recently, one such tool that often appears in the literature is the 'mind map', developed by Buzan (1974) and promoted by many artist-practitioners to aid their arts or research works.

In the years since Buzan's original work, the use of mind maps has been encouraged by scholars and practitioners in the field of art and design to record and present the implicit knowledge in their practices or artworks, or to assist the development of ideas and expand creativity. Many design courses and students use mind maps to present projects and ideas. For example, Goldstein's article (2001) on concept and mind mapping provided evidence of students' mind maps that included images and design elements. It is natural for creative students to express themselves pictorially and the concept of drawing map to represent thoughts is perhaps an easier way, rather than asking them to write down (visual) ideas in texts or essays. However, the more fundamental question is: what is

the purpose of a mind map? Is it to present knowledge in a practice, or is it to demonstrate evidence of knowledge in a piece of artwork, or is it to cultivate creative thinking as Buzan intended?

In Gray and Malins' book (2004), the authors presented an extensive study of research processes in art and design and presented the use of mind maps for visual and practice research. Many mind maps of students' works showed creative elements and often, pictorial elements that relied heavily on interpretation from the reader. Examples in Goldstein's texts (2001) also revealed that sometimes a mind map was used with the hope that it somehow increases the credibility of the work, as if the mind map can objectively illustrate the thoughts of a person and the process of their working. It is an easy mistake to think that by producing a mind map, a practitioner will improve their creativity and also clarify their implicit knowledge. Indeed, mind maps *can* demonstrate students' creativity to a certain extent and show visual thinking but their benefit of providing clarification of thoughts and evidence of critical thinking is questionable. Other disciplines also have claimed success in using mind mapping, for example in business management and nursing care (Wycoff, 1991; Rooda, 1994). Although the concept of a mind map is sound in most literature, there is little clear information as to how mind maps can be constructed, and how to measure their quality. On reflection, the literature do not provide enough clarity as to what a mind map *really* is or how one can begin to "map the mind" visually in a diagram.

To unwind the mystery and evaluate the views of mind map, I decided to turn to the original texts. This novel system of thought was described in the book "Use both sides of your brain", by Buzan (1974). Buzan's mind map was introduced to overcome the clumsiness of taking notes and difficulties in composition and learning. The original examples shown by Buzan were far less fantastical than the examples that I have encountered in the other texts. The older forms of mind map focused on keywords, arrows and occasionally, symbols; personal markers to aid the recall process. It was suggested that mind maps be used in parallel with texts and diagrams to expand the otherwise linear thinking* into holistic thinking* (Buzan, 1974). This ambition is similar to de Bono's lateral thinking* (1973) that tries to account for the parallel strands of interdisciplinary thought. In his book, de Bono suggested thinking 'sideways' (simply, adopting different perspective) to achieve the *best* solution for a given problem. In both cases the mind-mapping is not static – a mind map is dynamic, can be constructed, *de*constructed, *re*constructed, and *re*viewed as learning continues. Therefore, a mind map is not a stand-alone representation of ideas but a collection of ideas with impermanent connections awaiting further development with the aid of other means such as different mind maps, reflections or writing, etc. In this older form, the mind map is *definitely* not intended as a product for presentation of work or ideas but is instead an aid to the continuous process of idea generation and recall.

The main difference I found between the original concept of mind maps and the newer usage of it in art and design is that there is now more emphasis on the map generation stage, rather than the learning and thinking that goes on behind it. I do not doubt that such tools can be useful for exploring and evolving ideas, but their utility greatly depends on our understanding of what they are not and how to exploit their advantages. A diagram that does not collect ideas effectively, aid later recall and provoke thinking, in my opinion, cannot be a mind map. Equally if a figure confuses its readers, or if it does not hold meaningful information, then in the words of Edward Tufte, it is a Duck[18]. There are dangers inherent in the use of mind maps. Their authors may see them as the goal, rather than as an aid to a process. If used as part of a presentation, such diagrams may misconstrue the relationships between concepts and wrongly represent the classification of ideas. Therefore, artist-practitioners should be wary, and should limit their use of creative elements in a mind map, for it is only a conceptual tool to aid recall and improve thoughts, and is neither a vehicle for flagging artistic creativity nor the best means to present a meaningful concept.

Computer software has also been developed to apply the concept of mind mapping for different disciplines and during the literature review in this research, I experimented with two particular programs: 'mind-jet' and 'visual-mind'. With both software packages I found that they assisted in organising ideas, especially documents, in a graphical manner but that they did not necessarily assist idea generation nor did they enhance connections between ideas. I would argue that given the nature of computer software, the two packages restricted my freedom to organise ideas and confined me to a certain style of organisation - linear and rigid as people would expect from programming - in order to achieve a kind of visual presentation suited to a mind map. However, I noted that these packages could be useful for those who are not familiar with visual thinking or those who seek to improve their organisation skills and present ideas in a graphical format. Therefore, I concluded that those software packages (still under development) are not to be used lightly and currently would not benefit my research when concepts can be easily captured and cultivated using other more effective means.

2.4 Literature Review Summary

My literature review indicated that there is a lack of research in the area of animation and its practices. Computer animation struggles under the shadow of traditional animation and is too easily swept along by the rush of technology development. Because of the lack of research conducted by practitioners, there are insufficient methods for conducting coherent animation studies. More damagingly, the vocabulary is inadequate for describing critical thinking and

[18] An object whose sole purpose is decoration without information. His classic example is that of a large duck-shaped building. Its shape is arbitrary and distracts from its purpose.

practices in computer animation properly. Research in computer animation is currently dominated by computer science technology and little attention is paid to its qualitative aspects. Practice-related and visual research on computer animation may provide new insights for computer animators and perhaps, can bridge the gaps in transition between *old* media and the *new* medium, and more importantly, the gaps between knowledge and practice. Research should evaluate different research methods that may enable practitioners to conduct critical research and address the changes and efficacies. These points are not presently addressed by animators or researchers critically.

An animator's mindset, creative and cognitive process have not been widely studied in the field of animation studies. Even in the anthropological study of animators, priority is given to their experimental works and unique techniques or backgrounds. My review indicates that there is a division between those who study and write about animation and those who produce animation or work in the industry. I believe that it is one of the main reasons why there is a barrier to transferring knowledge from traditional animation studies to computer animation. A practice-related research will expand the scope of animation studies and will be in contrast to the mainstream (computer) animation research that focuses on techniques or technology development.

My literature review also showed that although there are different models of practice research used in various disciplines, animator-researchers in animation studies still seem to lag behind other disciplines in applying and evaluating those models in their doctoral research. It appears that even though we may have defined practice research models for practitioners to conduct critical study, implicit knowledge in a practice or the pure artistry therein is still difficult to capture when methods are scattered and not rigorously applied. Generic learning skills, reflection tools and positioning of the learner-researcher were recommended in various texts but were seldom evaluated for practice research. Moreover, my investigation showed that apart from intellectual knowledge of a subject, tacit knowledge being articulated in a practice and the intertwinement between research and practice, the success of a practice research might greatly depend on the character of the practitioners and the deployment of their flexibility in thinking. This aspect of practice research crosses the boundaries of several academic fields and has not been addressed rigorously in animation.

In the following chapter, I will describe my approach to critical computer animation research and propose a methodology for application to different animation fields.

3 "Practice as Research" Proposal

Overview

This chapter presents the following:

- The fundamentals of research methodology and practice research methods
- An overview of my practice research proposal
- The pilot study to evaluate the proposal and confirm the "Practice as Research" model for the research project

3.1 Methodology

The term 'methodology' is sometimes being used loosely among researchers. In some literature I have examined, it is also used in place of 'method', making it hard for novice researcher to understand their difference. Ken Friedman (2002, 2009) defines 'methodology' exclusively to be the comparative study of methods. A 'method' then in his classification becomes a well-structured and systematic way of arriving at a particular objective.

Two main classes of research methods are quantitative and qualitative; and the choice of their usage depends on the research questions and how the researcher wants to approach the study. Quantitative methods are widely used in scientific investigations to develop and then test hypotheses about materials, processes, and theories. This classical approach follows the deductive method where a researcher will deconstruct a system to study it, and by understanding the parts and their relationships objectively, hope to derive knowledge of the whole system (Coughlan *et al.*, 2007). However, the quantitative methods are inappropriate for research where information (such as human behaviour, thoughts or beliefs) cannot simply be measured, if at all. In those situations, qualitative methods are frequently used for research that is descriptive and interpretative (Ryan *et al.*, 2007). Onwuegbuzie and Leech (2005) suggested that there were many similarities between qualitative and quantitative methods and researchers might find advantages in using both methods appropriately in one research study.

There were fewer discussions covering quantitative and qualitative research methods for animation studies than in other research areas, for example in applied psychology and media studies as shown in the work of Power (2008). Similarly, there were also limited records of practice-oriented or visual research in (computer) animation for examination. Therefore, I proposed to use some research methods from other related disciplines and to develop a specific methodology to assess those approaches to initiate this research study. Many fine art researchers employed visual research methods, examples of which were described and analysed by Gray and Malins (2004).

Manning and Freimund (2004) suggested that visual research methods offered potential advantages over conventional textual or numeric ways of measuring quality. Additionally, they noted that visual research had been used to successfully study research with aesthetic dimensions. Since my literature review showed that there was a lack of records about animation practices, a form of data collection method might fill the gap in the knowledge. Qualitative methods such as case studies (Yin, 2009), interview (Seidman, 1991) and forum discussion (Dawson, 2006), proven by many researchers in other disciplines, would be applicable in this case. Besides, those practice research models presented by Borgdorff (2005) and Candy (2006) focused on helping practitioners to conduct academic research, would be used to form a methodology for my research in computer animation. More generally, there were two sides to the argument about the format of practice-based research - Macleod and Holdridge (2005) suggested that it required a dual submission of text and artwork, whereas Candlin (2000) had long argued that such a requirement divides theory and practice, and did not acknowledge the different ways of thinking and working, but instead forced art practice into the conventions of academia. I decided that an animator-researcher needed to demonstrate both the intellectual knowledge* and tacit knowledge* required for the practice and assessed the intertwinement between knowledge, practice, practitioner and outcome. My research would present the methodology, the process of the practice and applications, and the resulting animations, but also demonstrate flexibility and criticality in thinking. By that I mean that I should be able to articulate and study a body of knowledge, and at the same time evaluate the proposed "Practice as Research" model.

The latter requirements led to introspection and reflection playing an important role in the methodology. Introspection offered opportunities for an individual to understand their inner self (Dallow, 2005), the way one engaged with work and practice (Biggs and Wood, 2004; Aldrich, 2004), examined thinking (Boostrom, 1996) and encouraged creativity (Boden, 1997). Reflection catered for the understanding of preconceptions and emotions (Brookfield, 1987), and changes and transformations (Schön, 1983; Mezirow, 1991). Critical thinking (Glaser 1941) and mindfulness (Langer 1989) were employed to evaluate experiences and the quality of thinking. Although Schön (1983) suggested reflection to be performed *during* and *after* an action, Boud (2001) suggested that there should also be reflection prior to any decision or action. Later on, Gray (2007) promoted clear identifications between reflection (examining the justification of assumptions); critical reflection (assessment of the validity of those assumptions); and critical self-reflection (reassessment of the effect of one's position on the perceived), which were explored during my research.

Schön (1987) had concerns on reflection performed by the sole participant in the process. He suggested that a mentor could aid the practitioner. Prophet (2004) suggested that review should be constant and rigorous and might benefit from procedures and methods. Therefore, peer-expert

review was brought into this research to provide guidelines and widen the reflection process that evaluates animations, the process and research methods. Prophet also suggested that the resulting work from a practice research could have aesthetic qualities and had been championed by some studio practitioners. This contrasts the wider assumption that academic research is rarely concerned with artistic merit.

Power's review (2008) confirmed that the use of animation could assist understanding of a topic and that animation was a valuable tool for research, for example, cognitive psychology and neuroscience. Gauntlett (2005) suggested that studying media by making media was a conventional approach for solo practice-based research. Hence, producing animation to study animation or to explore certain problems within an animation context would be an appropriate method for animation research. The concepts of "action research" (Lewin, 1946) and "scenario simulation" (Brookfield, 2006) allowed changes to be made and simulated; by analogy, animation productions could be tailored with different assumptions, simulate different contexts and explore uncharted territory. In this sense, expert knowledge in animation making was required; as Boden (1997) had suggested that to extend any knowledge, we needed to deploy expert knowledge on the topic, a set of technical practices and our psychological abilities.

In view of all these different approaches, a diversified research model and its methods can be designed for (computer) animation research. Later in the chapter, I will detail how to structure different research methods and propose a methodology for animators to conduct their study.

3.1.1 Ethical, health and safety or risk issues in this research

Ethical problems can arise whenever research investigates social or moral aspects of the world. Qualitative methodologies relying on subjective data from individuals should be used with particular sensitivity to research ethics. Since interview method was used in this research, data collection method or questions were designed with great care so that problems arising from ethical or moral issues were either minimized or avoided.

Prior to the interviews in which I gathered experiences from animators, the participants were given time to read an explanatory statement about the research and their rights. Choices would be provided to the participants on a consent form about the options regarding recording rights and publication of the data. Transcripts or records of the interview were available for examination and if a participant was quoted, I would confirm the context prior to publication.

In the case of animation reviews (by questionnaire or interview), information about the research and the procedures were given to the participants. When the interview or review was conducted

using an indirect approach, then a debriefing session was organised to reveal the true purpose of the research. If duplicate animations were shown for calibration purposes, participants would be told in the debriefing session as well. Review reports were available for discussion. If participants' personal details were collected, for example, age, gender, ethnic origin, address, etc., then the Data Protection Act would be followed. Information about the individual would be used for this research only and would not be distributed to a third party.

The Hypertext stored on the Internet equipped with a self-monitoring system – Google Analytics to collect data from anonymous users of the research. It followed Google's privacy policies, see www.google.com/privacypolicy.html and I had no intention to expand the monitoring to collect extra data that might not follow the Data Protection Act.

The contents of the computer experiments were carefully designed to minimize ethical, political, or religious objections. Certain aspects of the animation might invoke awkward feelings or might show violence but in general, the animations were kept within the PG certificate introduced by the British Board of Film Censors.

3.2 "Practice as Research" model

This research proposed a methodology (see Figure 1) for animators to evaluate some available research methods and examined the proposed model that structured those methods to be used in computer animation research.

To enable the proposed methodology and those research methods to be evaluated, I proposed to produce character animations as experiments and conducted applications in different fields: narrative and experimental animation, and game development. Critical reflections and reviews were conducted, not only on the "Practice as Research" model but also on animation practices or other research questions. Due to the novelty of the approach and the complexity of my model, a pilot study was performed (see Figure 1) where I refined the model and exercised some generic practical and mental skills to assist this research such as interview, introspection and reflection. The refined "Practice as Research" model was then applied to the principal research that consisted of game and narrative applications, to investigate its applicability and to further examine the model and its validity.

Figure 3 details the proposal and shows how different research methods are related and the possible data flow between them. The method is divided into distinct areas:

1. Case studies to examine previous experiences and animation practices.
2. Interviews to collect practitioners' experiences and techniques, and assist reviews.
3. Animation experiment to create research space within the context of a study and allow "reflection-in-action" to take place.
4. Visual research to aid production and examine research outcomes.
5. Reflection and review processes to evaluate qualities of the research model, animation practices and experiments.

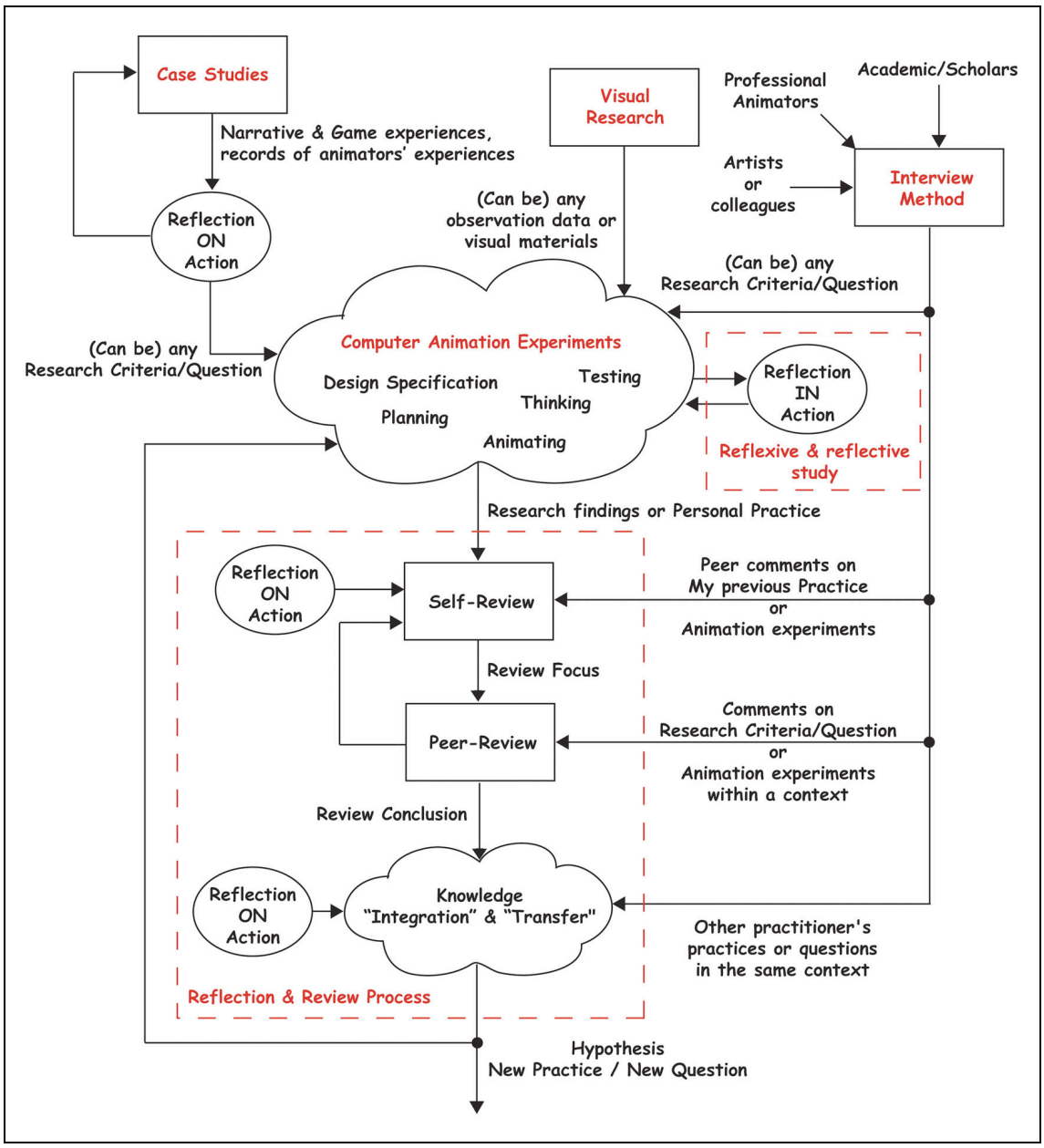

Figure 3. Proposed method to conduct computer animation experiment

My previous experiences in the industry and different animation practices were collected using case studies and "reflection-on-action" was employed to valid those experiences. I anticipated that personal experiences could vary but the records from the case studies provided a starting point for this research. Case studies and reflection-on-action took the form of a logbook, written report, presentation, or discussion and the records could be examined. Being interviewed might be a better way to elucidate implicit information about my previous experiences but for this research, I decided to limit the scope to the self-reporting only.

The interview method was used in two different occasions in this research. First, I interviewed professional animators and academics in different fields of animation to collect their experiences and knowledge - data that are difficult to obtain from the literature review alone. Running in parallel to the case studies, I also compared and examined my personal practice with other

animators'. Integration of knowledge had encouraged new insights or provoked certain research experiments to be designed. I was aware that there were other techniques for data collection instead of interview, which were equally valid for this research, for example, observation, practice with experts, on-line and forum discussion. One could argue that these techniques might yield comparable information on a given practice than self-reporting but such methods were still open to subjective interpretation by the researcher. I considered that these methods were outside the scope of my research currently but would recommended other researchers to try in conjunction with interview method. The second usage of interview was to collect comments from peers about the research experiments and methods. If conducted correctly, it would encourage different perspectives and aid critical approach in the examination of the "Practice as Research" model, its processes and animation practices.

Visual research was used in the animation experiment to aid the production of character animation and study the results. Animation making allowed the space for "reflection-in-action" to develop. This stage included documentation of thoughts, practices, problems and decisions during a production and at the same time exercised one's (self) awareness and mindful practice. "Reflection-on-action" and peer-review were used in post-production to assess the research model, processes and outcomes. I proposed to use critical writing and oral presentations to achieve in-depth reflection and assess spontaneous responses. Conclusions or hypotheses from critical reflection and review processes might lead to new insights and further experimentations.

In the next chapter, I will describe the pilot study and present my findings on those research methods.

3.3 Pilot Study

Overview

This chapter presents the following:

- A description of research methods and the pilot study
- Case studies, the results and difficulties encountered
- Animation experiments, the reflection and review findings
- Interview method and the analysis relevant to this research

Pilot study was necessary to examine my proposal in order to confirm that the chosen "Practice as Research" model was relevant and critical for computer animation. To create a research space and conduct animation experiments for the pilot study, I employed the secondary research questions (see Chapter 1.1) as guidelines for the design.

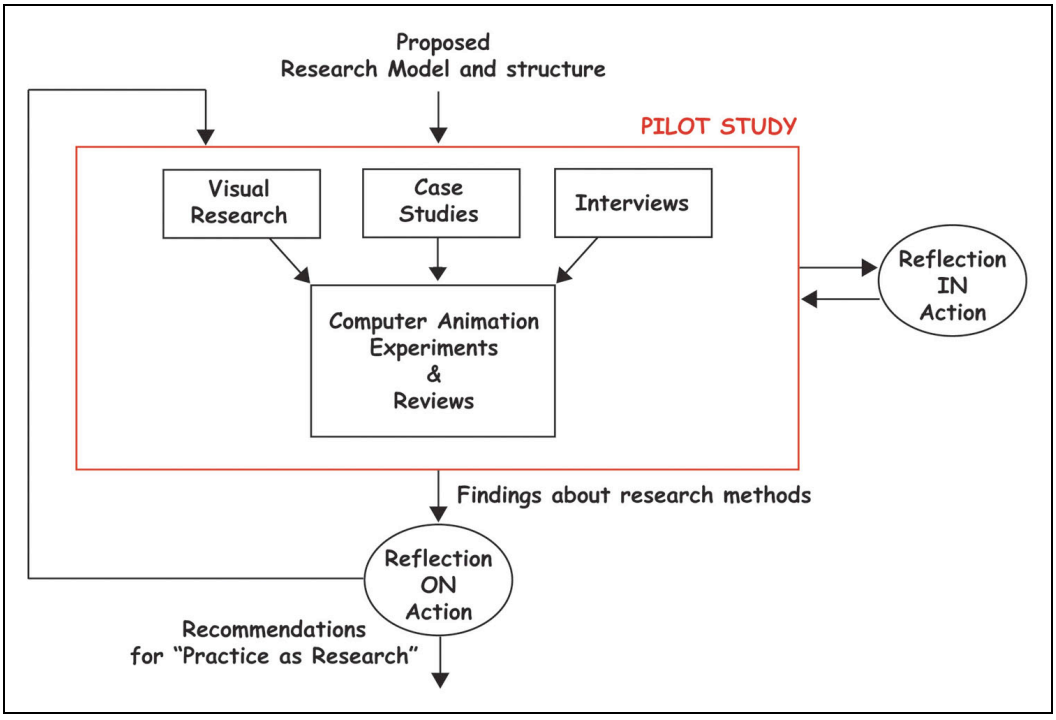

Figure 4. The process to evaluate the proposed research model and different methods in the pilot study

This pilot was not a goal-oriented study to answer those secondary research questions but they would guide me to design and develop different animation sequences, and allowed "reflection-in-action" to take place. Character animation was the focus of the production in the pilot; however, it was limited to styles and the chosen sequences *(see Menu: Pilot->Anim1 – Anim5)*. Section 3.3.2.2 describes how these animation experiments can be examined using Hypertext. During the pilot study, I kept an open approach and allowed myself the freedom to search for new directions as the

experiments progressed. It was noted to be important to use this opportunity to exercise mindfulness and critical thinking during the production; to adopt the correct attitudes for introspection and reflection; and finally attempt some of the recommended tools for learner-practitioner-researcher such as mental simulation, action research or journal writing.

As shown in Figure 4, some methods were conducted simultaneously with another and the outcome of one activity might influence the inputs of others causing a certain dynamic and unexpected results. For example, case studies might have driven the theme of an interview or some interview data might modify case studies' directions unexpectedly. Findings in the animation experiments or from different methods creating unexpected inputs, would be the case in any empirical work; therefore, such novelty in no way would damage the outcome, as the goal of the pilot study was to experiment upon, and evaluate the proposed research model.

In the following sections, I will summarise the results of different research methods in the pilot study and present my evaluation.

3.3.1 Case studies

I began the pilot study by conducting case studies on my previous experiences in the industry. I examined a story-based computer animation since the narrative and storyboard of that particular project were both initially poor and I had to redo all pre-production work. This case study gave a near-complete demonstration of how an animator would approach a 3D production. I also examined a game project to provide further comparison.

I employed note taking for recording at first but later, it turned into report writing as I felt the need for more organised recall of the previous work. The reports went through a few iterations as reflection naturally occurred when I read my own writing. During documentation, it became apparent that the practices for narrative animation might differ from that of game animation. This discovery led me to perform another case study on a game project in order to evaluate whether this perceived difference was meaningful. Hence, I selected particular game animations that did not involve a narrative and were based purely on fun and their engagement with the player.

While the actual animation production techniques were found to be similar for narrative and game animation, evidently, it was noted that there are were significant differences in the animator's priority, mindset, focus and practice *at least as shown in this case studies*. It was also noted that there were extra constraints on artistic input to game animation. For example, the aesthetics and fluidity of an animation were governed by the program design as much as they are by the work of

an animator. The timing of sequences tended to be restricted by the needs of responsiveness to the player leading to some degree of compensation in the animation.

It was found that sometimes, text was inadequate for documenting a practice and later on in the reports, diagrams and illustrations were brought in for clarity. It was noted that there were multiple stages in the computer animation production process and the making was only one of the means to create visual outcomes. Appendixes 1-4 show the brief overviews of the two case studies. Detailed records are displayed in the Hypertext *(see Menu: Practice - reflections)* and therefore, is not repeated in this thesis. The initial notes were found to be more personal than the final iterations of the reports. Although the written reports were comparatively clearer and focused, they seemed to be written for a target audience and lacked some of the subtleties of my personal practices.

Without noticing, I began to detach from recording my animation practices and started writing a manual for producing animation that was driven by the techniques. My writing showed that, like most animators in the industry, I focused on deadlines, animation techniques, and the results. Although I seemed to have developed a "good" practice, I noticed that my skills and my approach differed to those of my colleagues and some animators as I collected data from the interviews. On reflection, I had never consciously employed introspection or reflection to study the way I worked or myself. Some aspects of the documented practice were ambiguous and therefore, I presumed that I was not in full control of the way I worked or I was unable to describe my practice explicitly in words. It was as if I depended on intuition and insight to complete the animation. However, from the records, there was strong evidence that I constantly asked questions, reasoning through my own work as I progressed, and had assigned periods for review and allowed myself scope for modification.

The experience of writing about my previous works in the industry led me to write about some of my junior animators and incidents that happened to them or in the studios. I deliberately left those reports in a personal and immediate tone, in the hope that it kept the subtleties and was a closer reflection of the reality. However, I considered that those contents were outside the scope of this research and would be used as reference materials only.

Case studies provided me with the opportunity to revisit previous experiences in the industry and produced formal practice records for further study. Case studies allowed a relaxed environment for reflection and offered different viewpoints from which to examine old issues. They captured some implicit knowledge that would have been lost or considered explicit and well understood in a practice. With a clearer understanding of the know-how in animation, clarity in the practice, limitations and scope for improvement, animators might feel more confident to perform critical animation research.

3.3.1.1 Summary

Case studies as a research method confer significant benefits when a practitioner performs both reflexive and reflective study on previous experiences to gain understanding and evaluate one's (implicit) knowledge. Documenting a practice with text and diagrams helps practitioners to clarify information that would have normally been forgotten, or considered widely known and understood. Case studies challenge the practicality of those previous ideas and decisions from a different perspective or with a new stand since time has moved on. Many questions about personal practice and how others may have tackled a similar problem are likely to rise from reviewing one's own experiences. The formal descriptive records can be used for further study or as a standard of practice that the practitioner and others can re-examine and improve upon.

These two case studies described two applications of an animator's practices and production processes in computer animation. The studies showed that there were some significant differences between narrative and game animation though the actual animation techniques used, were similar. I hypothesized that these differences arose, mainly, from the nature of the applications – games are interactive while narrative animations focus on storytelling, and recommended the principal experiments to explore these issues (see Section 4.5.4). An animator's priority, working mindset, focus and practice for character animation were evidently different between the two production processes. These noted issues would be further examined in the principal research.

3.3.2 Pilot animation experiments

Practical animation experiments (making animations) were conducted in the pilot study to provide a research space to apply the "Practice as Research" model in a production and evaluate the research process and techniques. Introspection and reflection-in-action were used and I could study animation practice in an immediate and direct manner during a production cycle.

As proposed in Chapter 3.3, the animation experiment was left as open as possible to allow flexibility in searching for new directions as it progressed. I designed a simple scenario with two primitive characters to create a story and interactions *(see Menu: Pilot->Anim1 & Anim5)*. These characters were sufficiently simple to require little work to animate, and yet were flexible enough to explore, it was hoped, character and emotions. The problem then arose of how to animate them.

During interviews with animators and through my literature search, I frequently met discussions about using traditional animation techniques in computer animation. Many participants in the

interviews claimed success in applying those techniques to computer animation but when some of them described how to animate using a computer, their techniques seemed to deviate from the traditional methods (see Section 3.3.4.4). When I documented my personal practices in computer animation, it was also not clear as to whether I faithfully employed those traditional techniques and principles. Thus, in the first experiment I questioned those traditional techniques such as "straight ahead" and "pose-to-pose" that many computer animators claimed to use. The hypothesis was that those techniques were not directly applicable to the computer medium. (refer to reflection notes at Menu: Pilot->Anim1 & Anim5)

Figure 5 shows the structure of the five experiments in the pilot study and how they related to each other, the reasons to design the next experiment and what kind of information was interactively passed between different research methods.

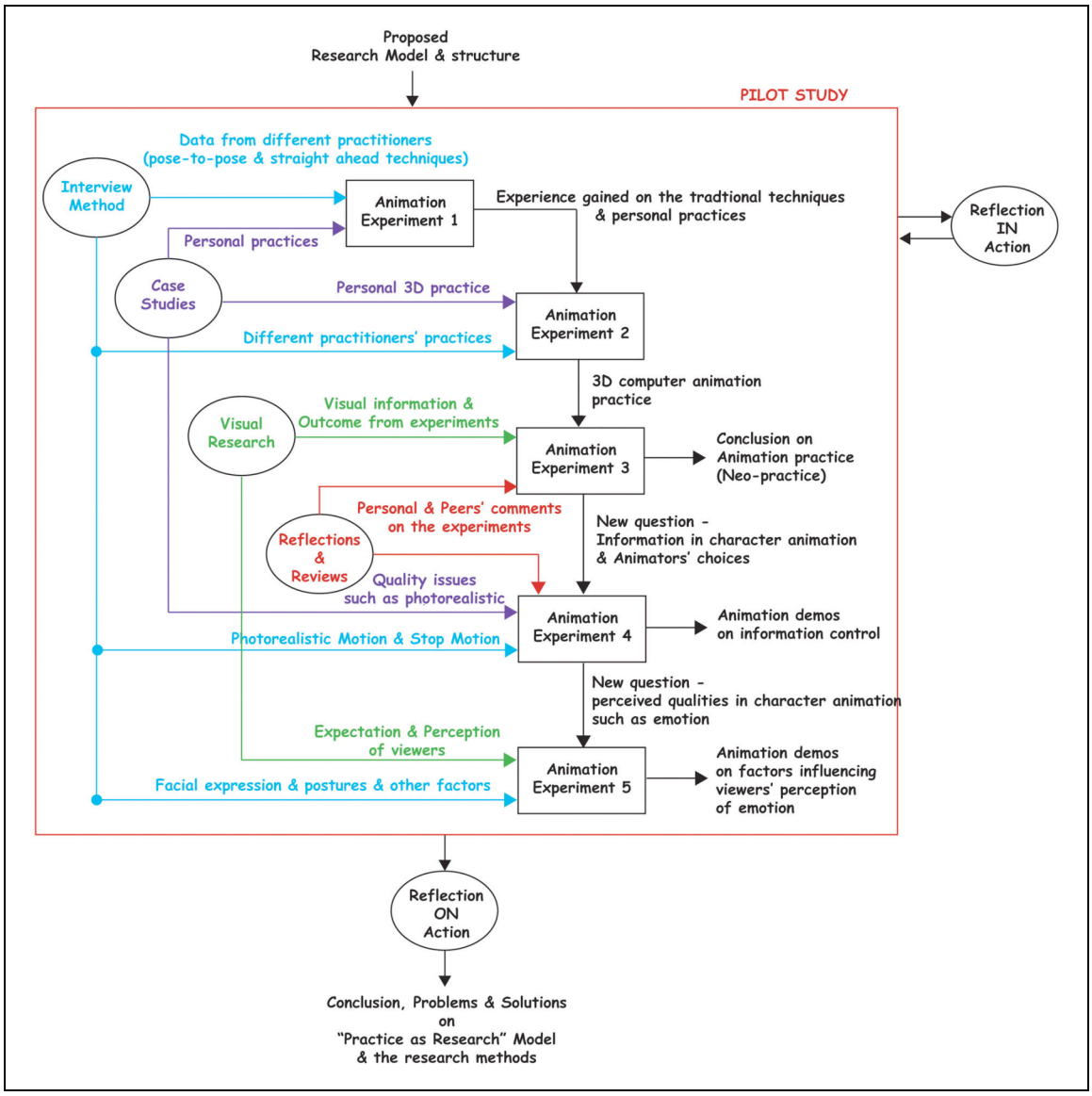

Figure 5. Animation experiments structured in the pilot study

As shown in the figure, the investigation on traditional animation techniques and personal 3D animation practice revolved during the pilot experiments. The application of the "Practice as Research" model and the use of different research methods allowed a practitioner to collect and integrate a variety of information into an experiment for evaluation. For example, information from interview and case studies was used to design Animation experiments 1, 2 & 4; visual research data and comments from both peers and myself were incorporated into Animation experiments 3 & 5.

Since the records of those experiments and discussions are displayed in the Hypertext (see Section 3.3.2.2) and they are not the main focus of this pilot study - to evaluate the "Practice as Research" proposal and different research methods - I therefore, will not repeat the same information in this thesis. Interested readers are encouraged to explore the visual results and reflection conclusions *(see Menu: Pilot->Anim1 to Anim5)* where discussions about the secondary research questions can also be found.

3.3.2.1 Reflections and Reviews

During the animation experiments, introspection and reflection-in-action were used. Note keeping in a logbook tracked ideas and problems during the production cycle and I revisited the information to aid my reflection on the experiments. Reflection notes were later turned into formal discussions and written reports which some examples are shown in the Hypertext.

I found that introspection was difficult initially since I constantly asked myself what I should think about or what I should watch out for in myself. The records in the logbook were mainly practical problems and random ideas about the production. Most of them were confused and not very fruitful. On reflection, I was tense and obsessed about recording everything, and did not understand "mindfulness" as described in Section 2.3.3.2. Later on in the experiments, I noticed that there was a change of style in how I reported my personal practices. Instead of recording facts as I had done in the case studies and writing manual-like instructions, internal discussions were formed when interview data about techniques and practices from different animators became available.

On completion of the experiments, reflection-on-action and peer-review were tried out in this pilot study to encourage critical study and to evaluate the research proposal. Reflection-on-action was performed in the form of report writing and discussion with peers and also supervisors in this research case. It was found that reflection logs and previous documentation from the case studies provided extensive information to aid the reflection process. Information about animation

practices, decisions made during the production and lessons learnt from the work was evidently more explicit than in my previous industrial experience and the case studies in this pilot.

The peer-review used a format suggested by many interviewed animators (see Section 3.3.4.2) and also employed by many industrial projects in my experience. For example, animations are shown to the animation team or project team to collect comments or an open discussion about the direction or option for improvement with the director or client. In this pilot study, I used my three supervisors to run a peer-review simulation and evaluated the process as well as the outcome of the review. The criteria of evaluation were simple - whether the process is effective and efficient, yields critical debates, and enhances a practitioner's perspective of the work.

The peer-review simulation turned out to be rather chaotic, with most of the topics addressing the visual components and the story of the animation experiments rather than the underlying processes, animation practices and the "Practice as Research" model. This, to an extent, was a symptom of the lack of experience (on my part) of organizing critical reviews and the general focus on animation as a visual product, similar to the situation reported by the interviewed animators (see Section 3.3.4.2) and my previous experience in the industry.

Because the review mainly targeted the visual outcome, I as the practitioner-researcher, did not find them useful for the evaluation of the proposed research model and the process, the two fundamental aims of this pilot study. However, I must add that those comments were found to be valuable in modifying the animation outcomes and for injecting new ideas into the design of future experiments.

I noticed that the group dynamic during the review not only drove it to embark on different discussions randomly but also naturally reduced the diversity of a discussion. Both of these observations were not healthy for critical assessment.

From this review experience, it was noted that the presentation of a practice, the thoughts and reflections of a practitioner and the outcomes of that practice were difficult to display coherently. For example, descriptive texts in multiple stages of the experiment and the resulting animations failed to demonstrate the details of the research process. The understanding of the practice, the new insights gained from the experiments and the hypotheses that led to the next stage of the experiment could not simply be captured by visual outcomes without other aids. I envisaged that there could be a better way to display intellectual thinking and demonstrate the knowledge used in a practice together with the visual outcomes, and such methods might include Hypertext or interactive presentations.

The general review format reported by some animators and used by some studios revealed its deficiencies in this experiment. This led to the hypothesis that an effective and efficient review required a tightly structured process that encouraged both the practitioner-researcher and the reviewer to be critical and focused on what they were looking for from a review – and not simply gather together to watch the animations and give comments. A process should allow reviewers to be familiar with the process, the contents and the purposes of the work. Bringing them to an equal level of understanding to that of the practitioner-researcher to conduct critical debate, would, no doubt, benefit a review. I envisage that such a process can also empower reviewers and can modify a group's dynamic within a review, perhaps leading to a more meaningful and balanced exchanges.

3.3.2.2 Hypertext and Interactive presentation

Hypertext, a method of linking documents and representing ideas in a structured but non-linear manner, had shown many advantages for presenting practice research found in this pilot. Texts could accompany images and animations, with an arbitrary level of detail available by links to more or relevant information. Such a document, if well-built and adequately well-linked, could form an exploration space for reviewers to experience, in this case, allowing them to examine the research and experiments. Animation sequences could be replayed for detailed study; explanations and reflections were presented in parallel with the animations. Arguments were displayed in descriptive texts and diagrams or even illustrated by experimental results interactively. A presentation in this manner had the potential to take the reviewer on a journey that closely followed that of the practitioner-researcher.

I used HTML[19] and JavaScript[20] to create an interactive space, in exactly the same way a web-designer would when making a website on the Internet. Hypertext links allow users to jump between different pages of information. This approach is flexible and can be used online – by uploading the material to the Internet for people to access - or run directly from the hard disc of a computer or a CD.

Media players were embedded inside the HTML to provide simultaneous viewing of different animation sequences. If it is online, it may take some time to load up a page depending on the Internet connection speed but once fully loaded, animations should play smoothly.

[19] Short for Hyper Text Markup Language, as the dominant development language for web pages
[20] A scripting programming language most commonly used to add interactive features to web pages

The Hypertext presentation for this research can be found at:

http://www.yas-studio.net/PhD

To enter, use password: Miko_PhD.

Or

Located on the CD submitted with this thesis, bound to the inside of the front cover.

The CD should auto-run when inserted into the optical drive.

If this fails, please locate and launch filename: Miko_PhD.html

The navigation menu (blue buttons on both sides of the page in Figure 6) allows users to access to all content pages. The left menu is assigned for research methods, pilot study and the principal game experiment, whereas the right menu presents the experimental works in term of the development stages. To recreate a close proximity of the research journey, the user can access the contents from top to bottom, and left to right of the navigation menu. Then, by using the other navigation buttons in the central content pages, details of the research can be examined.

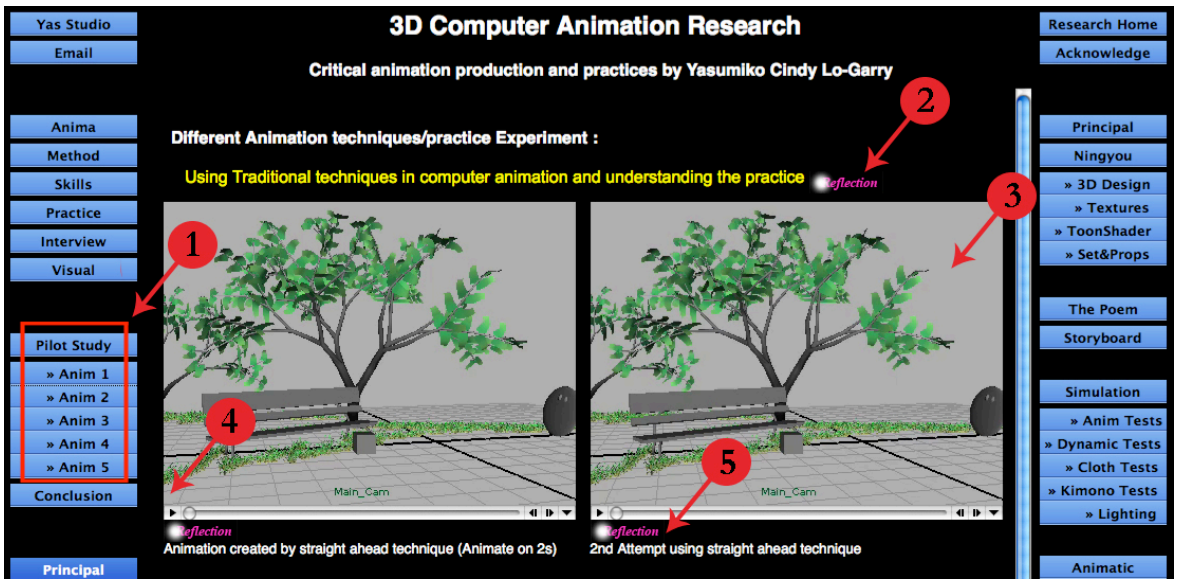

Figure 6. Screenshot of a page from the Hypertext interactive presentation of the animation experiments in the pilot study

Label 1 shows menus to access the animation experiments for this pilot study. All menu buttons are constantly displayed on both sides of the pages for easy access to the first level of the research. Further details about any content can be found via the "*Reflection*" link as shown in Label 2. Label 3 identifies a media player that displays the appropriate animation. If the animation is fully loaded, the timeline on the player will be dark grey, as shown in Figure 6. Depending on the browser, it may be necessary to *click* on the player to refresh the first frame of the animation sequence; otherwise, using the standard video controls (see Label 4) will play the sequence. If sound is present, a volume control will be displayed but there is no soundtrack for all of the pilot

experiments. The "*Reflection*" link (labelled as '5') provides access to experimental findings and discussion about that specific sequence.

The content on each page was designed to be self-contained. If a participant progresses through the navigation menu (Label 1) in a top-down manner, they will have a chronological view of the experiments. However, it is not necessary for the reader to follow that path. Since the pilot study focused on the evaluation of the research model rather than the findings for the posed questions, I suggest that readers should not take this Hypertext presentation as being the sole path to understanding the study. The additional contents are to be treated as supporting materials and to provoke discussion.

A Hypertext document was reported to be a useful method of presenting practice research from the review. Since interactivity and user dynamics may encourage different paths to approach the research, I fully anticipate that such non-linear modes of exploring research would lead to diversity and new insights for both the user and the practitioner-researcher. Such claim was examined further in the principal research. (See Section 4.3.4.3 and 5.3.6)

3.3.2.3 Summary

The use of animation experiments demonstrated an effective way to create a research space for animators. It can be an immediate and dynamic way of investigating the research process, animation practices and other animation related questions. It provides a different perspective from which an animator can form experiences; modify previous ways of working and thinking, in such a way that it may compensate for the rigidity of a case study. Reflections during the experiment can also be dynamic, taking the practitioner in and out of a process, creating diversity in understanding the intertwinement between intellectual knowledge, implicit practice, the animation experiment and the creator's psyche. Experiments can act as an exploration ground to valid claims and data from the interviews with variety of animators in different fields, bringing in critical understanding and research attitudes to the practice.

This practical approach allowed flexibilities for the practitioner-researcher to re-shape experiments in order to explore a particular topic when it became significant, or to vary the approach or assumptions to cater for different perspectives. For example, in this pilot study, there were three iterations in the experiment that dealt with the "straight ahead" and "pose-to-pose" techniques used in computer animation *(see Menu: Pilot->Anim1 & 2)* and four experiments were used to assess level of information in character animation *(see Menu: Pilot->Anim4)*.

Introspection and reflection-in-action was found to be difficult to perform within a creative process. The intense concentration required to produce artistic work seemed to divert the focus of the reflection process. The creative flow during an animation practice seemed to be easily interrupted when the practitioner-researcher conducted reflection-in-action during a production. This led to confused and unfruitful reflection records. I hypothesize that these issues arise because (self-) reflection is a convergent cognitive process whereas creative practices, it can be argued, require freedom and divergence in thinking. These are the issues needing to be resolved in the principal research. (See Section 4.3.4)

The peer-review simulation showed some shortcomings in the general format as used by many animators and some studios. The experience posed questions about review process and its qualities; and how it could be made critical for research purposes. Some factors that contributed to the failing of the review may be that: peer-review for animation research may require different procedures to that used for industrial projects, the current animation review formats have not been critically reviewed, sufficient organization and criteria may be lacking, researcher and peers' unfamiliarity with the critique of processes rather than visual outcomes, a lack of explicit language to describe processes and animation qualities. Since animation is a visual product, it is very easy to be drawn to the imagery and fail to maintain clarity between opinions and critiques. I fully anticipate further investigation of review process in the principal research to explore these questions. (See Section 4.3.5)

The pilot study revealed a much deeper problem in presenting "Practice as Research" than performing such research. Even with well-documented reflections at multiple stages of the production and detailed visual results, it was still difficult to clearly demonstrate the dynamic journey of such research and the transformation of the practice or even of the practitioner at the end. The missing links between the intellectual knowledge, research journey, practical experiences and visual outcomes, can destroy the coherent look of the "Practice as Research" model. A Hypertext interactive presentation may provide a way to tighten the relationship between knowledge, experiences, reflections and visual works. Reviewers or the practitioner-researcher may be able to use the presentation to prepare and organise the review process. Building such a Hypertext presentation may also encourage the practitioner to view the research from a different perspective. Furthermore, the interactivity associated with Hypertexts may encourage different paths or views from which the research can be examined. Hence, it can create diversity and provoke different insights for both users and the practitioner-researcher. I concluded that my research should continue to examine Hypertext usage for "Practice as Research" and its values in the principal experiments. (See Section 5.3.6)

3.3.3 Interview method

During the literature review, it was noted that very few animators had recorded their practices in texts and those who did, tended to write about how to make animation. In Canemaker's book (2001), the author recorded some conversations with the *original* Disney's animators, their descriptions and comments about each other, and their recollections of the old days on how they used to work at the studio. The contents of those informal exchanges did not easily fit with the animation principles or techniques. However, some of the stories from the *old* animators and directors strongly suggested the underlying qualities and mindsets needed for an animator and the required meticulous attention to the world and the understanding behind it. Therefore, I decided that to reach the information that was missing in animation texts, and to expand my knowledge on the variety of animation experiences, I had to ask animators.

Interviews have been widely used as a qualitative research method in education and social science (Seidman, 1991); recently, this method was broadly adopted by the health care professions to conduct patient research and in nursing practice – an article in Holloway's book (2005) discussed this particular topic. Therefore, it is appropriate to use interviews to collect information directly from animators about their personal practices and experiences, their views on different animation techniques and the industry and perhaps, their unique qualities.

Rather than examine popular questions - how an animator produces believable characters or how the traditional animation techniques is being applied to computer animation, I wanted to explore naturally about animators and their experiences. For example, how do they view their personal, studios' and colleagues' practices; and what do they see as being important to them and their works. Therefore, I imposed some criteria to select participants for the research interviews - animators with industrial production experience and with some practical experience in 3D computer animation. I also included academics who taught animation studies and were once practitioners themselves, studio artists who had a *good* understanding of animation and who worked closely with animators in the industry. To assist reflection, I also included some ex-colleagues in the interviews. By collecting their views I could account for any assumptions I might have in my previous work and own practice.

3.3.3.1 Preparation for the interviews

During the case studies and in the initial design phase of the pilot experiments, I had identified both areas of personal interest and areas where additional knowledge was required. From there, I drafted questions for the interview. Missing or unclear information in the literature also steered

some of those interview questions. To better understand the types of debates associated with traditional and computer animation techniques from a wider community, I visited online forums such as CGTalk or Autodesk Maya forum. By working through other's problems or suggestions, I clarified some of my own thoughts and also understood what could be missing in their discussions. That information was then used to further refine my interview questions.

Mock interviews were conducted and the selected questions were tried out on four participants. My prior experiences in the industry and my communications with animators showed that many practitioners could be introverted characters who might find it difficult to speak about their personal intuition or practice. Therefore, I decided that my interview should first focus on getting the animators to talk about themselves, to open them up and that the interview should take on a semi-structured approach and encourage them to discuss a topic without feeling that they were being quizzed.

On reflection, I noted that there were some problems in using a semi-structured interview. For example, the interview took the discussion away from my control and expectation. Secondly, the participants provided a lot of information that could be considered "useless" to the research and transcription of semi-structured interviews usually took much longer than structured ones. Finally, data were scattered, irrelevant and difficult to analyse. However, there were advantages in using semi-structured interviews when, for example, the aim was to explore a topic rather than finding specific answers, and when the topic itself varied according to the practitioner and the field. In this case, I wanted to use the flexibility to accept new directions and also to allow the participant to search inwards to reveal different facets of their personal experiences and deeper layers of thinking. More importantly for the mock interview, the semi-structured approach allowed me to reflect on the drafted questions from interview to interview. Hence, questions for future interviews were modified and improved.

An explanatory statement and consent form were prepared for the interview (see Appendix 5). Each interview was audio-recorded digitally with the permission from the participant and then manually transcribed. A software tool, "Computer assisted qualitative data analysis software" (CAQDAS), was used for organising the data and assisting further analysis. In the pilot study, I also briefly assessed that tool and its capabilities.

3.3.3.2 Mock interviews and lessons learned

The four mock interviews showed that the interview method could provide valuable data about different animation practices and animators' individual qualities. It was noted that some of that information could not be obtained by simply examining animators' works and techniques or by

working with them. Their individual experiences, artistic appreciation and preferences provided great insights for me and perhaps, other animators too. The semi-structured approach to the interview was found to be important for this research, in that it allowed flexibility, had widened the scope for data collection, and yielded unexpected information (see Section 3.3.4).

The interview questions were refined from one interview to another and had been through three iterations (see Appendix 6). This process of evolution was initially necessary to accumulate critical themes* for the future interviews. However, when one participant's experience differed from another widely, those interview questions were then used as guidelines only without further refinement. It was found to be more appropriate for the interviewer to assess the participant quickly in the interview, and tailor or rephrase questions to suit that individual.

I am aware that other styles of interview may also aid this research. For example, the interview can be arranged like a (group) discussion or a participant can be asked to take a reversed role - to question me about animation practices or what he/she wants to know. The main reason for these suggestions is that during the mock interview, I realised that the question-answer type of approach acted against my idea of opening up an animator and searching into their psyche or personal experiences. There were times when I felt that the participant was forced to answer my questions even though they did not have particular ideas to talk about. At other times, I found that the participant paused in their flow of conversation to allow me to ask other questions even though they seemed to have more to say.

Therefore, I believe that if I can allow the participants to have more control over the interview, I would obtain unexpected information about their experiences and their otherwise hidden qualities. Appendix 7 shows one of the responses from a later participant about interview-discussion method.

CAQDAS was proven to be a basic data organisation and analysis tool. Evolution of the research themes and the emerging pattern was noted more easily using CAQDAS than with manual methods. However, analysis could not be solely achieved by the use of CAQDAS especially, in the case of this research, when interviews were used for exploration and information gathering to pose the research direction and expand knowledge. In the following section, I will describe my method of studying and analyzing data, which can provide a critical approach and a procedure to ensure qualitative assessment.

It was noted that the data returned from the interviews could assist knowledge transfer between different animation practices and fields. Individuals' experiences could be informative for other animators and the qualities of a professional or experimental animator were valuable for others to learn from. However, this research was never intended to be a study of animators, therefore,

interview data and analysis would not be the main focus of the principal research and would not be dealt with in a manner similar to a formal qualitative research using interviews. Instead, I explored the data to fill some of the gaps apparent in the literature, to look for shortcomings in current animation knowledge and practices, employ animators' experiences or skills to design animation experiments and use some of their arguments to reflect upon and analyse the findings in my research.

3.3.3.3 Data Processing and Method of analysis

The concept of data processing and analysing are divided into four stages – organisation, interpretation, exploration and integration. There is some degree of overlap and interplay between those stages, as they are not rigidly defined; however, the following list attempts to identify some boundaries.

a) Organisation

Transcription is the first step in organising the interview data. It generally requires the researcher to convert spoken words into text for reasons of portability and clarity. In this stage, I performed some levels of categorization: creating themes* or categories, grouping data or participants, associating my observation and insights about the interviewee. Data organisation is subjective to an extent and in this case, it also was influenced by the interview questions.

b) Interpretation

Data Interpretation encourages the researcher to write and think about the data and to consider different interpretations and views. I used this opportunity to reflect on the organised data, clarify their meaning, and build on the understanding of the interviewee's position and experiences. The audio recording allowed me to re-listen to the underlying meanings rather than taking the face value of the conversation. Ideally, the process of revisiting data would eliminate much of the preconception within the interviewer's view and, hopefully, lead to a critical understanding of the data.

c) Exploration

Data Exploration assists the formation of robust themes or categories, creating subsets to aid data organisation and analysis. I explored new themes and re-assess previous concepts as data came in. For example when an interviewee described a new phenomena, I would return to previous data to check whether such phenomenon existed in some other form. Since some of the themes were driven by my initial interview questions, I would pose different research themes or use a new theme from the interviewee to test the data. Varying the criteria and assumptions also helped me to interrogate data differently to check for new relationships.

d) Integration

In this phase the researcher can bring in references or findings from different sources or from other researchers to further examine the data. Since this research was not focused on the results from the analysis of the interview data, I only tried to make sense of the data together with my previous experiences in animation and in industry. With careful interpretation and reflection, a pattern formed by the data pointed to a direction for my "Practice as Research" and a focus for further investigation.

The following Figure 7 shows a simple structure of how qualitative data were explored in this research. The comments in red between the stages, hopefully summarizes the concepts I described in the four stages of analysing interview data.

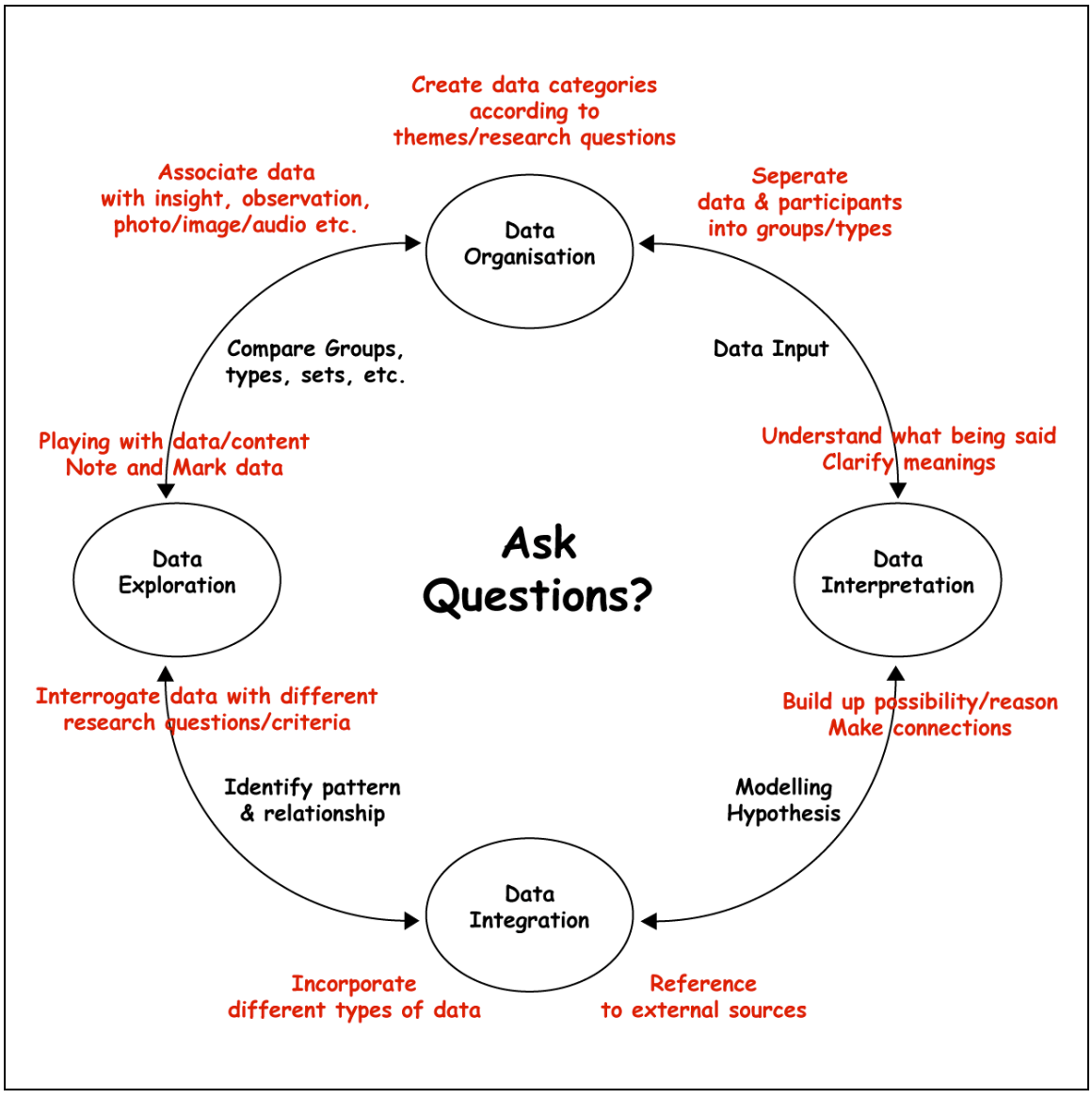

Figure 7. Showing the overall scheme for handling the interview data

Data organisation and analysis should be directed by the interview data, by that I mean, there should be no preconceptions about the type or number of categories, how to organise them, or their relationships. Only by sorting the transcripts, interpreting the data and exploring, should themes emerge and expand. Formed categories were grouped and ungrouped, divided further into sub-sets and isolated in this dynamic process as the interview data accumulated.

To a certain extent, the interview questions (see Appendix 6) had targeted certain themes, for example, animation techniques and character animation. However, as I started organising the interview data, those initial categories driven by the interview questions, changed and developed dramatically. Therefore, it was presumed that any initial influences on the interview direction or themes would diminish as the data set increased. To further reduce the influence, I introduced a constant evaluation process while the data were organised. For example, after a few interviews had been analysed or a new category emerged, I would re-examine the older data in the light of other participants' experiences or the new category. When the new category created an impact, for example, animator's qualities revealed in this research, the organised data were adjusted and new interpretations were explored. This emerging categorisation and re-examination of data encouraged critical reflection and organic analysis that it was found to be valuable for dealing with subjective topics such as personal animation practice in this case.

Qualitative data from the interviews led to descriptive coding[21] in this research and any analysis or conclusion is therefore, not absolute. For example, from the mock interviews, all four animators said that they prioritized facial expression in dealing with character's emotion and they did *not* emphasise other criteria (see Section 3.3.4.6). In this case, it does not mean that facial expression is the prime focus to deal with emotion. The absence of evidence for other methods does not imply that other methods are not used. Another example was a new theme - Reflection emerged within animation practices (see Section 3.3.4.1). Although only one of the four participants mentioned its importance, it does not mean that "Reflection" has less weight than other methods. There are many layers surrounding even the simplest datum and in general, definitive statements cannot be made with confidence.

In analysing the interviews, I had to use both "clinical" and "impressionistic" approaches. Clinical analysis allows data to be looked at without the worry of drawing *inappropriate* conclusions. It detaches the researcher's personal involvement and focuses on the absolute information returned from the interviews. In some cases, the researcher can also present the pattern using the quantitative component in the data, for example, counting the number of individuals who promoted certain choices of technique over the others in this case. Impressionistic analysis encourages the

[21] Coding means sorting data into themes or categories; often used in qualitative methods and also CAQDAS software

researcher to listen to the deeper meanings in the interviews and allows personal impressions and reflections about the interview and the participant to be included as data. For example, a participant kept on repeating the importance of acting as a technique for animation but in the actual description of how to animate a character, I found no evidence that acting was applied. In this case, impressionistic analysis would yield a very different pattern than using clinical analysis on the same topic.

I found that sometimes, it was impossible to justify whether a clinical or impressionistic approach was suitable for a particular analysis. I noticed that as my experience in interviewing animators increased, I developed a sense of telling how engaged they were with certain topics in their previous experiences, either from their language or tone of voice they used or even their body language. Re-listening to the audio records also allowed me to reflect deeply and sense the reluctance in their tone of voice and inconsistency in their words. Although it may seem unfair and subjective, I feel that I can model the reality better this way and perhaps give other participants a fairer voice on the topics they have mastered in or developed a deeper understanding.

3.3.4 Interview results and analysis

Seventeen interviews were conducted in a span of six months. Fourteen participants were animators and three participants were non-animators who had a good understanding of animation and currently worked closely with animators. Audio records were obtained apart from two of those interviews. Face to face interviews not only took time to organise but also were difficult to locate suitable and willing candidates, in comparison to online interviews or email correspondences, for example. The idea of having a well-balanced group of participants to represent the population of animators in film industry, game development, traditional animation and academia, also put some restrictions on the selection. Figure 8 presents the distribution of the participants, in terms of their experiences and their current working areas.

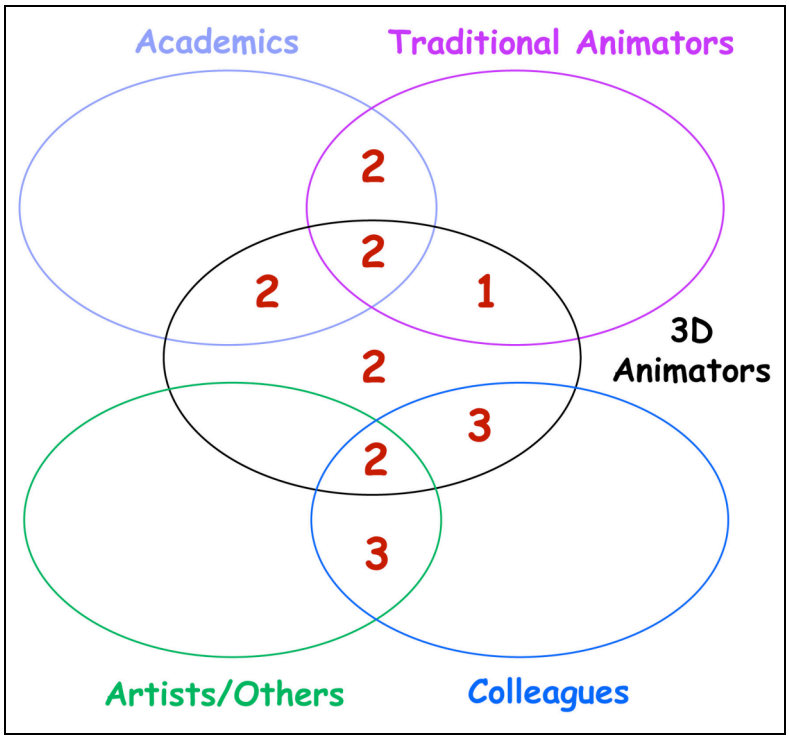

Figure 8. The distribution of the participants in the research interview

Note that some of the interviews were performed in parallel to the case studies and animation experiments. There was a certain dynamic between those methods - findings from one method could influence the input to another, a difficult situation to cater for. It is fair for me to say that my case studies on narrative and game projects interested me to find out whether other animators had found differences between practices in different fields. The lack of critical studies in computer animation texts, the frequent discussions about applying traditional animation techniques to computer animation, directed me to ask animators certain questions in the interviews. This also led to animation experiments being designed following some data returned from the participants on how they used traditional methods. New directions found during the interviews, for example, the

theme on animator's qualities and the use of reflection, led to new case studies on previously known animators and events in the industry. With animation experiments on-going and questions about the practice evolving, I used interviews to explore new issues with animators. I could imitate their practice and learn from their qualities, reflect upon my own work and design new experiments for the research.

Figure 9 presents the final themes of the interviews and the emerged pattern. The themes were organised in CAQDAS and its outlook can be found in Appendix 8.

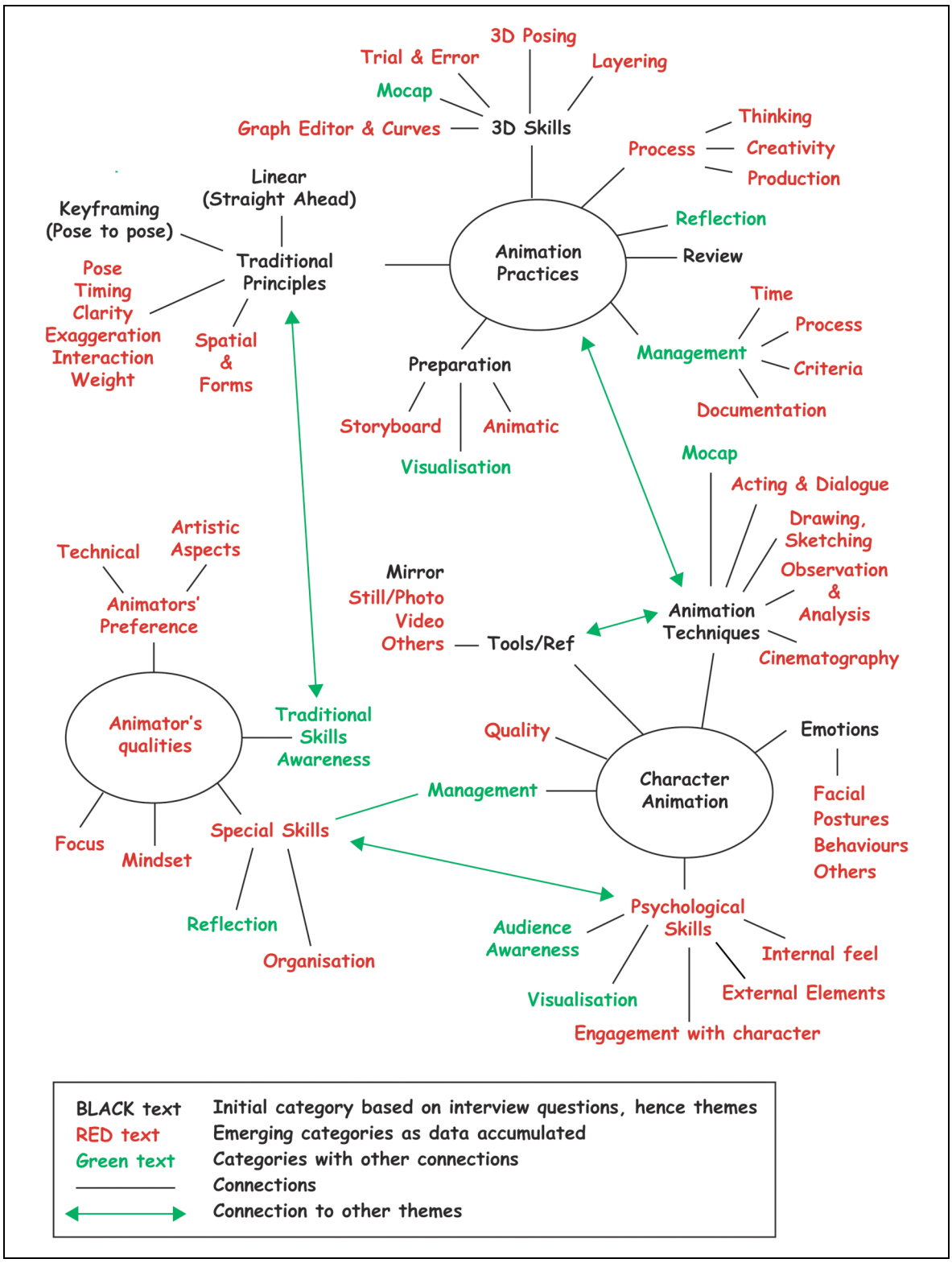

Figure 9. A conceptual map of the themes that emerged from the interviews

The semi-structured questions of the interview addressed animation practices and character animation, and thus led to the formation of those two main themes in the figure. Other categories emerged around the main themes as the interview data accumulated, leading to the emergence of "Animator's Qualities" as some animators mentioned concepts that were outside the original themes.

The dense and detailed pattern of ideas around 'Animation practices', as seen in Figure 9, suggests that many participants were familiar with traditional animation principles, in that they could describe many of the techniques used for production, such as drawing and acting; weight analysis and exaggeration. In contrast, techniques related to 3D computer practices were poorly reported and those mentioned tended to be software-oriented, for example, graph editor, Mocap or trial-and-error. It appears that when participants described 3D practices, they would not automatically think of animation as a general concept, but rather would identify the practice with the technology. This invisible barrier and perceived differences between traditional animation practice and 3D practice may be the reason why the integration of knowledge posed some difficulties and some animators seemed to find difficulties to move between fields. However, when the conversations continued, many suggested that traditional principles applied to their computer work or were used as a *way of thinking* (see Section 3.3.4.4). The pattern also shows that some aspects in 'Animation practices' were not as well developed as the principles and techniques. For example, participants failed to provide further details on reflection (see Section 3.3.4.1) and review (see Section 3.3.4.2), leading to Figure 9 showing no sub-categories under these two themes.

It was noted that many of the mentioned practices were considered as studio requirements and production process rather than personal choices or *best* practices for an animator. The majority of participants had suggested that, provided the visual outcomes looked *good* and the directors or clients were satisfied, the work was considered *done* (see Section 3.3.4.2 and 3.3.4.3). In general, participants reported that there were plenty of problems in how studios were structured and some of the working procedures either acted against their creativity or were not as productive as they would like (see Section 3.3.4.3 and 3.3.4.7).

Figure 9 also shows extensive understanding of 'Character animation' and the techniques required to produce believable characters from the participants. The pattern visible around this theme showed that management skills and how they assessed the quality of character animation, lagged behind their production knowledge (see Section 3.3.4.4 and 3.3.4.5). This phenomenon is echoed in Table 3 (see Section 3.3.4.1), in that an animator's qualities, including knowledge and technical skill, would increase over the years but their management skills appeared to grow much slower.

Character animation was used heavily in game development and some participants frequently reported limitations in the field and on character animation due to technical elements (see Section 3.3.4.7). However, apart from testing animations in the game as was mentioned, the participants failed to describe details of the problems and how they judged and resolved the issues. It again showed that their management and ability to clarify and analyse problems lagged behind their production skills. The detailed techniques used in character animation are not discussed in this

thesis apart from those that relate to the research experiments (see Section 3.3.4.4 and 3.3.4.5 and 3.3.4.6), for example, pose-to-pose and straight-ahead techniques; acting and drawing; and personality and emotion.

A new emergent theme in Figure 9 - Animator's Qualities, recorded the participants' emphasis, their passions and preferences, special skills and mindsets. Although the results showed that not many of them studied and reflected on themselves or their works (see Section 3.3.4.1), some of their insights were still valuable. Since my research is not about the study of animators, I only present some extracts from the interviews (see Appendix 9) to demonstrate that the interview method can indeed obtain unique qualities of an individual and assist the understanding of their talents.

Note: in the extracts, participants are represented by code- XX-?>N where

XX= CA-computer animator, GA-game animator
TA-traditional animator, MA-both traditional and computer animator

? = a sequential number assigned to the participants; 1 = first, 2 = second etc.

>N= bigger than Number of year in the industry (>5, >10, >15 etc.)

3.3.4.1 Report on Reflection

Table 1 shows an example of the collected information on the use of reflection from the participants in the interview. Clinically, a small fraction of the participants mentioned the use of reflection or they appeared to reflect in their practice. A few participants reported that they did not manage to reflect. It appears that there is no direct correlation between the experiences of the animator, their field of animation or training and their use of reflection, according to the data. Probably, the use of reflection is a personal choice and individual mindset.

		Area of expertise of the Participants		
Degree of reported reflection	Frequency	Traditional animation	Game animation	Computer Film animation
Did not do reflection	2	0	0	2
Claimed using reflection	3	1	1	1
Reflection - shown from action	2	0	1	1
Reflection - not shown from action	3	2	0	1
Reflection (mentioned)	6	1	1	4

Table 1. The use of reflection vs participants' experience

Although less than half of the participants mentioned reflection in their practices, it could be possible that others might be using reflection unconsciously. However, when re-examining their self-reported workflows, I noticed that reflection was not a natural or frequent occurrence for many of them. This led to a conclusion that perhaps, even smaller fraction of those participants consciously performed reflection (see Appendix 10). Those participants whom I considered were using reflection, actually revealed the activity in their workflow rather than directly pointing to it.

To refine the exploration, I gathered participants' comments on what and how they analyse their practices. The data in Table 2, seems to show that animators found it easier to comment about other animators and/or their techniques and production methods. Many participants experienced difficulties and reported failure in analyzing some aspects of their work or practice. It was noted that the analysis of oneself (self-reflection) seemed to be much harder as only one of them described the activity related to self-reflection and the frustration.

		Position of the Participants	
Type of analysis	Frequency	Computer animator	Traditional animator or tutor
No analysis or reported failing	5	3	2
Analysis of others	7	5	2
Analysis of self	1	1	0
Analysis of practices	6	5	1

Table 2. What do animators analyse?

Another sampling shown in Table 3 explores the correlation between different aspects in the animation practice with the years of experience in animation.

		Years of Experience of the Participants		
Type of reflection	Frequency	>5 years in animation	>10 years in animation	>15 years in animation
Reflection shown	2	1	1	0
Review – did & good	1	1	0	0
Process	3	1	2	0
Criteria	4	1	3	0
Documentation	2	1	0	1
Time	2	1	1	0
Management	1	1	0	0
Artistic aspects	8	2	4	2
Technical	7	3	2	2
Special skills	9	4	4	1
Mindset	8	3	4	1

Table 3. Qualities acquired by animators as years of experience increases

Data show that the length of experience seems to allow animators to improve on their animation-related skills, artistic aspects and mindset improvement. In fact, it is nothing special for someone acquiring wisdom as experiences accumulated. However, reported management skills seem to improve at a much slower rate than animation skills. The data appear to show that skilful use of reflection and review do not improve with the years of experience. It may be possible that animators failed to describe such activities. Perhaps, when a production was considered successful, reflection and review were not seen to be important. On the other hand, these practices may not be suited for their work and the industry or were not found to be productive. Without asking for more detailed reports, we cannot identify the *real* cause at the moment.

3.3.4.2 Report on Review

The degree with which the review process was understood showed similarity with the discussion on reflection, in that, most of the participants would report something about reviewing but failed to describe reviews in detail.

		Area of expertise of the Participants		
Aspects of reviews	Frequency	Traditional animation	Game animation	Computer Film animation
Did & good	1	0	0	1
Mentioned only	3	1	0	2
Not at all	3	0	1	2
Useless	3	1	0	2
Review	8	2	1	5

Table 4. The use of peer review vs participants' experience

The data in Table 4 indicate that about half of the participants had some experience in reviewing during their career. As there were interview questions focused on the topic, I presumed that those who did not elaborate on review in detail, implied that they did not perform it in their work or that they did not know enough about it to comment. The collected information from many participants showed that while reviews were definitely performed in the industry, they seldom initiated the process to obtain feedback personally. However, there was strong evidence that 'almost none' of the studios or individuals had reviewed the review process itself. I presume that this may be one of the reasons leading to the difficulties and deficiencies in review as reported by some of the participants (see Appendix 11).

Even when the review process was mentioned, it was unclear about who was in the review and whether the animators would be present. Some reports suggested that animators were outside the loop and that only the lead person or the director would review their works. There was no mention of how a review was performed but some evidence implied that it merely consisted of people

looking at the animations. Some reports also suggested that people were keen to dismiss reviews for many reasons: individuals could be defensive towards the notion of review, disliked others looking at their work, did not want to waste time on a review, if the work satisfied the client/director then the review was considered complete; etc. There was no indication that the studio or the director would review other aspects of the animator's work apart from the visual outcomes. The process of review then simply becomes unidirectional and focuses on one outcome – a 'tick' to continue the production. Review would then seem to be built around the purpose of approval and involve minimal interruption to the production to the extent that sometimes it would disregard the existence of the animator and their views. The accumulated information from the interviews does not create a positive or critical image about the review process and clearly summed up the reason why some animators may not enjoy the process and may regard reviews as unproductive uses of their time (see Appendix 11).

The lack of critique experiences may explain why the data showed that some animators did not seem to improve their skills of reflection and review as their years of experience increased (see Table 3), in contrast to their other skills. It seems that the industry and some of the studios focus only on the product and neglect staff development and their enjoyment at work. In such a situation an animation director or lead animator may fail to monitor standards of review for the benefit of both the project and their staffs.

3.3.4.3 Report on Studio practices

The findings on the loose review processes due to either individual or organization failings, led me to explore the general studio practices among the participants' reports.

		Area of expertise of the Participants		
Aspects of practice	Frequency	Traditional animation	Game animation	Computer Film animation
Poor Communication	7	1	1	5
Divided practice	5	1	1	3
Restricted practice	7	2	2	3
Review – not at all	3	0	1	2
Review - useless	3	1	0	2
Studio practice – not organised	4	1	1	2
Studio practice - organised	3	1	1	1

Table 5. Explore Studio Practices

Table 5 shows that less than a quarter of the participants considered their studios 'organised'. Over half of the participants reported poor communication, divided and restrictive practices, and disorganisation within the companies, leading to difficulties in performing their work, lowered quality of work, and diminished personal enjoyment. However, in some of the reports, it was noted that animators and their colleagues contributed to some of those problems in the studios. This may be better explored through participants' reports rather than the generalizations expressed in this table (see Appendix 12).

From those conversations, it does appear that institutionalised studio practice and 'unclear to none' studio practice caused dissatisfaction among animators in the trade. However, it also reveals that some of those problems are directly related to animators themselves or the people whom they worked with rather than the studio practices. For example, influences might include people's communication skills, their willingness to move outside their area of expertise, their involvement and care for others' work and their attitude to change for the better, and so on. Reports gave me an impression that computer animation, or *rather* the use of computers, seemed to encourage isolation. Studio practices were shown to be compartmentalized and either restrictive or poorly controlled, and gave little room for expansion or critical assessment. The intense animation work and the tight production schedule also caused animators to ignore many aspects of the work and development. In turn, they failed to contribute to the general good for other team members and the studio. It was noted that, in general, animators focused on the final animation or product and when studios did not have diversified practices or did not encourage animators to see differently, it was hard to imagine how improvement could come about. The concept of self-advancement was almost entirely missing from the accumulated information, compared to the development of technical skills, for example. Appendix 13 shows the *only* concerns on self-development from two participants, which is rather limited and not encouraging.

There was a notable lack of reported critical thinking and mindfulness among the participants and a lack of standards for practices and critical processes used. Studios and their management were also implicated as being responsible for these situations. This summary leads to my recommendation that these areas need to be investigated further not only for the sake of animator's development but also for the improvement of studios' standards and the working environment.

3.3.4.4 Report on Animation practices and techniques used

Although the study of animation practice and techniques is not the main focus of my research, exploration of these areas can lead to an understanding of different practices and one's preconceptions. Table 6 shows the high-level processes that participants reportedly used in animation production. The first two entries – reflection and review are displayed for comparison. Animation process and preparation are the main production process and the rest of the entries are management-related.

		Area of expertise of the Participants		
High-level processes in animation practices	Frequency	Traditional animation	Game animation	Computer Film animation
Shown reflection	2	0	1	1
Peer-review	1	0	0	1
Animation process	9	2	2	5
Preparation	10	3	2	5
Working Process	3	1	1	1
Criteria	4	1	1	2
Documentation	2	1	1	0
Time management	2	0	1	1

Table 6. Diversity in practices with different experience

Table 6 shows that the majority of the participants were skilled in the production process but were less concerned about general management issues. Although the selection of participants for the interview formed a relatively well-balance population (see Figure 8), I do not feel that it would be meaningful to draw conclusions about animation practices in general. However, if more data were to be gathered in future, it would be interesting to see whether there is any correlation between reported practice and the field of animation. For the benefit of the research experiments, I decided to use the data to explore different animation techniques within a given practice, especially between traditional and 3D approaches (see Table 7).

		Area of expertise of the Participants		
Techniques	Frequency	Traditional animation	Game animation	Computer Film animation
3D	9	3	2	4
Layering animation	6	2	2	2
Graphs and curves	3	0	2	1
Trial and error	8	2	2	4
3D posing	2	0	1	1
Mocap	6	0	2	4
Traditional	1	0	1	0

Exaggeration	5	2	0	3
Timing	9	3	2	4
Keyframing – pose-to-pose	9	2	2	5
Linear – straight ahead	6	1	1	4
Spatial and form	4	1	2	1
Pose	5	1	2	2
Interaction	2	1	0	1
Weight	3	1	1	1
Clarity	3	1	1	1

Table 7. What techniques do animators use?

It was noted in Figure 9 and Table 7 that specific techniques for 3D computer animation were not described in the traditional animation principles. However, the data revealed that the use of traditional techniques and new 3D techniques seemed to share a balance among computer animators. In contrast to some animation texts that claimed traditional techniques over 3D computer techniques to improve the quality of animation, or computer animation would slowly move away from using traditional techniques. However, some participants in the interviews showed mixed and inconsistent views (see Appendix 14) on the topic. For example, the uses of Pose-to-pose and Straight-ahead techniques were not clearly described; this led me to design an animation experiment to clarify this point *(see Menu: Pilot->Anim1-3 - reflection)* and explore my own 3D practice for comparison (see Chapter 4.1).

3.3.4.5 Report on techniques used for character animation

It was noted that most of the discussed techniques in the interviews revolved around character animation. Table 8 displays a few commonly reported tools that assist character animation.

		Area of expertise of the Participants		
Tools and techniques	Frequency	Traditional animation	Game animation	Computer Film animation
Animatic	5	0	1	4
Acting – in animation	3	1	1	1
Acting – mentioned	4	1	0	3
Acting – not done	5	2	0	3
Acting	9	3	1	5
Did drawing	3	2	1	0
Mentioned drawing	5	2	0	3
Not practicing drawing	4	0	1	3
Drawing	9	3	2	4
Studying and observation	3	0	2	1

Table 8. Explore some techniques specific to character animation

From the data in Table 8, it may infer that computer animation is changing the usage of traditional techniques. It is notable that more than half of the participants did not mention the use of Animatic in their practice at all; which used to be one of the important techniques to test and assess both moving images and the storyline. The principal research would examine this issue with the aid of animation experiments (see Section 5.3.3).

Also, few of the participants reported the use of acting as a tool. Some of those who claimed benefit of that method, turned out to have a vague appreciation of it in their personal reported practice. Some participants openly stated their discomfort in acting before people or a camera. Others disclosed that animators were shy and in one situation, the term "wounded actor" was used to describe an animator and it was given as a reason why they animated instead of performing. Some of the conversations (see Appendix 15) revealed that some animators would go through a thinking process resembling that of an actor in that they would study the character, metaphorically putting themselves into their character's shoes. However, physical acting seemed to be poorly appreciated and little-used among animators.

Apart from acting, drawing and sketching as tools for animators also suffered some changes in its application to computer animation as revealed by some of the participants (see Appendix 16). The majority of the participants mentioned that drawing helped to improve animator's skills (see Table 8) but it was noted that drawing and sketching seemed to have less presence when they described their own animation practices using computers. Only a few participants gave me the impression that they still draw to a certain extent. Some others mentioned that drawing was no longer crucial for animators and could be replaced by other methods. It seemed that the highly praised skill of traditional animation was mentioned because of its legacy and not because of its practicality in computer animation. Participants were not fully aware of their own practice and thought that they were indeed using the tools (acting or drawing) described in animation texts. Re-examining interview conversations, I also found other inconsistencies in other topics, not *just* specific to traditional techniques. An example in Appendix 17 showed that an individual might not be aware about his/her own practice.

Drawing or sketching were once vital techniques for traditional 2D animation but were found to be not fully applicable or economical for computer animation. This argument seemed to support by those participants who did not speak much of drawing were mostly computer animators and those who used drawing intensively were trained traditionally. I can proposed other possible reasons; for example, 3D animators may be too lazy to draw/act, perhaps they do not have time in the industry, maybe they undervalue the importance of traditional techniques, or even, drawing and acting for 3D animation does not yield as much benefit as it does for 2D hand-drawn animation. Drawing

may still provide training for animators but *perhaps* those who use this tool to aid their computer animation would be those who are fond of drawing. It is a personal choice rather than a 'must'. If there is other ways to improve an animator's skills without using drawing and acting, I would like to see those approaches being used and assessed by animators with critical eyes to provide more choices for the future generation. With this remark, it is worth noting that a few participants suggested observation and in-depth study for animators (see Appendix 18). In the principal research, we would examine these topics with the aid of animation experiments (see Chapter 4.2).

3.3.4.6 Report on personality and emotions

Personality and emotions have always been the major focus for bringing characters to life in animation. I briefly present the basic discussion here because one of the principal experiments explored the topic (see Chapter 4.4) as the secondary research aim. Many of the participants explained facial expression and postures, and how computer animation allowed more details and better lip-syncing (see Appendix 19). Less commonly discussed aspects such as behaviour but in my opinion are equally important, were only briefly mentioned by two participants (see Table 9). Character traits and how they interacted with others and the world, can be more subtle ways to convey emotions but according to the interviews, those issues were not studied extensively by the participants. This may be because many animation texts tend to describe facial expression and postures, and in animator's training, observation and human watching are rarely taught or encouraged to be a habit.

		Area of expertise of the Participants		
Character emotion by	Frequency	Traditional animation	Game animation	Computer Film animation
Posture	6	0	4	2
Facial	7	2	4	1
Behaviour	2	1	0	1
Others	1	0	1	0

Table 9. Emotions in animation

3.3.4.7 Report on Computer and Game specific problems

My reason for collecting information on computer and game problems for this research was to expand my awareness of aspects that other animators might find challenging in 3D animation and game projects, and compared with the case studies. The principal research also used narrative and game applications to create a research space to perform "Practice as Research"; therefore, experiences from different animators could allow different knowledge and modified practices to be articulated.

Since this research is not a qualitative research on the problems of computer animation and data varied from one participant to another, I decided to present some of the relevant comments from different participants as raw data only (see Appendix 20) and would not attempt to draw any conclusion in the thesis. The information would be used for discussion and analysis during or together with the results of the principal experiments.

3.3.4.8 Summary

As anticipated, the interview method readily allows researchers to tap into animator-practitioners' deeper psyche, their previous experiences and practices, and their values and individual qualities. The method provides information that one does not normally obtain from animation texts or even from working closely with an animator.

The reported experiences were varied and sometimes were found to be contradictory; making it difficult to analyse and draw any absolute conclusions. In an interview, it was found that both parties could latch onto fashionable topics or new ideas without deeper investigation. Therefore, it is important to prepare for interview thoughtfully and perform mock interviews to evaluate the topics and the direction prior to data collection. The interviewer should have the mindset of opening up the participant as the priority and should not focus on obtaining data for the research alone. It was noted from my seventeen interviews that if the participants were comfortable to talk about themselves, the data would come in with little prompting from the interviewer. It is important to understand the drawback of self-reporting and the nature of recalling previous experiences; hence it is the responsibility of the interviewer to ensure that questions or discussions are formed from different perspectives and to obtain a clearer picture of the described experience. Though the variety of information is difficult to organise, it was noted that the qualitative information was valuable for others to examine. With further investigation or exploration of the gathered data, patterns can be identified to make preliminary hypotheses.

Interviews can create a non-invasive space for animator-practitioners to discuss sensitive topics. It was noted that during the session, some participants would begin to self-reflect and sometimes, even question the interviewer to obtain support. I noticed that if the participant began or wanted to take control of the interview, it would be more fruitful to turn the interview into a discussion to allow maximum exchange of information. Appendix 7 shows some participants' comments about the interviews. Because I am a practitioner myself, I found that I also prefer a discussion-style rather than a question-answer style of interview. Discussion led to unexpected knowledge and understanding, and the whole interview process was found to be more enjoyable and valuable for both parties. It was noted that in some interviews, the participants were so involved that they

started moving outside my intended scope of the interview. I definitely feel that interviews can improve diversity in thinking, empower animators and assist them to expand knowledge. I feel that some of those who had participated in my research interview would return to their work with a different approach and mindset, knowing more about themselves and how their views can be different.

Apart from obtaining various information, as the interviewer I found unexpected results from those interviews. Without noticing, I also started reflecting during my discussions with different animators. I learned how to lead the participants to talk about themselves and to clarify the implicit area of their knowledge. In turn I became more aware of how I could review my own actions and clarified some of the questions about reflection and review processes for animation production. I would recommend that animators and students conduct interviews as a form of training to assist their practices. I envisage that the activity can:

1. Bring out their personality and confidence
2. Train them to be open about their practice, work and thinking
3. Help them to articulate their knowledge not only in production with clarity but also with clear explicit dialogues
4. Assist them in their own self- reflection process
5. Prepare them for a mentoring role to assist their peers and improve the quality of critical review

The quality of interview method depends greatly on the experience of the interviewer. If he or she happens to be a practitioner in the same trade as the participants, then it also depends on how flexible the interviewer can engage with the participants' position without imposing own experiences. Willingness to talk about one's experiences and deeper feelings, and sufficient communication skills are also important factors in raising the quality of an interview. Revealing one's deeper thoughts can be uncomfortable; hence I recommend any interviewer to practice basic mentoring skills. It was noted that since I am familiar with both traditional terms in animation and computer animation software packages, the language used in interviews was adequate for clear communication. Since this research is not a qualitative research on computer animation using interview method, the results and analysis satisfied the aims to fill the missing knowledge of the current animation texts, identify the gap in knowledge and practices, and draw a few hypotheses to allow the development of the principal research.

3.3.5 Pilot Study Conclusion

The pilot study performed a trial run of the "Practice as Research" model for computer animation and evaluated those research methods used in the process.

The investigation demonstrated the strength of the proposed methodology outlined in Figure 1 and Figure 3 conducting research in computer animation. Case studies on animation projects and previous experiences not only proved to be valuable for understanding personal practices but also provided formal records for reflection and for other practitioners to examine and improve. Animation experiments were demonstrated to be an immediate and dynamic research platform for investigating research practices or other animation questions. Making animation allows the researcher to conduct reflection-in-action during a production cycle; and on completion, the results – documentations and visual outcomes are available for further reflection and can be reviewed by other researchers. The interview method demonstrated potential in obtaining animators' experiences and missing information in animation texts. Valuable data such as an individual's qualities, preconceptions, and gaps in their knowledge can be studied and clarified - information which may not be easily revealed by other methods.

The refined "Practice as Research" model would be examined in the principal research under a game and a narrative application. Problems identified in the pilot study would be investigated, for example, difficulties in reflection during a creative process and a critical review process. The principal research used some of the hypotheses drawn from the research interviews and new insights from the case studies and experiments, to pose criteria and examine animation practice and related questions in computer animation. The principal research also continued to build on the artistic and stylistic understanding of animated characters.

Apart from the examination of "Practice as Research", I anticipate that the principal applications can aid personal development in different animation fields. The investigation into an animator's mindset will be one of the most interesting aspects since I speculate that those insights can withstand the changes underway in the computer animation industry. I will describe the principal research and its three experiments in the following chapters.

4 The Principal Research

The principal research applied the "Practice as Research" model refined by the pilot study (see Figure 1 and 3) to two different applications – an industrial game development project and an experimental narrative animation. Both applications produced character animations that allowed the animator-practitioner-researcher to study within the research space. Reflection and review processes, in particular were the target studies since they were found to be problematic in the pilot study and were revealed to be unclear or least appreciated in the research interviews (see Section 3.3.4).

In the pilot study, reflection was found to be difficult to perform during a creative practice. The review process described by animators in the interviews and also used by myself in the industry, failed to provide fruitful discussions and critical examination when applied in the pilot study and for animation research. Therefore, this principal research aimed to study the problems of reflection and to investigate difficulties in the review process.

From the research interviews and case studies, it was found that an animator's personal qualities shaped their practices and perspectives. Therefore, during the principal experiments, I felt that it was necessary to be mindful and aware the psyche changes. In doing so, I tried to challenge the preconceptions and decisions made during productions and adopt an attitude to critical thinking. Note that the actual interview period overlapped with the principal research and the gathered data had caused dynamic influences to the experiments. Interviewing ex-colleagues also provided information to assess my preconceptions and aid reflections in the principal research.

An overview of the proposed principal research experiments is shown in Figure 10. The arrows show the anticipated flow of data – based on the proposed model of "Practice as Research" and the aims of the principal research.

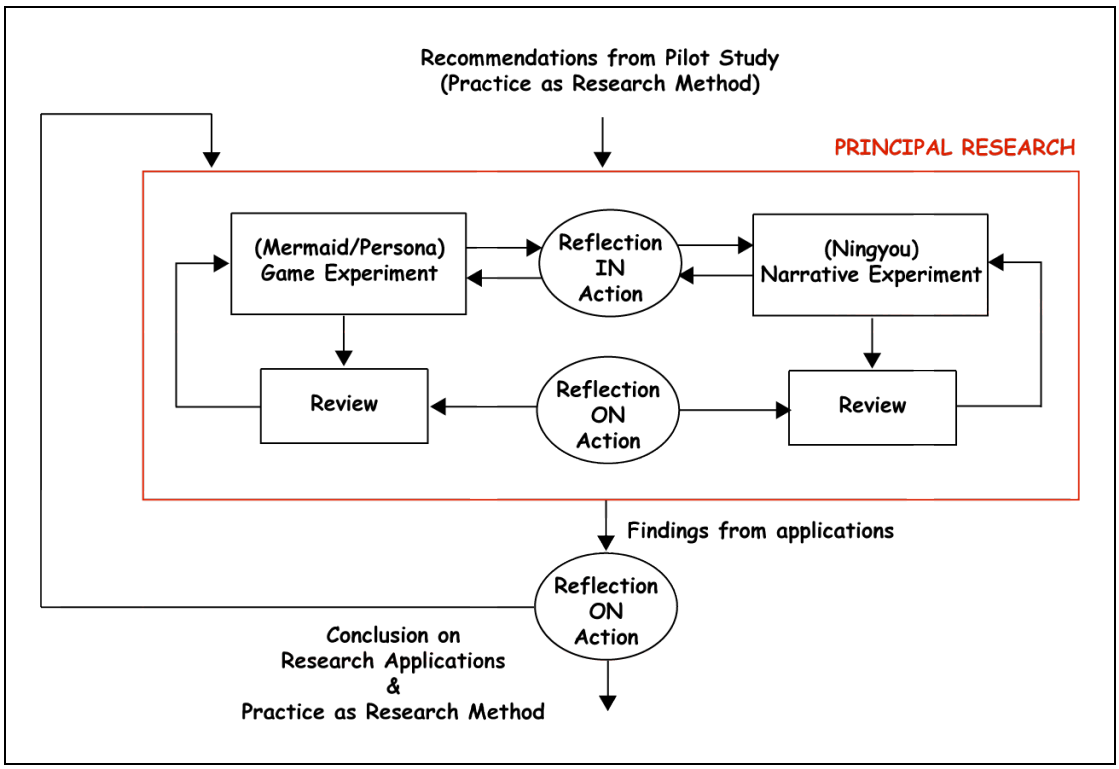

Figure 10. An overview of the proposed model for the principal research

In the game application, two experiments named Mermaid and Persona were made. During the course of these experiments, mindful practice and critical thinking were deployed, and on completion, reflection and peer-review were carried out on the research methods and their qualities as well as the functionality and aesthetics of the character animations.

The narrative application consisted of one experiment named Ningyou. In contrast to the game application, it was an experimental project that had neither a set goal nor industrial constraints. The experiment also provided a storytelling element which the game applications lack and in which different experiences could be gained.

The "Practice as Research" model was applied to these experiments and assisted personal development. The aim was to further investigate the qualities of this model as an animation research tool. On completion of the experiments, the model and its process were evaluated. Other research questions could also be pursued such as the difference between animation practices in different applications or the ways in which an animator might handle character animations in different situations.

4.1 Game and Industrial Application

Overview

- This chapter describes the principal game application.
- It presents findings on pre-animation and production processes used in character animation.
- It describes reflection tools and techniques that can encourage a critical approach to computer animation.
- It presents reflection and review processes and aims to resolve the difficulties found in the pilot study.
- It explores the need for a visual demonstration for practice research – Hypertext* presentation and its potential use in a review process.
- It hypothesizes the need of tightly structured reflection and review processes in the "Practice as Research" model

This experiment is a commercial game development project. It used an interactive character - Mermaid (see Figure 11) to demonstrate the production process in game development. During this experiment, the application of "Practice as Research" to an industrial project with a clearly defined goal was examined. Figure 12 illustrates the whole process of the game experiment.

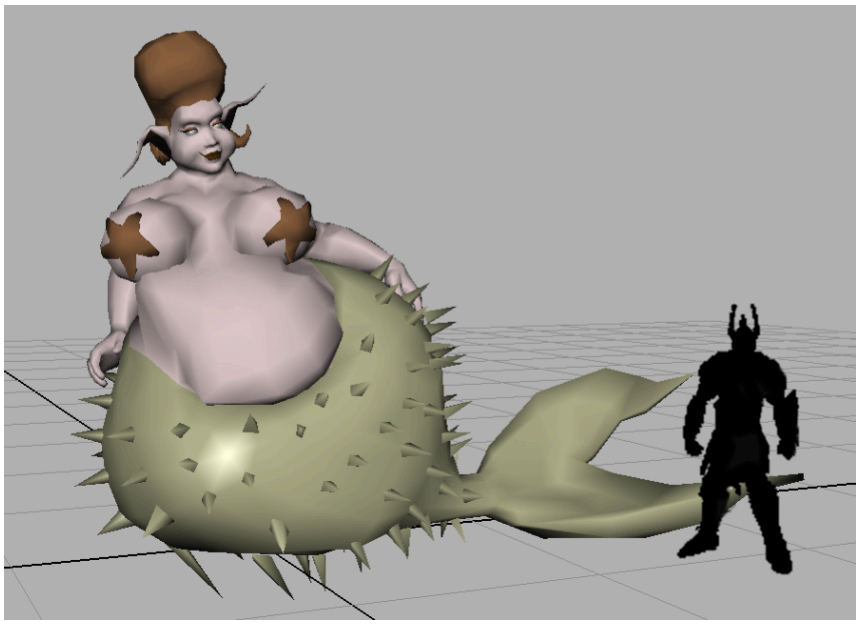

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Figure 11. The interactive Mermaid character for this game experiment

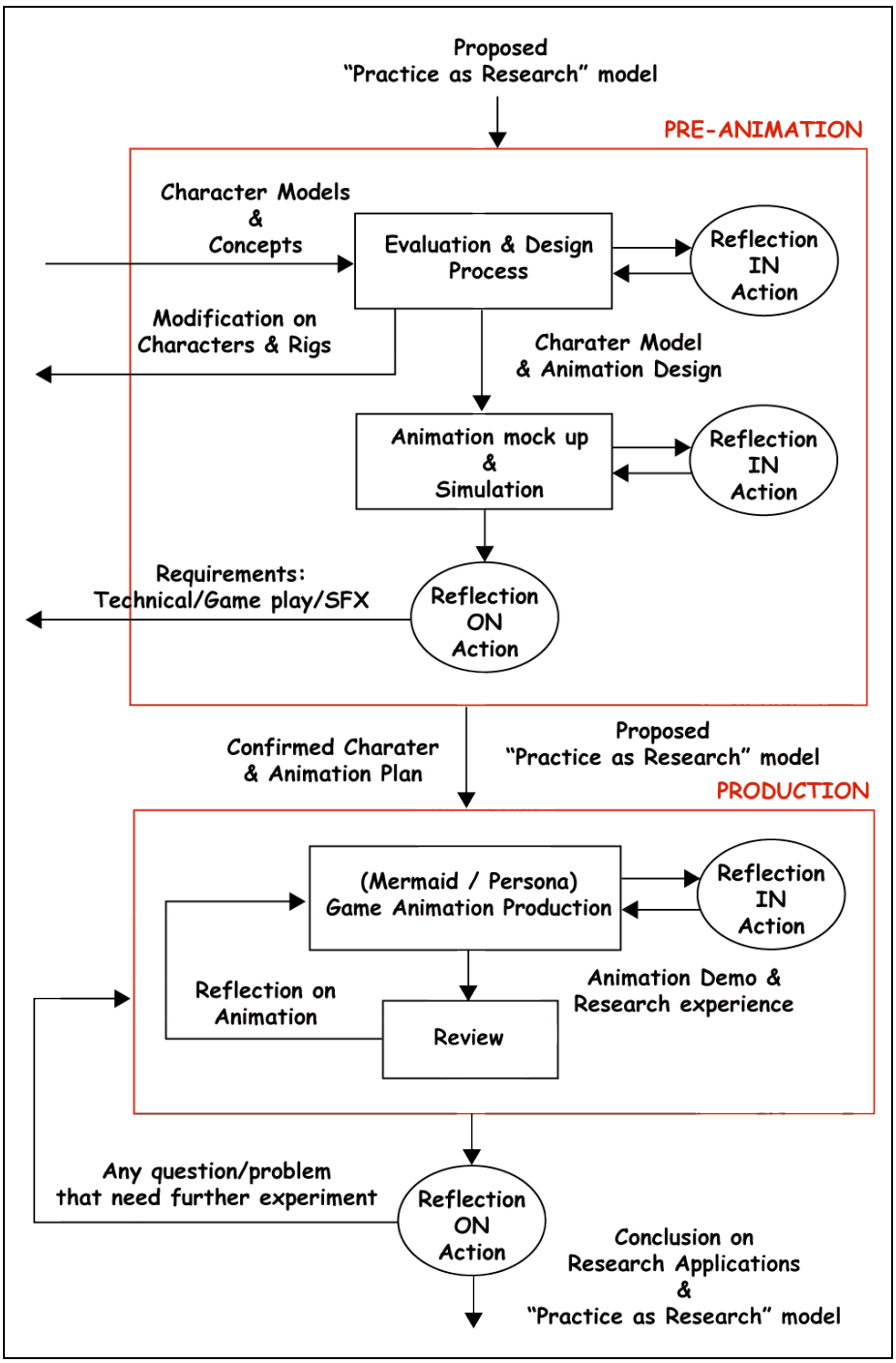

Figure 12. The proposed structure for the game experiment

Since the basic character concept and the game design were provided as starting material for this experiment, the production began with evaluation and animation design. Specific details of individual processes will be discussed in later sections.

Although some of the limitations and constraints of a game project were documented in the case studies *(see Hypertext Menu: Practice)*, this experiment used in-practice examination during the production period to validate the information. Additionally, close monitoring of practical knowledge and cognitive processes were exercised in this application, and my previous experiences from industry were challenged and refined using the "Practice as Research" model. To

demonstrate critical analysis, reflection and review processes were employed during and after the experiment. Hypertext* presentation (described in both Sections 3.3.2.2 and 4.3.4.3) held records of the production and research processes *(see Menu: Mermaid)* along with a series of visual animations and practical reflections *(see Menu: Mermaid->Anim - reflection)*. This allowed a non-linear exploration of the experiment and was open for other researchers to examine.

This experiment not only used specific goals from game development to initiate the project but also was designed to challenge some of the findings from the case studies and interviews (see Section 3.3.4). For example, it was noted in the case studies that both personal preferences and flexibility could limit an animator's practice and the quality of the animation. From interviews, it was revealed that game animation was often loosely controlled. Animators would, for example, mention that they were unable to attain given standards and provide high quality work. It was also apparent that some animators failed to challenge themselves and make progress forward at a pace that satisfied themselves, leading to lower creativity and a reluctance to apply their skills differently. Therefore, during this experiment, a secondary research focus was to monitor personal flexibility and an animator's difficulties in game animation production. It was hoped that such study might provide information for later analysis into the differences between game animation practice and narrative production.

4.2 Game Application pre-animation processes, findings and reflections

I had spent over three months in planning and producing character animations for the Mermaid experiment. During that period, logbook and reflection notes about the production and my research questions were kept for future analysis. Peers and colleagues provided review comments on the completion of different stages of the production. In the following sections, I will present the stages of the experiment and its results.

4.2.1 Specification and Assumptions

Previous personal experience in the industry along with interview data showed that animators might not be involved in the initial concept or design stage of computer characters (see Sections 3.3.4.3 and 3.3.4.7). Many interviewees confirmed that a character was often handed to them for animation. Among the game animators I interviewed, some had worked with characters that were poorly designed or improperly built, leading to inefficiency in the process and difficulties in animation.

For this experiment, a specification and initial information about the Mermaid was gathered from an industrial game project. The character was a prototype for a game character; designed and built by a third party[22] *- a common situation in the industry. It was noted that the initial information was minimal, and consisted of only a few photos, brief notes about the game play and some practical information on how to drive the 3D model. These initial data did not describe how the character would behave, or how it would work within the game or its relationship to the game's story and environment. This situation echoed some of the problems that game animators had reported in the research interviews (see Section 3.3.4).*

Due to this finding, a detailed visualisation and evaluation process (see Figure 12) was called for in this experiment to verify what could be lacking from an animator's point of view. Details of the visualisation could be found in the Hypertext* presentation *(see Menu: Mermaid – reflection)* and therefore, this thesis would only address the processes and the analysis.

4.2.2 Visual research and animation specification

Visualisation is one of the challenges facing animators to create a believable character before an animation can be created. Specifications put a framework around the character and identify possibilities. In this game application, it was noted that a design specification included visual

[22] The use of the character in this academic work was sanctioned by the character's owner.

elements, notes on the implementation, and a story outline might assist a game animator to identify with the character, though games do not normally require a story. These elements are common to narrative production, but a game also requires extra information about the functionality of a character, its integration to the game world and how it would impact the game play.

Although it could be argued that for fantasy characters (see Figure 11), specifications could be loosened and allow more freedom in their creation, this experiment showed that there were still limits on how a huge Mermaid could move believably and display convincing poses. Additionally, the animator could encounter constraints in game animations during integration with the game engine – in contrast to a non-interactive animation production. Therefore, a detailed specification *(see Menu: Mermaid - reflection)* was needed for animation design compared to a visual character data sheets. With a specification catering for game application, visual research could be performed efficiently and critically.

The visualisation process for animation design in this experiment explored a deeper relationship between the visual form of a character, its anatomy and possible movements. In a game application, it was necessary to consider the limitations related to its implementation; for example, the Mermaid's size in relation to other characters in the game and its natural habitat, the game play requirements and technical aspects of the game software. As one would expect, such limitations influence an animator's creativity and design choices; hence, in this experiment, a two-stage process was used. Firstly, the visual design of the character was reviewed and its behaviours were visualised disregarding its implementation or any constraints for the game. A specific research stage, here called Persona and Functional Design, were introduced to design character and its performances in the game.

In revisiting the visual research as in this experiment, problems and mismatches between the intended animations and the visual appearance of the character could arise. The review began with my personal understanding and experiences *(see Menu: Mermaid - reflection)* about the character and the collection of new visual data. From there, visual appearance of the character and animation specification was evaluated.

Mickey Mouse; a cartoon character from Disney's studio suffered from poor initial visualisation and his design had to be modified in order for it to be animated easily (Canemaker, 2001). A master animator from the studio described Mickey's unconvincing factors and its poor quality as an animated character, showing that visual design was strongly related to animation. Similarly, Canemaker also related how Disney's Pinocchio was shelved for six months and the animator had to redesign its appearance for convincing animation.

The above examples emphasize the need for the look of a character to synchronise with its animation, rather than the animation being designed to fit a certain appearance (as is often the case in game applications). These examples also echoed the importance of revisiting visualisation by an animator and performing visual research for animation design, as proposed in this experiment. It was noted that visual research allowed the animator to expand the scope of the character and verify given information. This activity also encouraged the animator to engage with characters in a more conceptual manner and was concluded to be a form of good practice in the "Practice as Research" model.

The director, Fumito Ueda, argued that a design with too much detail could destroy closeness to audiences, in other words audiences seem to prefer a simplified non-realistic level of detail (Morris and Hartas, 2003). Furthermore, when describing character design for games, the artist Christian Johnson suggested that there was a need for them to be quirky in some way (Morris and Hartas, 2003). This feature was emphasised by the animator Eric Larson, through having his characters share aspects of realism and fantasy (Canemaker, 2001). This goal was also echoed by the animator Marc Davis who stated the importance of such shared qualities in that his Disney characters were something unique; their design lay somewhere between human and animal.

The above examples provided a focus for visual research and a framework for critical judgement of the Mermaid used in this experiment. In the following list I summarize these points for character design in game application, with a focus on character quality and winning an audience's approval.

1. Individuality - characters that attract attention and stand out from their peers, are original and excite the audience visually.
2. Visual cues - an animator or an audience should be able to relate to the character easily and yet there should be features to allow the projection of an experience and emotion; and room for the imagination to expand.
3. Share qualities – the idea is to focus on hybrid design or concepts that encourage unique or contrasting styles to excite audiences and achieve their suspension of disbelief.
4. Simplicity - never over-design, promoting a balance between creativity (which is not an excuse for chaos) and limitations.

Such specifications are subjective and are therefore, only guides for animators to verify a character's appearance and design appealing animations. There is *really* no rule to ensure high quality design. If people feel comfortable with the character and accept its visual representation, an animator has won half the battle of creating believable animation.

4.2.3 Persona Design process

The results from visualisation and character design processes in traditional animation usually are character sheets and expression sheets (see Appendix 21). Animators would draw a few unique poses of the character and depict its costumes and accessories. The personality of the character may be apparent in some action sketches or by facial expressions. Professional artists may specify a colour palette or even paint the character in a scene to convey deeper meanings. Unfortunately, the interview records (see Section 3.3.4.7) and my experience in games, revealed that these practices might be missing. Although such practices are still used in 3D production, animators are not usually involved in the concept design due to job allocation in the modern compartmental settings. Furthermore, it was found in the research interviews that the majority of 3D animators would animate directly with computer software *(see Menu: Skills)*, leading to possible insufficient preparation.

As described in this chapter, it is not easy for an animator to begin their work with only a few images and a few lines of description about a character. Character animation requires a deeper understanding than the visual appearance of a character, for example, information about personality, style, and desire. Disney's animators described this as 'Personality animation' (Canemaker, 2001) but details about the approach were not clear in the literature. Drawing was described as a critical key to that style of animation but drawing did not automatically lead to creating a personality. Many modern animators animate directly using a computer so creating personality through drawing may not be economical. In 3D computer animation, instead of drawing characters, animators also work with an underlying skeleton via virtual controllers *(see Menu: Skills)*. The design and construction of the skeleton directly influences the performance and flexibility of the character in a way very different to traditional animation production. Hence, skeleton design and anatomical knowledge has, in 3D computer animation, become more important than the ability to draw.

From the case studies and interview data, there is usually no description of the size, mass, anatomy and suggested skeletons in the given information of a character. Animators and riggers have to use trial and error to build and rig the character from 2D images. This is clearly an inefficient process and arises because the characters are under-specified, using an original method designed for a traditional medium. Whenever a process is transplanted from an older medium to a more modern one, without critical review from practitioners, the outcome cannot be validated. Similar problems seem to be less apparent in 3D film production though some film animators in the interviews also mentioned their difficulties to obtain clear information (see Section 3.3.4.3 and 3.3.4.7).

Reflection on traditional 2D animation revealed that animators generally think, analyse, reflect upon, and improve designs while they draw. However, when animating in 3D, the animator can be detached in at least two ways - first by the physical hardware of the computer (mouse, keyboard, stylus), and secondly by the interface of the software packages. Even though many 3D animators promoted the idea of sketching or acting as noted from the research interviews, there was a tendency to start animation quickly on the computer (see Section 3.3.4.7). As hypothesised in the interview report (see Section 3.3.4.6), perhaps some of the traditional techniques - drawing and acting - does not yield as much benefit for 3D animation as it does for 2D hand-drawn animation. These hypotheses would be tested in the experiments.

To cater for the differences between traditional and computer practices, a specific process - Persona Design - was introduced in this Mermaid experiment to direct computer animators' attention to character personality design, its animation and implementation in 3D computer animation.

With insights into traditional animation and game industry *(see Menu: Practice)*, the proposed Persona Design covered the behavioural and mental design of a character and its evaluation. It incorporated different stages in the design and the techniques allowed animators to acquire alleged benefits similar to those traditional techniques, for example, moving away from the use of drawing or acting to Buzan's original concept of mind maps. Notable aspects of the Persona Design were the use of mental rehearsal and a careful selection of personas - tasks that led to deeper engagement between an animator and the animated. In this experiment, it was found that the exercise not only provided a framework for exploring personality but also expanded the animator's creativity by ensuring actively engagement with the animation design. In the following sections, I will describe the details of the Persona Design process demonstrated in this experiment.

4.2.3.1 Character Abstraction

Character Abstraction is the first stage in the suggested Persona Design process. It aims to capture effectively the widest span of animation possibilities for a character in a short period of time. Disney animators attempted to capture a character in one drawing and achieved a degree of success with that purely visual method in their productions according to Canemaker (2001). Although it is often said, erroneously, that one image is worth a thousand words, we need to identify when to use images instead of text and vice versa. As we are dealing with animation it seems natural that pictures take priority, but when one creates a character that may have a complex personality or when the drives of a person are studied, it is impossible to capture these elements with drawings alone. Pictures require interpretation and are time-consuming to make. Some methods, such as mind-maps (Buzan, 1974) using keywords can allow the whole production team, including non-artists, to communicate or contribute more effectively. Many *random* ideas or *ridiculous* concepts

can be captured in the shortest period of time. Artists sometimes use keywords to annotate their drawings but this activity has not been promoted to the same extent as using sketches for animators. Hence, I suggest that Character Abstraction with text-based records may allow for the widest possibilities of the design.

Appendix 22 shows some example phrases and sentences that my colleagues and I recorded for the Mermaid in this experiment. We revisited the records to build up the image of the Mermaid within a month and proved the text-based approach to be economical.

The aim of Character Abstraction is for animators to explore possibilities and to understand the character and capture their essences and style in a short period of time. It was noted in this experiment that the initial attempt at Character Abstraction could be narrow, biased, and inaccurate even when peers' suggestions were accounted for. To overcome this subjectivity, a form of expansion and validation was required and this took Persona Design to a next level – observation and analysis.

4.2.3.2 Persona Observation & Analysis

Wolfgang Reitherman, a long-standing animator for Disney, stated (Canemaker, 2001) that he was taught to analyze characters instead of simply using his creative impulses. His mentor, Hamilton Luske, said, "It is a matter of observation and trying to apply these observations to your work". Luske reportedly never stopped studying and analysing motion even in social occasions and he concluded, "The first time you animate something is the first time you analyze something which you take for granted". His role at Disney was not one of the hands-on animators, yet his insights were much sought-after. Through the narratives of Frank Thomas and Ollie Johnston, we understood that these two great animators would spend hours watching people (Canemaker, 2001) but it was interesting to find no strong emphasis on such practice in their own book (Thomas & Johnson, 1989). Instead, we were given the principles of animation.

From the case studies, I learned that I valued observation and analysis to such an extent that for my 3D animation I would train these skills instead of practicing drawing. Indeed, the animator Marc Davis once said, "If you can't draw it, you can't animate it". However, as the mode of production changed with the advent of computer animation, I finally understood the fundamental lesson that drawing can give to an animator are the skills of observation, analysis and application, but not drawing skill itself. Animators can still acquire these abilities through drawing but equally there are other paths, such as real life observation and mental analysis that can provide the same benefits. Those activities are not yet promoted to animators with an emphasis equal to that given to

sketching or acting. Morris (1977) used these techniques to study and capture many facets of human behaviours, of notable benefit to character animation.

In this experiment, observation was used to accumulate information from the *real* world, expanded and validated the data gathered by Character Abstraction. Frank Thomas and Ollie Johnston were said to observe women in grocery stores when they were tasked with working on the three fairies in Disney's 'Sleeping Beauty' (Canemaker, 2001). However, what exactly were these animators looking for? Movements? Stances? Character traits revealed through actions? How did they observe people?

As I found out in this exercise, the answers might ground in physiology and to some degree in ergonomics. In this proposed Persona Design process, Character Abstraction had given an animator a rough framework about the character's possible personalities and behaviours. Then, by Observation and Analysis, one could collect *new* data – what style, postures or actions might reflect those possible personae, and also explore other possibilities. The analysis of information is a cognitive process where an animator may need knowledge from outside the field of animation, such as science, anthropology or psychology, to verify the observed data and reason about the outcomes.

In this experiment, analysing how the Mermaid might move on land or in water was enabled by observing the movements of overweight or disabled people, along with the habits of different sea creatures. In addition, awareness of anatomical features that allowed certain motion (the fish tail) and environmental factors (dry land or the sea) that governed animal behaviours was also found to be useful. Although it was a process reliant on interpretation, this activity exercised the creativity of an animator.

Appendix 23 shows an example note that I made while observing overweight women. As described in the previous section, keywords and short sentences were used for data collection.

'Inductive Observation'[23] was the term I used to describe how I studied characters. This meant an observation that attempted to draw some type of conclusion; the conclusion could be wrong but at the moment of scrutiny, could be accepted as being true within the observed dataset. Further observation and analysis could lead to different interpretations. Examples from this experiment were - the curved form of a woman might be read as a certain choice of style (clothing choices can also lead to an impression of a style) or as an expression of her inner emotions; similarly, social

[23] The concept comes from inductive reasoning which is a kind of logic that allows for the possibility that the conclusion is false even where all of the premises are true.

inter-relationships between people could be guessed from their behaviour among peers, strangers, or in different environments.

Observation and Analysis required patience, a form of record and constant practice, and no clear recommendations for these could be found in the animation literature I had examined. In the Mermaid experiment, Persona Observation and Analysis was demonstrated to be useful and I recommended this technique to be developed into an animator's habit. This echoed Ward Kimball's suggestion that animators should read, observe, analyze, and become involved with a variety of interests (Canemaker, 2001).

4.2.3.3 Persona Selection

In this experiment, it was found that an overwhelming amount of character information was collected during the first two stages of Persona Design process. Observation and Analysis allowed the animator to expand ideas but also eliminate some of the irrelevant data collected from Character Abstraction. Persona Selection was introduced as a critical phase to identify and select multiple personae for the animated character. This stage focused on the subject's novelty and individuality, visual animation cues and shared qualities between the identified different personae. For example in this experiment, the Mermaid carried multiple personae - the Willendorf Venus, a Japanese Sumo wrestler. These sources were deliberately chosen to be in contrast with each other and yet maintain certain coherence for the character. Also, the Mermaid was concluded to take on an athlete's style and a dolphin's movement in its actions that fitted well with the game play requirements.

Persona Selection is subjective so it was found to be useful to incorporate a third party's opinions in the final choices. This experiment demonstrated that selected keywords could deliver meanings in describing a personality more effective than drawing and allowed other to assess the choice easier.

Keywords such as 'cool', 'awesome' or 'beautiful' were not useful for recording in Persona Selection. Keywords with richness such as 'composed' and 'reserved' were picked for the Mermaid when it was first introduced to the game player. Keywords with contrast such as 'playful' and 'aggressive' were given to the Mermaid in its active state. The collection of well-chosen keywords assigned to the character's personae allowed animators to elaborate on ideas and focus on a coherent entity leading to individuality and variety in behaviour.

The separate personae that form a character are defined as having a common set of 'shared' qualities. This concept is an extension to Eric Larson's shared aspects of realism and fantasy in his

character design (Canemaker, 2001). The persona idea is that an animated character would only be seen to be alive if it displayed personalities and behaved in ways that we could understand. Complete comprehension and absolute coherent between the created personalities are not needed (because it would appear dull in my opinion). Also Morris and Hartas (2003) quoted that character might require "quirkiness" to capture attention. I add, an audience only needs enough information for projection of experiences and suspends disbelief. To incorporate different personae in one character allows greater variety, in a way similar to how people may wear many social masks. By carefully linking those personae with some underlying drives for that character, a believable and interesting character can be created. Persona Selection resulted in a set of unique keywords and descriptions, and as found from this experiment, it was not important whether the animated character eventually displayed all those chosen personae or not. This exercise focused the animator on a unique personality and during the process, the animator subconsciously engaged with the character. Then, when animation production started, the character would have independently evolved and the animator would not "own the character up on the screen" as Frank Thomas beautifully described in Canemaker's book (2001).

Some may argue that "a picture is worth a thousand words" and computer animation is a visual product that requires the animator to present ideas by images. This Persona Design concept demonstrated that other techniques using keywords, descriptions, inductive observation and analysis could be as effective. The knowledge and insights about a character created from Persona Design was found to resonate within the animator in the later production. Such a process could generate coherent and convincing animations whilst embodying multiple personalities within a character that could lead to originality, as seen in this work.

4.2.3.4 Persona Application

Evaluating a 3D computer character requires a level of technical skill that is more complicated than that of drawing and line testing used in traditional animation validation. A process of Persona Application was introduced in this experiment to verify the designed character, its 3D model and its flexibility for animation to satisfy the selected personae. The knowledge from Persona Observation and Analysis, together with the intended animations and style for the character from Persona Selection, gave a solid decision about the best workable rig for a character.

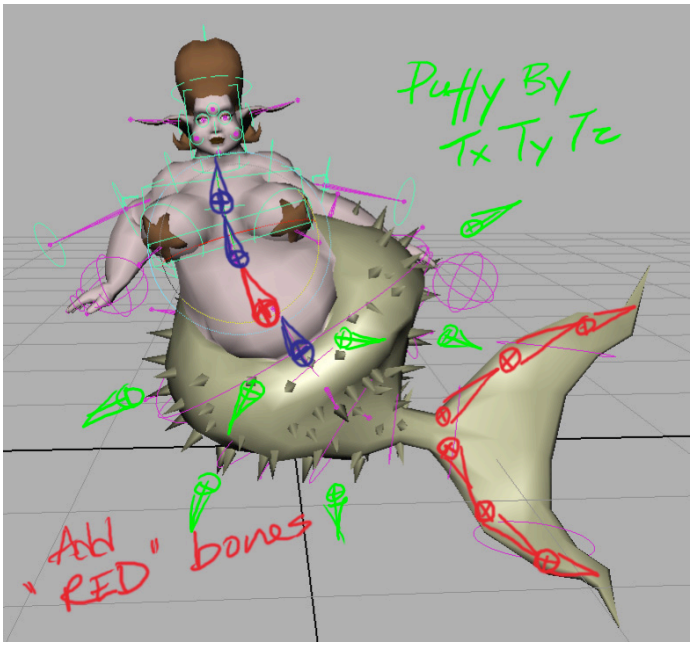

Figure 13. The best workable rig for the Mermaid used in this game design application

In this experiment, Persona Application used applied poses and animations to verify the character's chosen personae, its rig and controls. This followed the suggestion of Ward Kimball - "The problems of animating bring out the fault in your design and you can correct them." (Canemaker 2001). '3D posing' was the named test for the articulation of the character rig and deformation of the model. Here, the term means using the interactive 3D environment to pose, study and analyze a character, replacing the repetitive drawing process used by traditional animators. The aim of this '3D posing' is to explore a variety of postures that carry the essence of those selected personae and evaluates the aesthetics, rather than creating poses for the character. Applied animations – producing selected animations that stretch the capability of the character - were used to confirm the controls' construction and the flexibility for animation. In this case, short game sequences - idles and attacks, were made for validation. The notes made during the examination (see Appendix 24) revealed those properties of the Mermaid that could be best exploited by an animator. Other aspects might need to be worked-around or re-worked as shown in Figure 13 - the modification of the skeleton and extra required controllers to cater for body expansion (puffing up) in this experiment.

4.2.4 Functional Design concept

Data from the research interviews showed that Functional Design was not a common concept for animators in the game or animation industry (see Figure 9). Furthermore, there was no mention of that mode of thought in traditional animation studies either. Although the process was not apparently recorded, a few game animators in the interviews did refer to technical limitations in

their work and mentioned that they needed to perform some form of tests to ensure animation production (see Appendix 20).

From the case studies, it was noted that the standard practice found in narrative film production was not directly applicable to interactive sequences in a game. For example, in a gaming project an animator was not allowed the complete freedom to design character animation without having to worry about how to divide animation into shorter sequences to suit the game engine or cater for the game play. Many times in games, the length of a sequence would be fixed; and so animators might lose control over timing. Since the game engine would organise the final animations, the in-game representations might look very different to the rendered animations outside the game. This is due to blending (joining) between shorter sequences to create a continuous motion and the adjusted timing in the game engine.

In this research, the case studies and interview data revealed deficiencies in game practice and in this experiment, the concept of Functional Design that targeted the problem was examined. A Functional Design process (used more frequently for game design and programming) was introduced to clarify how a character operated within the game environment and to identify any technical limitations and solutions early in the animation design stage. This process targeted the quality of game animations and ensured critical design through prototyping and practical solutions before animation production commenced. It was hypothesised that Functional Design might also extend the understanding of a character's functionality within a story or the integration with other characters. However, this issue could only be assessed together with the next narrative application.

Some animators readily overlook animations within games but the quality of animation therein plays a large role in communication emotions in a game (Morris and Hartas, 2003). Apart from the complexities of animation, considerable artistry is required to blend animation sequences flawlessly. Technical expertise is needed in planning where and how to divide animation sequences effectively and flexibly, so that when animations are blended or combined, the character still executes convincing movements and behaviours. This ability to seamlessly accommodate the different paths that can be potentially taken by a character, is the main skill in design required from game animators. This is also the most important pre-production process in game development, where art (animation creation) meets technology (game play/engine design).

4.2.4.1 Functional Design process breakdown

A typical Functional Design process begins with some degree of mental visualization. The process leads to State Flow diagrams* that show how a character is going to behave in terms of states and conditions.

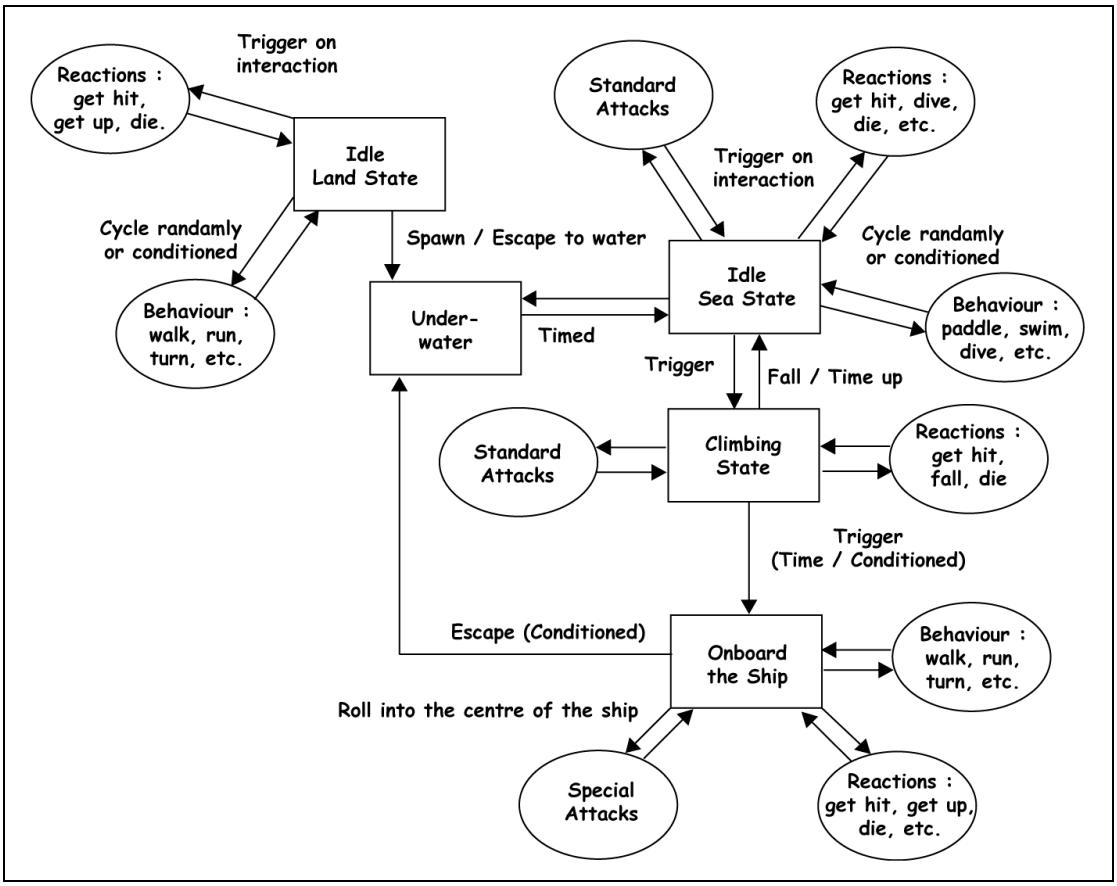

Figure 14. Functional design diagram for the Mermaid's behaviour

Figure 14 illustrates the functions of the Mermaid in this experiment using a State Flow diagram* that is normally encountered in software design. From the diagram, it was noted that animators could determine the type and number of animations required (see Appendix 25), and how they might be joined. The Functional Design allowed animators and others to identify those regions where technical aspects limited the artistic scope and those sections where greater artistic freedom was allowed. Game designers and programmers who were interested in functionality and aesthetics could also use this Functional Design diagram to exploit the character more fully. Once the Functional Design had been confirmed by different departments, a functional specification could be drawn up along with criteria for character animations – which would aim to balance animation aesthetics and technical capabilities. It was proven that the process effectively reduced integration problems between animation and game design.

It was seen in this experiment that the Functional Design process encouraged people to suggest and discuss ideas prior to animation production. The process of animation design became transparent to the team and not just the animator. Many were engaged with this Mermaid character and were eager to contribute extra effort. For example, the artists described their visions of the character in the game to me and suggested animations; designers expanded on game plays and requested different animations after they saw how flexible the Mermaid could be; and

programmers explained technical needs and suggested how animations could be organised for higher quality or avoid limitations.

The experience of using Functional Design showed that the approach could also encourage technical support and animation tool development. It pointed to a simple process that had the potential to bring in new possibilities, allow work to be better planned and benefit the whole team in game development. I suggested that animators *should* initiate this Functional Design process to ensure animation aesthetics and smooth integration. The goal is to apply critical design to animations for a game character that can work within the limitations of a game engine and can maximise animation qualities.

Because the design of the Mermaid in this experiment was complex and the implementation into a game involved close integration between animation, game play, and AI programming, it was found that the evaluation phase was similarly complicated. For example, the attack sequence that allowed the Mermaid to climb the ship and then attack if the player failed to throw it overboard within a time limit, was mocked up with simple animations and examined before the final production. This procedure flagged up an extra requirement for the sequence to return the Mermaid to previous states (see Figure 14 0 Fall/Time up), and an animation change in the attack sequence since in the game engine, the Mermaid was parented to the ship and travelled sideway. With the early findings, the final animation was completed with relative ease. This experience demonstrated that a validation process had to be present in the Functional Design process, especially for complex implementations.

4.2.5 Conclusion – game pre-animation process

The study of the design process in this game application revealed that visualisation for computer character animation could differ to that used by character artists or in traditional animation. The proposed Persona Design process demonstrated its potential to extend creativity for animated characters and ensure critical assessments for 3D character animation production. However, since the character in this game was not a conventional figure (humanoid-alike) and did not require extensive design on its personality and emotions, the application of Persona Design was somewhat incomplete. Hence, in the next experiment named Persona (see Chapter 4.4), more sophisticated character animations were designed to complete the examination of Persona Design for the game application.

The Functional Design process, though unfamiliar to traditional animators was found to be useful for computer game animators. It successfully organised character animation for games and integrated animation with other aspects such as game play and programming. It was questionable whether the use of Functional Design was independent of the interactivity requirement of a game character and whether other animation projects would also benefit from such a process? The first half of this issue would be addressed in the Persona experiment (Chapter 4.4) whereas the second half of the issue would be addressed together with the insights from the narrative application (see Chapter 5.3).

Both the Persona Design and Functional Design processes were found to be essentially contemplative stages in which the animators primarily required to think about their work rather than perform it. The "Practice as Research" model brought clarity to critical design and demonstrated that a body of knowledge had been articulated.

I was initially sceptical about the Mermaid design as an active 'boss' character but my views were changed in the process. I do question how much our subconscious governs our thoughts and in turn, our actions? How much do we *truly* understand about ourselves and about knowledge? How many opportunities do we reject simply because we use our limited view to judge? Are we willing to challenge the *old* way of thinking and do we have the skills to do so? These questions cannot be answered all at once but so far, this research showed that a *coherent* attitude and a set of well-organised processes could lead to their answers.

4.3 Game Application production process, findings and reflections

The proposed "Practice as Research" model was used during the production cycle to continue to study computer animation practice. The pilot study (see Section 3.3.5) showed imprecise analysis of why reflection-in-action was found to be difficult within a creative production. The review process that used to claim a degree of success in an industrial setting was also found to be ineffective. This experiment was designed to clarify those questions and aimed to verify the model of "Practice as Research" for computer animation (see Figure 15), and in particular, game application.

The major difference between this experiment and a more general production is that apart from achieving a piece of animation work, a full work-record of the animator's activities and research processes were captured. This log was achieved by applying the "Practice as Research" concept and the use of reflection-in-action and reflection-on-action to require the animator to think actively. This provided an opportunity to tap into ideas, data, and even the *self* of the animator - aspects that normally would be easily lost during a production. A director-producer; Pintoff (1999) once wrote that he was concerned that analysis would affect his art and alter his spontaneity but later, he was reconciled to the opposite view. This experiment, within its small but detailed scope, confirmed his later view that analysis is not necessarily the '*killer*' of creative work.

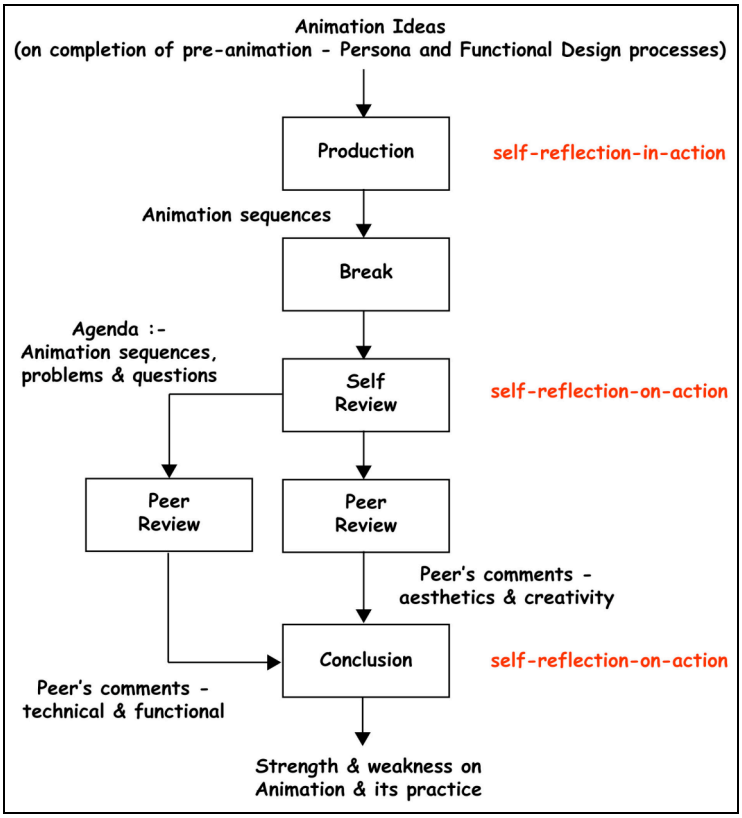

Figure 15. Proposed "Practice as Research" - reflection and review processes during and after the game animation production in this experiment

The making of computer character *(see Menu: Skills)* and the completed animations for the Mermaid *(see Menu: Mermaid->Anim - reflection)* were displayed in the Hypertext* presentation together with reflection notes and therefore, do not need repeating in print. Instead in the following sections, I will discuss techniques and processes, and analyse some of the important findings and reflections about the "Practice as Research" model and computer animation practice.

4.3.1 Practical issues for production

Although the test model of the Mermaid (see Figure 13) was custom-built for this project, the rig had to be modified due to some failings found in the pre-animation process in order to ensure sufficient flexibility for the production. The test model was not optimally weighted but since the experiment only aims to investigate "Practice as Research" and character animation practice in games, the weighting scheme was deemed acceptable and of little relevance to the outcome of the experiment. Although visual defects were noted in the final animations due to the rough model, this did not alter the conclusions of the experiment unless aesthetics issues were examined.

Maya was used as the 3D modelling and animation tool in a dual-monitor scheme. The setup was very simple with the central perspective view of the character shown on the main screen. The outliner, the Channel Box and the Time slider were displayed constantly. Animation windows, such as the Graphic Editor and Trax Editor were spaced out on the second screen. The physical desk setup was similarly well spaced with the keyboard and tablet sharing the major work area. As an aside, I seemed to prefer minimal obstacles (devices or interface elements) between the animated character and myself.

Research interviews showed that very often in the game industry, limited work-hours (see Section 3.3.4) were assigned to animators. Therefore, in this production, time records and details about each animation sequence (see Appendix 26) were kept for future analysis including whether the "Practice as Research" model might impact time management and productivity in game animations.

4.3.2 Tools and techniques for reflection

In the known animation literature, discussions about tools and techniques for animators are focused on the making and tend not to be focused on thinking. In this experiment, I tried to examine the tools for reflection during animation production. It was noted that some tools performed more effectively than others in certain situation. For example, recording aspects of the work in a

logbook was effective at capturing data during a production but was not detailed enough for critical reflection of the finished work.

The reflection tools/techniques employed in this experiment and found to be useful for "Practice as Research" are:

1. Active recording – logbook using texts, sketches, and diagrams
2. Mental rehearsal and internal dialogue
3. Observation, Noticing and Intervention
4. Reporting "the story" and discussion with a third party
5. Audio/Video recording
6. Decompression

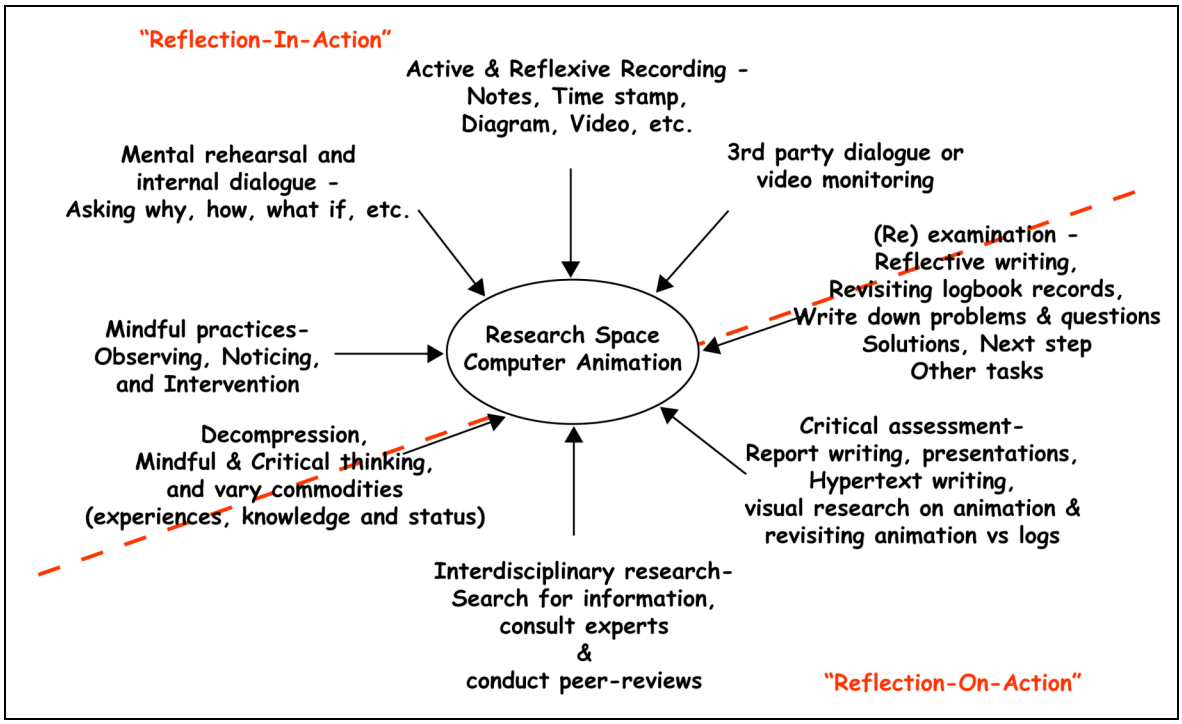

Figure 16. Different reflection tools recommended for computer animation production

Figure 16 shows the usages of different reflection tools. They are divided into reflection-in-action and reflection-on-action and some tools were noted to be effective for both.

Active recording during animation production and frequently update reports were the two main methods to collect production progress and ensure possibility for reflection. For example, in this experiment, the production record was kept in a logbook and reports summarising progress and reflections were made every two weeks. On completion of the experiment, revisits of the logbook

and reflection records were conducted using reflexive and reflective writing and a final report[24] was produced.

Recording data into a logbook seemed to be wasting my time initially and reports were difficult to write when usually nothing came to mind. However, as the log grew, it helped me to recall incidents and decisions that normally I would have forgotten or considered not important. Writing about the work in a report made me recall explicitly what I had done, allowing me to clarify and expand on ideas. Then, it was natural to notice personal choices, alternative solutions and preconceptions in decision-making.

I would recommend using two different logbooks during the animation production – one to record the animation's progress, ideas and problems, and the other for thoughts that seemed to be not directly related to the immediate production. In this experiment, writing seemed to occur in bursts in different stages of the production and the exercise resulted in clearer and more profound thoughts than before. Depending on the stage of the production and the complexity of the written work, different qualities within the analysis were noted. It was seen that information from both the logbooks and the reflection reports allowed others to trace thought processes. I noted that the medium used for the records might also be of importance; for example, audio dictation could ease the burden of written logbook but it would only be effective if the practitioner revisited the audio record and produced reflection notes from it. On the other hand, video recording might capture actions that a practitioner was not aware of during a production but would not reflect deeper thoughts.

This experiment demonstrated that sharing information in simple and clear manners, documenting facts and novel experiences in a production, not only allowed a practitioner to revisit the work and understand the workflow but also allowed others to examine. This practice resembles a systematic and scientific approach to a problem and provides a possibility to recognise thoughts and logical reasoning behind an action.

Perhaps, one may argue that art-practice is difficult to document unlike science. Professional animators in the research interviews rarely mention documentation of their practice (see Figure 9) but experience from this production experiment showed that it might be difficult but not impossible! It is difficult because we do not allow ourselves to think and act differently; difficult because we as animators only want to focus on making; difficult perhaps because we subconsciously want to maintain our traditional image of being creative. However, as I found out, the documentations were valuable for production assessment and personal development.

[24] Note that some of the contents of the report became the content of this thesis.

From this insight, techniques for reflection were concluded useful for animation practice and research. Clear cognitive processes such as mental rehearsal and the use of internal dialogues can clarify actions and decisions, but more importantly, point to preconceptions and allow the scope for '*Perspective Intervention*' in the "Practice as Research" model. For example, a different set of assumptions can be used for experiment or the practitioner can deliberately challenge oneself by making unconventional choice. As the concepts of *Observation*, *Noticing* and *Intervention* that are usually promoted for scientific experiments were employed in this production, it showed that before a self-learner could achieve 'Perspective Transformation' (Mezirow, 1990), 'Perspective Intervention' using some forms of experimentation and verification were essential to establish criticality. These exercises encouraged clarity and understanding of both a body of knowledge and the practitioner, and had the potential to raise the quality of the visual product. Finally, as would hopefully be the case in any robust model of learning, critical thinking and analysis were attempted throughout this experiment. This defined a process that re-examined decisions and practices during animation making. It was noted that sometimes, qualitative measures could be *better* presented as a narrative, such as a practitioner's experiences, in this case. The tools for reflection were inherently subjective and to balance the approach, the involvement of third parties or professionals to mentor reflections and contribute to discussions could increase credibility.

The tools and techniques described here were designed to make practice and knowledge transparent for others. With reflection notes and reports, and the final animation results, an animator's cognitive processes and the research process could be questioned and evaluated, as described in the next sections.

4.3.3 Animation practice and animator's mindset in a production

Any analysis of an animator's workbook may reveal quirks and habits that may not be found in other practitioner's records. Thus, I do not seek to *prove* those specific personal styles but instead, to explore why *any* given style is used, and how it can be studied.

I found that animation practice in this experimental production used sketches, keywords, brief descriptions and stick figures, similar to the Persona and Functional Design approach. My reflection notes revealed that I did not use sketches or live acting for animating the Mermaid. Instead, I used arrows frequently (see Figure 17) although that habit was not apparent until the logbook was revisited. When compared with my case studies, it was clearer that arrows appeared more frequently than poses or sketches when I depicted action in character animation production.

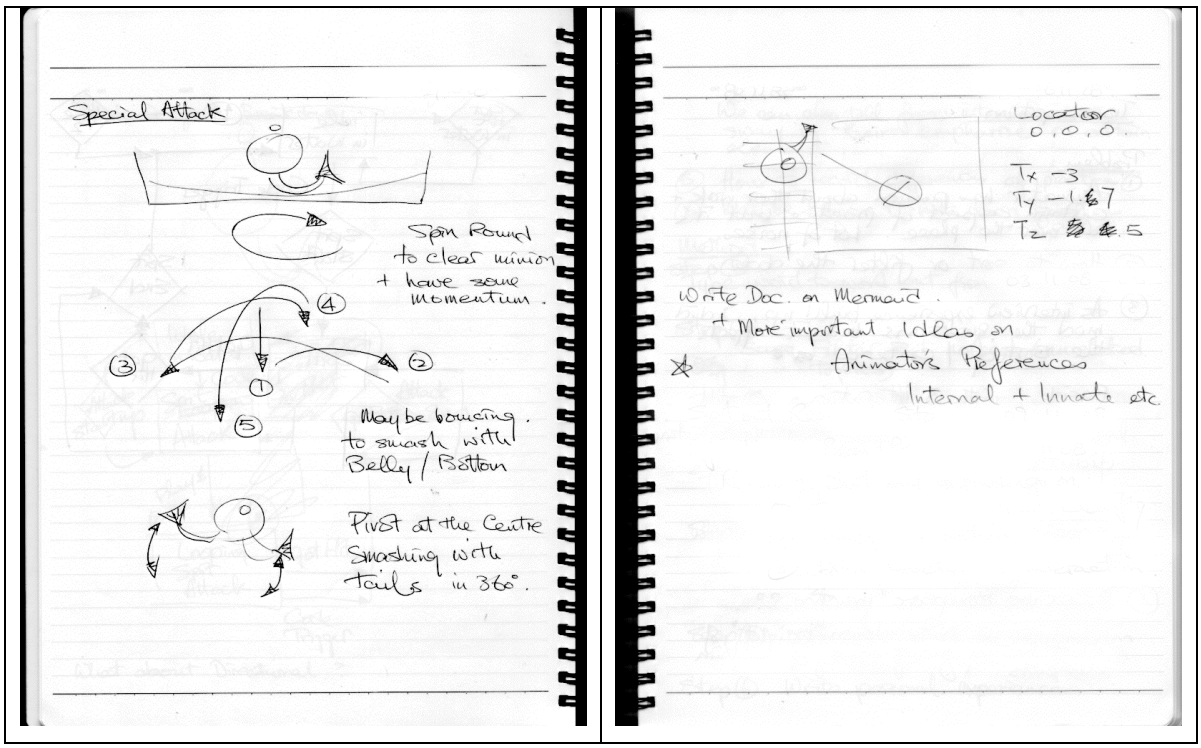

Figure 17. Example of arrows sketching in the game experiment

This discovery about my own production practice led me to examine how I used arrows and their underlying purposes in character animation. The logbook excerpt showed that there was a degree of mental rehearsal of an action present, which focused on location, the intended movement of a character and the holistic impression of the action (see Figure 17). The concept of using key-poses found in traditional 2D animation seemed to be second in this planning. This, perhaps, is a result of the geometry underlying 3D animation and the need for a more complete appreciation of the character in space. This experience is in accord with some reports from the interviews that 3D computer animation practice could be differ from the *traditional* approaches such as pose-to-pose technique, the straight-ahead technique and the mixed methods mentioned in some animation literature, outlined below.

In the pose-to-pose technique, an animator would concentrate on one key-pose, another key-pose in a later frame and then, considering the in-between frames. This technique of breaking down movement into specific key-poses and reverse engineering them back into a continuous movement may seem unnatural but it was an effective way to control hand-drawn animation, as shown by Thomas & Johnston (1989) and others. The straight-ahead technique employed by puppet and model animators and sometimes also used in hand-drawn animation as discussed in Williams' book (2001), was said to be more flexible and intuitive. Animators could be spontaneous in their work and experimental while animating. However, this technique does not easily provide tight control in timing and in quality. The technique found in this experiment was the result of refining some "principles of animation" to suit a 3D animation application. I will describe the concept in details in the following.

The concept behind the noted 3D technique in this experiment, could be explained by Figure 18 which shows two frames of a sequence. Let the left image (pose) be the initial state, which then becomes the image (another pose) shown on the right.

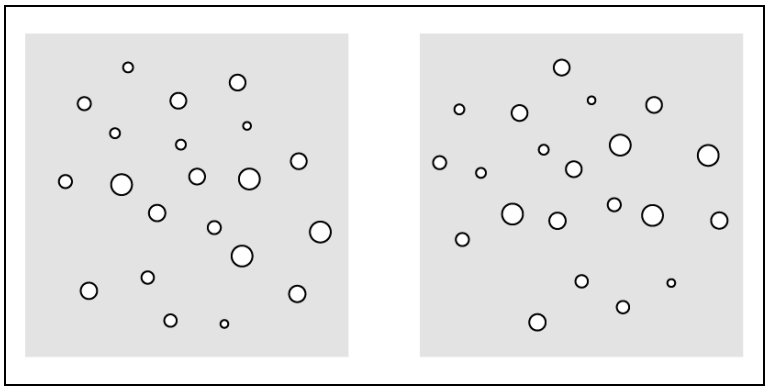

Figure 18. Representation of two poses in a sequence

One may decide that there is no simple link between the two states. Figure 19 shows that the right-hand image was simply a rotated version of the left image. However, there is still no single unambiguous route for the circles to take - there are *at least* two specific possibilities for the animation. The left image can be rotated clockwise or anti-clockwise to form the right-hand image. Even this disregards the potential for multiple rotations and the possibility of individual circles movements.

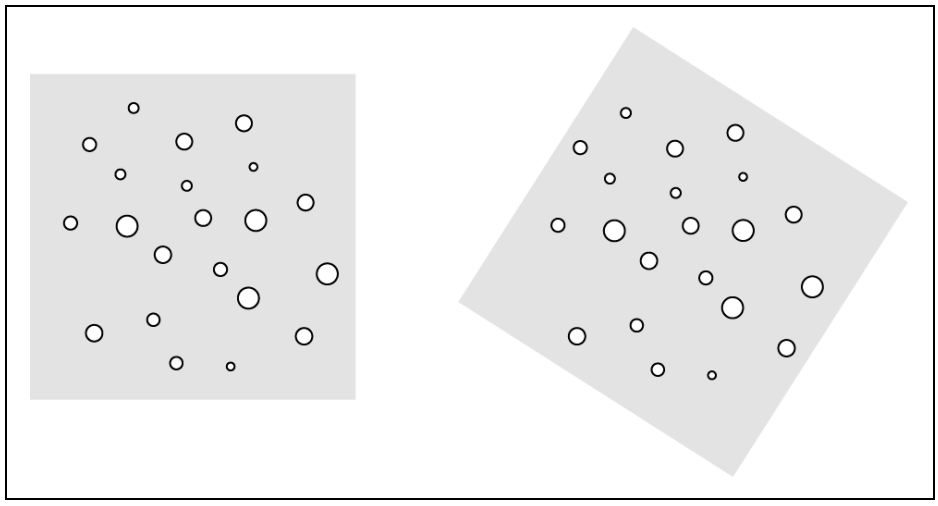

Figure 19. Relationship of two poses in rotation

Rather than showing the animation at a given instant as in the case from one image to another in a pose-to-pose situation, Figure 20 rather shows the motion than the positions that make up the motion (using anti-clockwise movement as an example). Here the arrows themselves show the directions and speeds that the circles have to reach their final state.

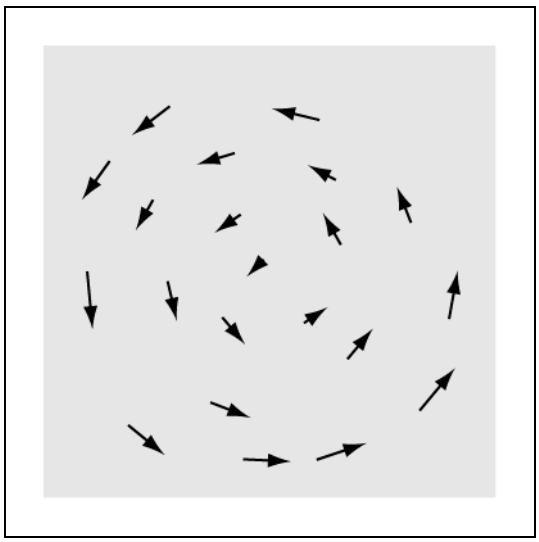

Figure 20. Vector Visualisation for animation (Flow of the action)

In the Mermaid experiment, instead of creating individual poses for an action or animating spontaneously, the focus shifted to the possible vectors of the motion and their effect on an action. An ideal state (or pose) would be an obvious target for the flow to drive towards but that end-state would often itself be modified.

Although so far described in 2D, to apply to 3D, an animator could extend the visualisation for an additional dimension and cater for the increased number of probable paths linking one state to another. I used this flow concept as the prime visualisation tool and performed mental rehearsal of an action during animation production in this experiment. On reflection, this technique allowed freedom and variation during animation making without losing the sense of control over the character or the timing of an action. I found that treating a sequence as a series of snapshots using poses as worked in traditional 2D application, did not reveal possibilities for 3D as readily as using this model of action flow. This might explain why in the research interviews, many 3D animators spoke of traditional techniques and drawing poses (see Sections 3.3.4.4 & 3.3.4.5) but in reality when they described their 3D production, their techniques might vary.

The flow concept shown here can be described as *'Pose Targeting'* and *'Trajectory Visualisation'*. Pose Targeting refers to the idealized state that the character is constantly aiming for. Trajectory Visualisation is the mental rehearsal of the possible paths that shape the direction, movement and timing of the performance (see Figure 17). Pose Targeting and Trajectory Visualisation arose from a need to assist a computer animator to think about the holistic impression of an action in 3D space, rather than focusing on manipulation of character parts. These methods encouraged the animators to mentally expand the intended action and visualize the animation in 3D rather than drawing *dead* poses on paper or responding only to visual stimuli. Pose Targeting and Trajectory Visualisation were noted to be weakly influenced by key-poses and allowed for expansion and experimentation during the animation's creation. The flow concept gave no constraints on key-poses but provided a

prediction of a target and possible trajectories, thus allowing spontaneous decisions and flexibility to modify an action during the making; hence, it led to a critical and yet flexible approach to computer animation production.

This clarity of a practice for character animation would not be possible without the case studies, practice information from the interviews, practical application and reflection-in-action in an experiment. Hence, it proved that "Practice as Research" could assist the understanding of a personal practice and expand a practitioner's view.

Lastly, I would like to share a quote from the animator Norman McLaren that is relevant to the findings from this experiment. He said "How it moves is more important than what moves; What the animator does on each frame is not as important as what he/she does in between" (Canemaker, 2001). If it is true, then perhaps, the key-poses that occur on the frame should not be animator's prime focus. This again supports a view that computer animators may actually need to think and experiment differently to the well-established pose-to-pose or straight-ahead techniques.

4.3.4 Reflection processes

Since the author was both the researcher and the practitioner in this experiment, any reflections *should* be treated with scepticism especially with regard to feelings and experiences. The aim of reflection should be the clarity of thoughts, rather than passing judgement. When recording events, techniques such as the use of a logbook or mental dialogues were found to be beneficial. Reflective writing and repetitive study on the experiences were noted to allow a subject to be de-constructed into its components for analysis, re-constructed for reflection and formed knowledge – a deliberately linear approach to a traditionally non-linear subject.

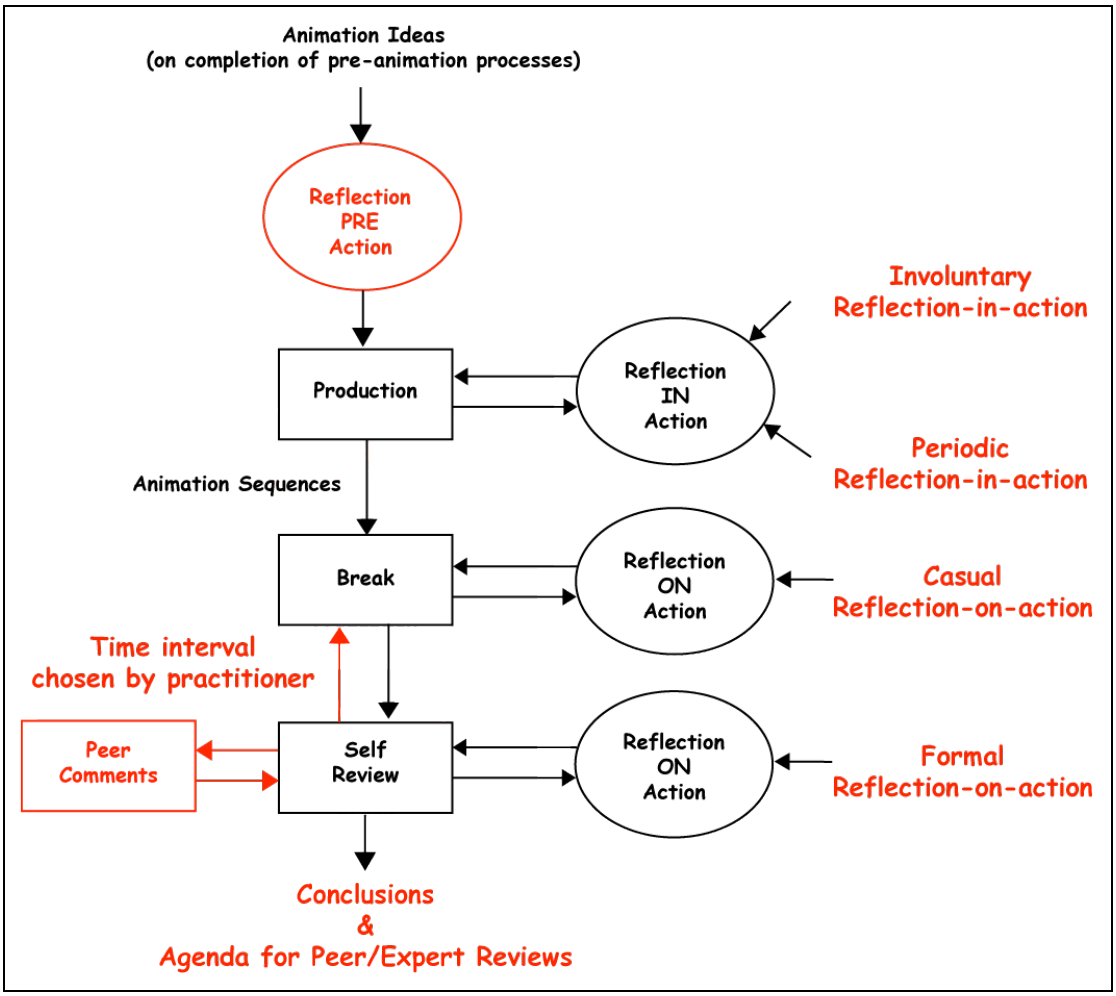

Figure 21. Reflection processes identified for "Practice as Research"

Figure 21 summarises the reflection processes found in this principal experiment for the "Practice as Research" model. The black labels in the diagram show the initial proposed stages (see also Figure 15 for comparison) and the red texts show the additional findings during and after the experiment. The following sections describe and analyse the three stages of reflection: pre-action, in-action, and on-action.

4.3.4.1 Reflection-pre-action

The pilot study showed that case studies could encourage a practitioner to review one's past experiences and learnt from them. In this principal experiment, the pre-animation stage called for a clear understanding about game development and my preconceptions about game character. I also noticed that evaluation of one's past experiences and skills was crucial in identifying gaps in one's knowledge and aiding future reflection.

At the beginning of the principal experiment, I reviewed the records of the case studies, tried to identify some of my preconceptions about game development – one of them being the Mermaid's visual design was hard to develop into an active boss character and the new insights from the pilot. Using internal dialogues, I summarised my distinct experiences about game animation production and identified the areas that I did not consciously perform reflection on, for example during animation making.

The natural call for a revision of the game case study and the need for reflection on the "Practice as Research" model before the Mermaid production started is termed *reflection-pre-action* to keep inline with Schön's reflection terms. In this principal experiment, reflection also involved other areas, for example, general knowledge or preconceptions on aquatic animals and anatomy, practical knowledge about character animation and the use of computer techniques, and other animators' experiences from interview data. Better understanding of what one knows, what one does not know, can heighten awareness and encourage mindfulness in taking action or making decision.

4.3.4.2 Reflection-in-action

In this research, I used Schön's (1987) terms - *reflection-in-action* and *reflection-on-action* to define reflection processes conducted during the production and examined the work on completion. Due to the inconclusive finding about reflection in the pilot study, reflection-in-action was performed with care. A raised level of self-awareness, mindful practice and note taking were deployed during this experiment. The preparation gained from reflection-pre-action readily allowed me to work or think clearer during the production.

It was noted in this experiment that there were definite cycles of thinking, working, reflection and then working again. The constant interruption to reflect and take notes, led to tension within myself and somehow my brain was not happy.

After a few days of struggling with the process and not knowing where the difficulty lay, the work became smoother. I thought that the reasons were because I was more comfortable with reflection

and more familiar with the animated character. However, reflections during the pilot study and the pre-animation had demonstrated that I had some experiences in the process and was familiar with the mermaid and found no difficulty animating her. Therefore, the difficulty noted did not come from the practical/technical sides of the production nor my inexperience. The truth was revealed when I re-visited my logbook records. The time I experienced difficulties in reflection was when I constantly switched between the task of animation and reflection. I seemed to force myself to record everything during a production for the sake of reflection. The time when I was not troubled by reflection was when I stopped the constant interruptions during animation. Records were fewer in number but the quality of the content seemed to be different and I am not strained.

The above experience initiated a new strategy for the reflection-in-action process -reflection should not be conducted constantly while in action. For example, if the animator was deeply engaged in work, one should allow the continuous flow of thoughts to appear. Notes could be made as soon as the engagement eased and reflection could be performed in immediate recall.

However, I ask - if I only perform reflection afterwards, what is the difference between reflection-in-action and reflection-on-action in Schon's model? Perhaps reflection-in-action and reflection-on-action could be simply idealized models that, when applied to art-creation and practice, were actually the same thing.

If the reflection-in-action and on-action are *really* different, could reflection-in-action *really* be a real-time process during a production? And what is the time frame for reflection-on-action to be performed in?

New insight from comparing between the initial reflection notes and later ones, revealed that reflection-in-action could arise spontaneously. Reflection-in-action is a habit of mindful thinking that does not focus on validity. The practitioner simply records the situation and their thoughts without intellectual constraints for later recall and reflection. I recommend it as a practical training where knowledge of doing and thinking are implicit during work. It was found that reflection-in-action as a habit allowed me to capture some aspects of my inner creativity and personal experiences that would have been lost otherwise. It was also noted that reflection-in-action allowed modification of a practice and encouraged animators to intervene preconceptions for future investigations of the work.

For clarity, I define **Involuntary Reflection-in-Action** as random and spontaneous reflection that occurs during a production. This could be seen as an almost real-time log of experiences and could expose an animator's intuition and their thoughts due to reflexivity. It requires the practitioner to be mindful and have the discipline to treat it as a habit or a practice without immediate judgement

and analysis. If one is not aware of the active practice of reflection-in-action, its advantages of acquiring and clarifying implicit knowledge will go unnoticed and it will not yield mindful records for critical study. However, it was noted that involuntary reflection might not occur frequently during intense work, and so the practitioner might need to be prompted to reflect periodically. For example, in this experiment I prompted for reflection to re-examine random ideas that had arisen during the day. This type of reflection was defined as **Periodic Reflection-in-Action**. It ensured that if Involuntary reflection-in-action did not occur, the practitioner could still perform a form of immediate reflection during production. Periodic reflection-in-action is not as immediate or spontaneous as Involuntary reflection-in-action but it has a degree of in-depth thinking and it may distance the practitioner from the immediate work, encouraging different reflection aim. It also allows practitioners to reassess ideas from Involuntary reflection-in-action and bring in different aspects for consideration while a production is still on-going. For example, if an animation problem is encountered, one can reflect systematically on the use of different tools or techniques, or modifying a design or the piece's aesthetics, and so hopefully create different solutions to a problem. Periodic reflection-in-action provides an opportunity for animators to fuse concepts, mull over their experiences and perform analysis.

4.3.4.3 Reflection-on-action

On completion of the production, the review stage began, as is shown in Figure 21 that outlines the game application structure.

Reflection-on-action was used in self-review where the practitioner revisited and examined their own work. In this experiment, reflection included the game character in terms of their animation design, aesthetics and functionality, and the use of research techniques and the "Practice as Research" model for games and commercial production. According to the insight gained from the pilot study, a break from the task was foreseen to encourage the animator to *decompress* from the production before the review started. By doing so, the animator hopefully would have the opportunity to surrender the ownership before adopting a critic's role.

In the Mermaid experiment, reflection-on-action occurred two weeks after the completion of the production. The reflection process initially dealt with practical and aesthetic issues about the animation (see menu - Mermaid -> Anim), and technical solutions for the game. Since reflection-on-action on animation practices and the "Practice as Research" model did not show much clarity, I decided that I had conducted reflection-on-action too early in the process and that reflection-on-action should continue in a later day.

Due to the tight schedule of the research, the second game experiment - Persona was conducted in parallel with the reviews of the Mermaid experiment.

The extra time given to the decompression led to casual revisits of reflection notes and encouraged the intervention of thoughts. I found that those exercises stimulated reflection-on-action and contributed tremendously to the evaluation of research methods and, specifically the "Practice as Research" model. During longer decompression, reflection occurred naturally and it was found that writing an interactive Hypertext* medium to combine visual animations with reflection notes, was helpful for examination and analysis.

During the construction of the Hypertext presentation, I found myself began to look into wider aspects of the research that I had not thought of before. For example, how could I assist an individual to understand practice research? How could I present the practical journey of the experiment? How did the visual animations relate to the practice research? Unconsciously and without effort, I readily surrendered ownership of the animation sequences. I was able to look at my work like an outsider and when I reflected upon issues. I managed to debate the topic, or so it seemed, rather than holding onto my prior experience.

Reflection-on-action used in self-review was therefore suggested to be *better* handle as a dual-process. The dual-process was divided into *Causal* reflection-on-action and *Formal* reflection-on-action (see Figure 21). Causal reflection-on-action was the process used during the decompression period that aimed to detach practitioners from the ownership of the work and broaden the perspectives without intellectual judgement. Formal reflection-on-action was a critical examination (see Appendix 27) and was also aided by a third party or external resources, as in this experiment. For example, colleagues in the game industry were asked to judge the results (see Appendix 28). These 'formal' judges were a game designer, an artist, and an animator for this experiment.

The game designer managed to load the character into the existing game engine for testing and the artist and the animator focused on the animations (see Appendix 29). This trial was similar to review style in the industry and revealed similar problems as found in my pilot study. Professional or industrial reviews may narrow the variety of feedbacks and can be visual, expertise or project oriented. However, my colleagues' comments were valuable in that they confirmed the functionality of the character and its animations to support formal reflection-on-action and also the preparation for later peer-reviews.

External stimuli such as a range of opinions from colleagues can provide fuel for Formal reflection-on-action, modify the view of a practitioner and also encourage critical assessment. For a game

project as shown in this experiment, validation was essential not only for the functionality of the animated character but also to study the aesthetic quality *in real-time* within the game environment. Although it was possible for the animator to conduct tests as reported in the interviews, this experiment showed that a third party approach could be more credible. The collective thinking and comments could readdress the approach to game animations and their aesthetics, encouraging the development of an open and diverse view.

At the end of the process, it was found that the length of the decompression was not the main factor influencing the success of reflection-on-action. It was the exercises conducted during the decompression, the self-understanding, collective ideas and the reflection techniques used that assisted a practitioner to achieve higher quality in their reflection and product outcome.

4.3.5 Peer-review and Expert-review

The case studies and interview records revealed that animators and studios used reviews to assess projects and the qualities of animations. In some animators' reports (see Section 3.3.4.2) and findings in the pilot study, review might not be as useful as one might think. Often, animators received contradictory comments leaving them with the choice of either staying with their original idea or modifying their work to suit others' requests. This type of review was therefore concluded to be loose and *should* be performed with a tighter control if it is to be credible.

From the pilot study and the trial review aided the reflection-on-action in this experiment, I found that reviewers could be easily distracted by visual outcomes and it was much harder for them to discuss a topic than making comment. The research interviews also showed that although review was performed (see Table 2) in the industry, there was little evidence that animators were satisfied or studios assessed the quality of the review process (see Section 3.3.4.2). This might explain why the review process that claimed success in the industry, did not yield positive results for this critical animation research. I concluded that there was a general lack of understanding of critque and a lack of standards for the review process.

In this Mermaid experiment, a procedure and a standard for peer-expert review were drawn from three sources - the findings of the pilot study; the review trial that assisted reflection-on-action (self-review); and insights from scientific review. The review procedure set down in this experiment was considered to be a research method as well. Therefore, this review process not only reviewed animation production but also reviewed "Practice as Research", and in turn reviewed the procedure itself and its quality. In this model, the researcher organised and conducted the review. A third person could be brought into the review process to observe and later assist reflection on the process. However, this action could complicate the review in this premature stage

of exploration and therefore, it was considered to be outside the scope of this research. Instead, audio recording was used to build a record for future analysis.

The following Figure 22 shows the review process within the "Practice as Research" model. The black texts in the diagram show the initial proposed stages (see Figure 15) and the red legends show the additional findings during and after the experiments. The diagram is divided into *Individual peer-review* sessions and *Group-review*.

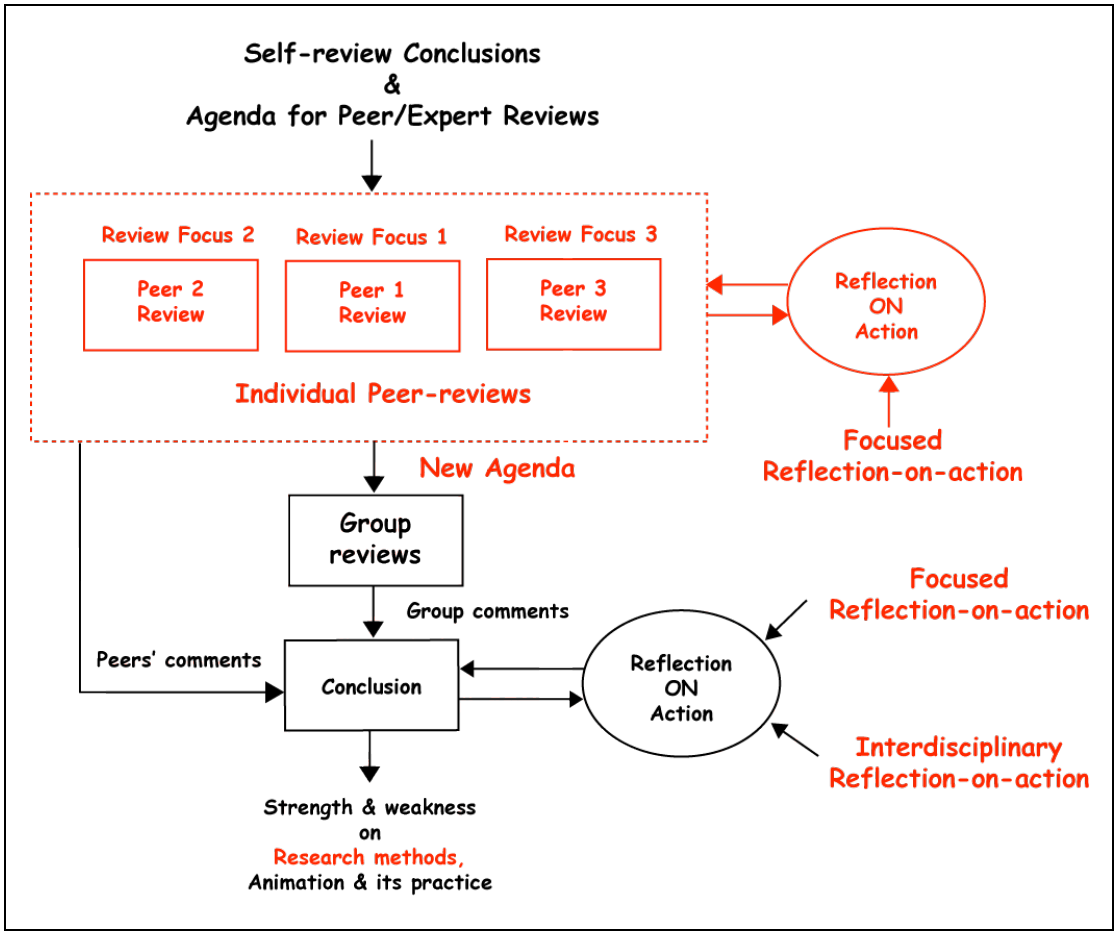

Figure 22. Review process identified for "Practice as Research"

4.3.5.1 Individual peer review

Due to the visual-oriented nature of the review trial in the Formal reflection-on-action, individual peer-review in this experiment used a different approach and a number of peers in an attempt to explore the process. Individual peer-review consisted of one-to-one sessions conducted in an interview style. Each reviewer was given the procedure (see Appendix 30) and encouraged to explore the experiments and results via the Hypertext prior to the review. Questions used in the reflection processes (see Appendix 27) were also provided to aid the reviewers in understanding the main concerns of the researcher and hopefully prepare them for discussion. The focus of the

review was decided between the reviewer and the researcher according to the interest or expertise of the reviewer prior to the session. In this case, three reviewers were given two weeks to prepare for the procedure and read the research materials, and they were encouraged to query aspects of the research prior to the review.

It was noted that the reviewers had a general anxiety about the review procedure and the level of details that I was asking for. To ease their concerns, I clarified the procedures and reasons behind the work and reassured the reviewers that the individual peer-review was a pre-process to optimize the quality of a later critical review (see Appendix 31).

Three peer-reviews were conducted within one week and reflection-on-action reports (see Appendix 32 and 33) were produced for the reviewers to examine. These individual reviews acted as a preparation for the critical group-review that was scheduled to discuss the reviewers' comments, address research questions and the qualities of the review process. A member of the public was also asked to review this experiment to give a viewpoint akin to that of a general audience and assist to frame a balanced agenda. The re-examination of the reviews' themes and reviewers' comments had led to a new agenda (see Appendix 34) for the group-review.

In this experiment, it was noted that individual peer-reviews were difficult to conduct properly and they were time-consuming even with defined procedures and well-prepared materials such as animations, reflection records, and the Hypertext presentation.

It was found that two out of the three reviewers required the agenda and procedure to be repeated and had not able to study the research materials. Two of the reviewers preferred a question-and-answer type of approach that defeated the idea of a genuine and spontaneous discussion. Two out of the three reviewers focused mostly on visual aspects of the research, a similar outcome arose from the pilot study and the interview reports (see Section 3.3.4.2).

One of the reviews failed to make progress despite three different attempts. There seemed to be a problem in exploring the research prior to the session and the reviewer seemed to expect questions instead of an open discussion. Therefore, a different format for the individual review was incorporated to resolve the issue. In the revised form, the reviewer drafted questions and I gave clear answers using a text-based discussion. However, when the reviewer failed to participate in further discussion, this attempt had to be abandoned. In this particular situation, it showed that an interrogative style of review was adequate for many reviewers but it was ill-suited for researchers seeking thought-provoking discussion.

There were gaps in the understanding of reviews from both the researcher and the reviewers, leading to confusions similar to those reported by professional animators (see Section 3.3.4.2).

Interviews or discussion-based reviews were found to be difficult to organize but might yield fruitful debates if it was well structured and well prepared. In rare cases, for example the abandoned review in this experiment, text-based question and answer discussions were found to be not helpful. Those situations might appear when either the reviewer or researcher were ill prepared or did not comprehend the work fully.

It is worth illustrating the unique nature of the individual reviews. One of the three reviewers had expressed a clearly defined interest at the beginning of the individual review and during its course, the reviewer managed to lead the discussion into areas that were unexpected. Another reviewer suggested that certain aspects of the research could not be separated for discussion, and significantly, one reviewer managed to liberate from the visual distractions of the animations and commented directly on the research methods.

The experience showed that even with well-defined procedures and detailed preparation, critical performance still depended on the quality of researchers and reviewers, their skills in articulating knowledge and engaging in discussion. Critical review, one might conclude, is difficult to conduct if one seeks rigour debates and non-judgmental outcomes.

On a positive note, individual peer-review allowed the researcher to raise questions that were appropriate to the expertise of the reviewer and so explore the research area that interested an individual. It provided the opportunity for reviewers to clarify ambiguities and misunderstandings prior to the critical review - the group-review in this experiment. This individual-focused review might lead to more engaged and rigorous discussion; and hence lifted the quality of critical review.

4.3.5.2 Group review

A group-review was organised after the completion of all the individual peer-reviews. Reflection-on-action and individual peer-review reports provided a study opportunity to clarify comments and possibly expand the review focus and individual's perspective. A modified agenda (see Appendix 34) was built for general discussion in the group-review.

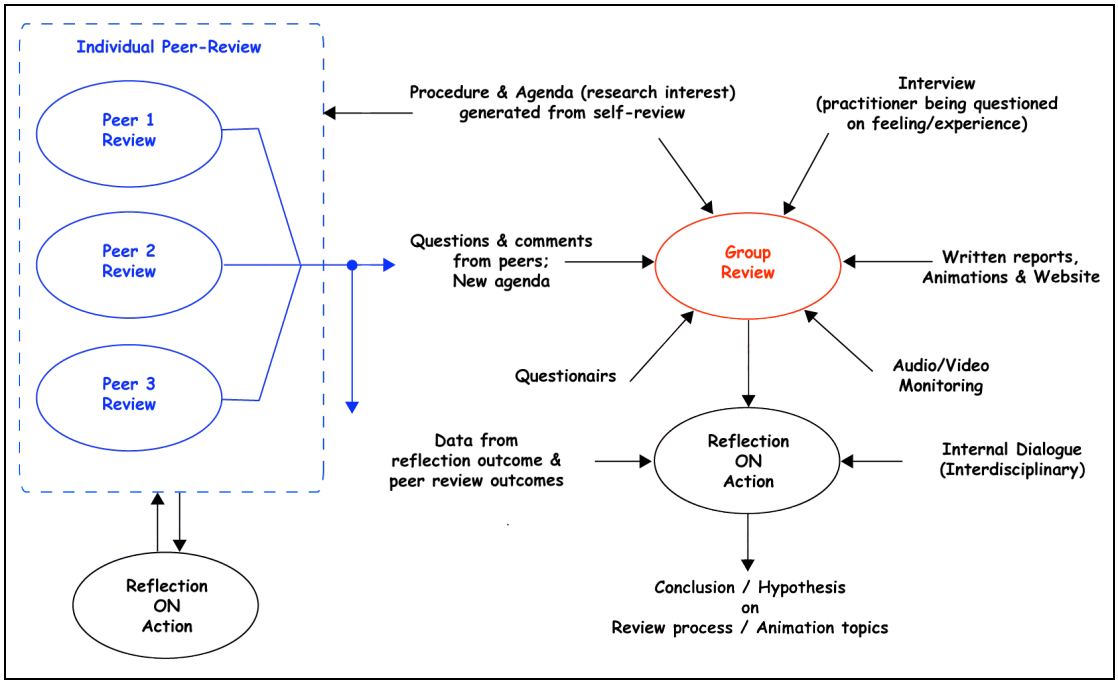

Figure 23. Techniques and tools used in group-review

Figure 23 shows the techniques used and the relationship between reviews and reflection. Prior to the group-review, an agenda and individual peer-reviewed reports were distributed to ensure that all selected reviewers were aware of each other's interests and comments. The interval between the individual reviews and the group review *should* be minimal to maintain continuity. A questionnaire was formed to guide the review discussion (see Appendix 35) and audio recording was used to build a record for later reflection-on-action. It was worth noting that the questionnaire was not given to the reviewers to provide direct answers in this review. By setting a goal for the group-review and formalising the discussion, the reviewers were led to focus on issues driven by the interest of the researcher, differed to the exploration style that used in the individual peer-review.

Depending on the research questions, original participants of the individual peer-reviews were selected to form the group-review panel. The criteria for the selection were - overlapping interests between reviewers, interests related to the research questions, and their ability to mentor. By this last term, it is important but yet found to be difficult in this experiment that a reviewer was able to

empathize with the researcher at different stages of study and engage in a meaningful dialogue. The group-review should consist of *at least* three members – two reviewers and the researcher to create a more balanced dynamic. It could be argued that more members with yet more diverse views might improve the quality of the review. However, in larger and more varied groups, in-depth discussions may loose coherence and make the review harder to control. Evidence for such focus-drift was found in the pilot study and reports from the interviews. If a group-review panel could not be formed for any reason, the researcher would need to return to the individuals to seek a wider range of views or possibly conduct more individual peer-reviews.

In this experiment, the review panel consisted of two reviewers and myself. The main reason why one of the three individual reviewers was not included in the panel was due to the absence of a satisfactory individual review. Individual peer-review reports showed that one selected reviewer concentrated on the research methods and the presentation of the research while the other focused on the presentation of the research and the animations. Therefore, when my research questions dealt with presenting knowledge and practice for the "Practice as Research" model, and how the Hypertext might assist reflections and review, there was common ground for discussion.

Since the aim was to obtain honest opinions without preconceptions, the focus of the group-review - Hypertext presentation as a vehicle to display practice research, was kept from the agenda and the reviewers were not asked to assess it directly, rather they were encouraged to comment on the materials shown by that medium and their understanding from it. The group-review discussions were found to be more dynamic than the previous individual reviews. The reviewers were more ready to raise questions outside the research context, whereas previously, they appeared to be more reserved. This shift in attitude could be simply due to the team becoming more familiar with the review style and each other. Additionally, when compared with the pilot study where people were simply brought together to perform a review, this group-review was found to be more organized and fruitful – probably as a result of the prior individual reviews, the preparation and the use of a repeated procedure. It was observed that reviewers displayed more individual arguments in this group-review than in the pilot study where they tended to follow the group dynamic.

Despite of some positive outcomes, the reviewers still reported difficulties in the process. It is possible that the complex review process mentioned by one reviewer, and certain misleading points in the procedure might have contributed to those difficulties. However, there were many other unaccountable factors too, for example, the inherent complexity of this research, the multi-tasking noted during the review processes, the meta-cognitive process* required to assess research process and to comprehend animation practice and its implicit technical skills, and critical review experiences of the researcher and the reviewers, etc.

It was concluded that the group-review needed to be coherent, rigorous with respect to use of procedure and repeated to encourage reflection. The review processes used in this experiment showed that having some form of procedure to assess the review process could benefit improvement on future approaches and qualities. It demonstrated that different level of reviews with different reviewers could yield different qualities and also exercise the researcher to become a critical mentor in review process.

Although feedback on animations and the outcome of the review were not as important as the experiences gained on review processes in this experiment, critical suggestions were obtained in some areas of the research. It was confirmed that the Hypertext presentation had the potential to aid reviews; therefore, the research would incorporate this tool into the "Practice as Research" model and also used it to present a practice research via the Internet for further investigation.

4.3.5.3 Debriefing session

Debriefing (see Appendix 36) was conducted at the end of the group-review. It aimed to reveal the purposes of the whole review process – how to organise critical review; how to present implicit knowledge and practices in the "Practice as Research" model, and whether Hypertext presentation perceived qualities. Debriefing also allowed the reviewers to express other concerns arise from the group-review and prompted reflection.

It was expressed that the whole process of group-review was intense. Debriefing was driven in a hurry by both the researcher and reviewers. On reflection, debriefing was important especially when the main purpose of the reviews was hidden from the reviewers and the research was complex. However, it might not be appropriate to conduct immediately after the group-review. Reviewers should be involved in deciding when and how the debriefing is to be conducted afterward. To ensure critical dialogues, it was recommended both reviewers and the researcher should take time to decompress and reflect on the experience; hence, allowing the reviewers to shift from an authoritarian role into an open and initiative mentoring attitude for debriefing. Furthermore, to preserve the vigour and enjoyment of a discussion, it was felt that there should be a nominal limit of about an hour for a critical review. If there were multiple review themes, it was recommended to conduct multiple group reviews to deal with individual issue rather than to burden an hour review with an overwhelming agenda.

4.3.6 Conclusion - game production experiment

Applying the "Practice as Research" model to a game application revealed how it might aid an animator to clarify animation practices, expand their views and create novel possibilities. The experiment demonstrated that different research methods such as applied animations, reflection and review processes, visual research, case studies, and interviews played important roles in "Practice as Research" to study computer animation and was applicable to industrial game projects.

The reflection process is divided into reflection-pre-action, reflection-in-action and reflection-on-action before, during, and after the production for the "Practice as Research" model. The difficulties of reflection-in-action revealed in the pilot study, were resolved by identifying *Involuntary* reflection-in-action where spontaneous ideas were captured effectively without intellectual constraints, and *Periodic* reflection-in-action where reflections were promoted or re-examined in the next immediate opportunity or later organised period. Reflection-on-action was divided into two phases. *Casual* reflection-on-action was conducted during the decompression period with the aid of comments from third parties and exercises such as editing animations, revisiting reflection notes and building Hypertext. These were found to encourage reflection without interrupting decompression. In this reflection stage, it was noted that reorganisation and exploration of thoughts and experiences to embrace preconceptions and personal emotions, allowed clarity and also self-understanding. *Formal* reflection-on-action was the second phase and would only be useful if the practitioner managed to surrender ownership of the production and adopt an open mind to criticism. By critical writing and reflecting on new experiences, one could integrate new thoughts with previous experiences to produce different insights. The success of reflection-on-action was influenced by the quality of records obtained from reflection-in-action, exercises conducted during decompression, self-understanding, openness and the application of different reflection techniques. It was hypothesized that the identification of different reflection focuses for example, practical, technical, aesthetic, and so on, might improve the quality of reflections. However, in this experiment, there were not enough data for detailed analysis and it was concluded that the issue would be taken up again in the narrative application (See Section 5.3.7).

Reflection tools and techniques for "Practice as Research" were examined. It was found that different tools yielded different qualities of reflection and some tools were more effective than others in certain situations. Reflective writing could reveal the depth of a topic and also one's thinking whereas diagrams could simplify concepts for display and sometimes, reveal ideas that texts failed to present. The complexity of the written texts would govern whether it would be useful for recall or critical reflection. The quality of reflection was found to be influenced by the choice of reflection techniques used during different stages of "Practice as Research" more so than the type of tools. Although this experiment had identified and used skills such as mindfulness,

critical thinking, mental dialogue and meta-cognitive processes, decompression and critical dialogues, there was insufficient awareness and too few records during the experiment to pass critical judgement at this moment.

The review process was found to be complicated to organise. Three models of review were tested in this experiment, aiming to answer the question of why some animators reported that reviews were not helpful (see Section 3.3.4.2) and why the same review style failed to yield positive result in the pilot study. It was evident that there was a general lack of understanding of the review process and its qualities, and there was neither a clear review procedure to follow nor a general practice to assess the practicality and quality of reviews. Different review models, imposed structure of a review process and a clear preparation for review proved some success but at the same time, revealed many other factors which would lead to a confused review and its lack of criticality. It was concluded that a *good* practice also required a process to examine review and its quality. There were many uncountable measures influenced review quality, such as critique knowledge and the skills of the practitioners and reviewers, their personal qualities and goals that were not looked into in this experiment. It was suggested that further investigation on review process was needed in the next principal application (See Section 5.3.5).

A significant outcome of the review was the confirmation that a Hypertext presentation of this research had the potential to show the research journey and assist in the review process. It was possible to demonstrate how an animator articulated knowledge and practice of a creative subject whilst displaying visual outcomes and reflection notes for assessment. Together with the written thesis, the final Hypertext presentation may provide a complete picture of a "Practice as Research" in computer animation.

"Practice as Research" was demonstrated to be valuable for (computer) animation studies and research. It showed that the model was applicable to game and commercial applications. It encouraged animators to examine their mindset and personal qualities, clarify and evaluate *new* experiences, aiding creative thoughts and possible knowledge, and in turn going through transformation of perspectives. The research journey clearly demonstrated that "Practice as Research" could allow multi-contextual* study and required multi-tasking from the researcher, flexibility in thinking and interdisciplinary views. There was a potential for the scope of the study to become increasely broad. Therefore, for this particular PhD research, I decided that a single subsequent game experiment (Persona) be conducted to complete the study on computer animation practice and also address remaining issues about the game application (see Section 4.2.5). The second principal application - experimental narrative animation would focus on refining "Practice as Research", its reflection and review processes.

4.4 Persona experiment procedure

Overview

This chapter addresses the following points:

- It presents the second experiment in the principal game application.
- The Persona Design is clarified and tested by using (humanoid) characters and personality animations to complete the evaluation.
- It re-examines the Functional Design process by varying interactivity in game animations.
- It confirms the "Practice as Research" model for the next application - narrative animation.

The summary of the first game experiment (see Sections 4.2.5 and 4.3.6) suggested that there were still areas within game character animation production that required clarity.

In the preceding sections, the Persona Design process was shown to be useful for 3D animators when designing characters. However, the previous experiment was somewhat limited in that a fantasy creature might not fully demonstrate human emotion or personalities. Thus, the experiment described in this chapter applied character animation to a humanoid character to complete the evaluation of the Persona Design process.

In the previous experiment it was not clear whether the interactivity of a character, or the use of computer animation necessitated a Functional Design process. To address the first point - the degree of interactivity, this Persona experiment was designed to make character animations for non-playable characters within a computer game scenario. The second part of the issue was be explored in the narrative principal experiment (see Sections 5.3.2).

The procedure used in the previous experiment (see Figure 12) was applied to this second Persona experiment, using Persona Design and Functional Design processes in pre-animation, and reflection and review processes in production.

4.4.1 Specification and Assumptions

This experiment illustrated in Figure 24, produced animation sequences of three different humanoid characters *(see Menu: Persona)*. They had identical rigs, skeleton structures, and controls but were designed and animated to show subtle differences in personality and style. These differences to the previous Mermaid would hopefully shed light on the applicability of the Persona Design process. A game studio supplied the characters but I had complete freedom to modify their design and create their animations provided that the results could be put into a gaming environment. In the game, the player did not control these characters and they had little interaction.

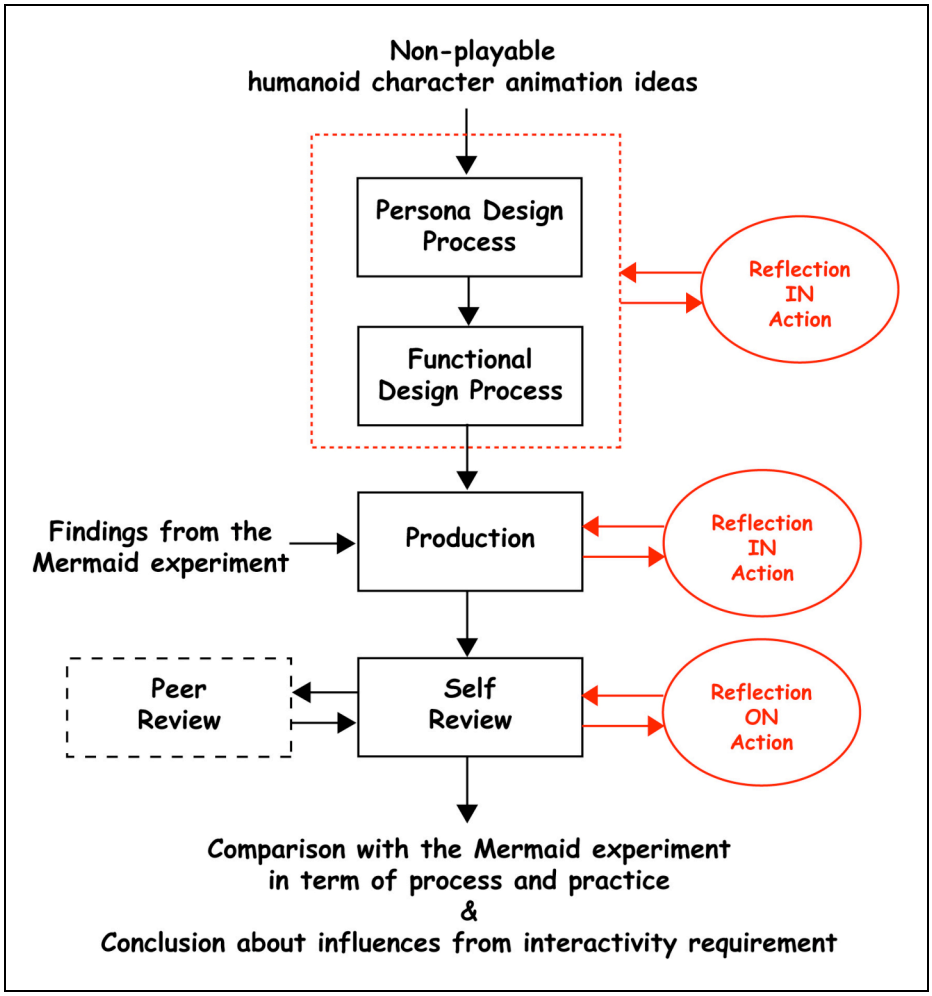

Figure 24. The proposed structure for the Persona experiment

I created a brief specification for the three humanoid characters with different personality traits. The three characters were defined as: a maid, a high profile lady and an elegant Queen. Their behaviours were to be consistent within themselves, and were to be shown through their different behavioural animations. It was important that the three characters should stand out from each other in terms of their actions and style *(see Menu: Persona - reflection)*. Facial expressions were

deliberately excluded from the animations in order to focus on how postures and animations could convey both emotions and the apparent personality of a character.

4.5 Persona experiment, findings and reflections

4.5.1 Visual research

The visual research method to clarify and modify animation specifications of the characters used similar approach to that in the previous Mermaid experiment. Visualisation and its results are displayed in the Hypertext *(see Menu: Persona - reflection)* and therefore, not repeated here.

It was noted that preconceptions on human characters appeared to be stronger than those of the fantasy creature studied in the first experiment. Such preconceptions might arise from mass media, current fashions in computer characters and perhaps more importantly, our intimate interaction with the world and fellow human beings. With these points in mind, reflection was conducted during pre-animation and production to explore this tendency to imbue human characters with assumptions.

It was found that a professional's opinions on a subject could be narrow whereas an outsider might be able to offer naive but thought provoking leads as shown in this experiment. In an attempt to achieve this emotional distance, casual arbitrary stories were imagined about the characters so as to write over initial preconceptions and engage the animator with the animated entities. In this experiment, the stories gave the three experimental characters different backgrounds and experiences, which would tend to result in different personalities and desires in their imagined lives.

4.5.2 Persona design process (continuous study)

This section presents the additional information of the four stages in Persona Design process and compare with those in the previous Mermaid experiment:

1. Character Abstraction – to maximize design possibilities
2. Observation and Analysis – to expand and filter ideas
3. Persona Selection – to select relevant elements, identifying shared qualities
4. Persona Application – to verify character and animation design

4.5.2.1 Character Abstraction

The process of Character Abstraction made use of the experiences of team members irrespective of whether they were animators or artists. One of the difficulties, also encountered in the previous experiment, was that professionals in the industry were automatically aware of the project's direction and catered for possible limitations; hence non-professionals were asked to contribute wider possibilities *(see Menu: Persona - reflection)*. Another difficulty arose in the choice of keywords that were intended to reflect the subtle differences between the three characters but at the same time, create contrast and empathy. Appendix 37 presents the initial notes and peer's opinions on the three female characters created in this experiment.

4.5.2.2 Persona Observation and Analysis

Persona observation and analysis was found to be a straightforward task because the near-human nature of the characters meant that little effort was needed to search for studied subjects and to lead the viewer to imagine a plausible personality for each character.

Prior to my research I had a well-established habit of observing human behaviour. For this experiment, I deliberately focused on women and studied those ladies of specified ages to the characters, the physique, and behaviour. One of my observations was that simple changes in physique and clothing-style could give rise to unusual gaits that in turn influence movement and style. Similarly, choices in clothing could further modify postures and the overall impression of the character.

Real life observation was not as successful for this experiment due to the faux-historical nature of the characters' clothing. Therefore, observation was narrowed to examine only relatively slender tall women, wearing long dresses with different types of footwear. Watching women in coffee shops chatting or women standing on the street provided examples of natural styles and a variety of gestures for reference.

I did not document my observations in detail or conduct detailed analysis since due to my habit, I had plenty of stock ideas for them. Instead, in this experiment, I used the exercise to reduce my preconceptions and expand my views. This approach can be described as 'holistic observation' focusing to capture essence of personalities as opposed to 'inductive observation' described before in section 4.2.3.2.

The exercise revealed that observation criteria would develop during the process, focuses of the observation might need to be modified and filtered whilst the analysis was carried out. It refined

towards those items that were found to be interesting and relevant to the animated characters. Often, it was found that the unpredictable nature of public places meant that a degree of openness was needed – whilst waiting for particular subjects to appear, all too often, people with other notable attributes would appear.

Furthermore, *how one should observe* could be a personal choice and depend on particular purposes. For example, 'inductive observation' (see Section 4.2.3.2) was used in the previous experiment where as 'holistic observation' was used here. These identifications about observation and analysis only became apparent in this experiment when reflecting the differences to the previous Mermaid experiment.

4.5.2.3 Persona Selection

A selection process was used to reduce the quantity of data and creative ideas about the characters, and was found to occur even during the observation and analysis stage. In this experiment, an important goal was to ensure the three characters were equally interesting and had varied personalities. Their personae were intended to be multi-faceted and yet showed similar behaviour at times so as to drive them towards a similar goal in the game's story.

Keywords (see Appendix 38) were identified to mark the special qualities or desires of the characters.

4.5.2.4 Persona Application

As in the previous experiment, '3D posing' and applied animations (see Section 4.2.3.4) were the methods used to verify the 3D character design, rig, and controls that could best generate the desired animations and so improve production effectiveness. *(see Menu: Persona ->Design)*

Persona Application revealed advantages of each character but also its limitations in terms of practical problems with the rig and so on. Such information would allow animators decide how to exploit aspects of the character or modify it to avoid difficulties.

The following image shows different ways to create bones for a dress. They all influence how and with what efficiency the dress could be animated and the resulting quality of the animation. Persona Application allowed those possibilities to be tested prior to the production *(details in Menu: Persona ->Design - reflection)*.

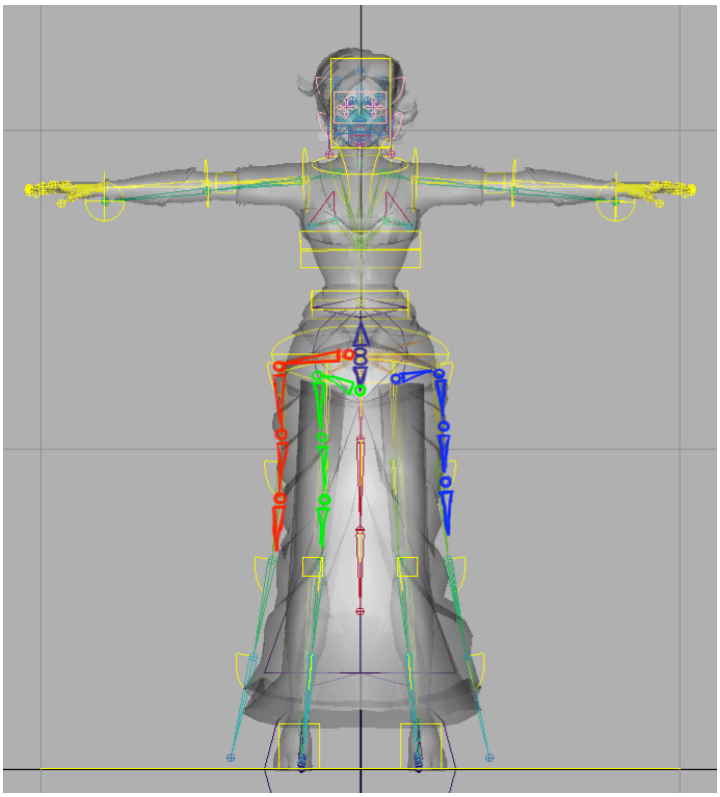

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Figure 25. Three locations for the dress chains to join the main skeleton

Persona Application identified the need to separate the hip movement with the centre of the character if I wanted to provide extra subtlety for feminine postures. It also identified three different locations to where the six dress chains to be linked to the main skeleton – directly from the character's centre (in red), from the end of the hip (in green) and from the top of the thigh (in blue).

In the production of their animations (see Appendix 39), I came to a deeper understanding the relationships between posture, personality, emotion and style, which were topics frequently discussed among animators and in my research interviews (see Section 3.3.4.6).

To gather different opinions, I presented those poses and animations to a colleague and a friend for discussion.

My insights on posture and style led me to conclude that Persona Design process was not only useful for computer animators dealing with characters' personalities and animation planning (also found in the Mermaid experiment), but also could expand one's general and stock knowledge for character animation. Therefore, it is seen as a *good* practice for animators and can train observation and analytical thinking independently to animation work. The visual results and practical reasons *(see Menu: Persona ->Design)* are shown in the Hypertext and therefore, are not discussed in this thesis.

4.5.3 Functional design process (continuous study)

Functional Design in this experiment (see Figure 26) was found to be much simpler in this experiment than in the Mermaid experiment (see Figure 14). The main explanation for this simplicity is that these three characters have less degree of interactivity and the integration requirements with the game engine were not as complex as for player/playable characters. Hence, less time and effort was needed to resolve practical issues or technical limitations to ensure that the final animations could perform in the game engine seamlessly.

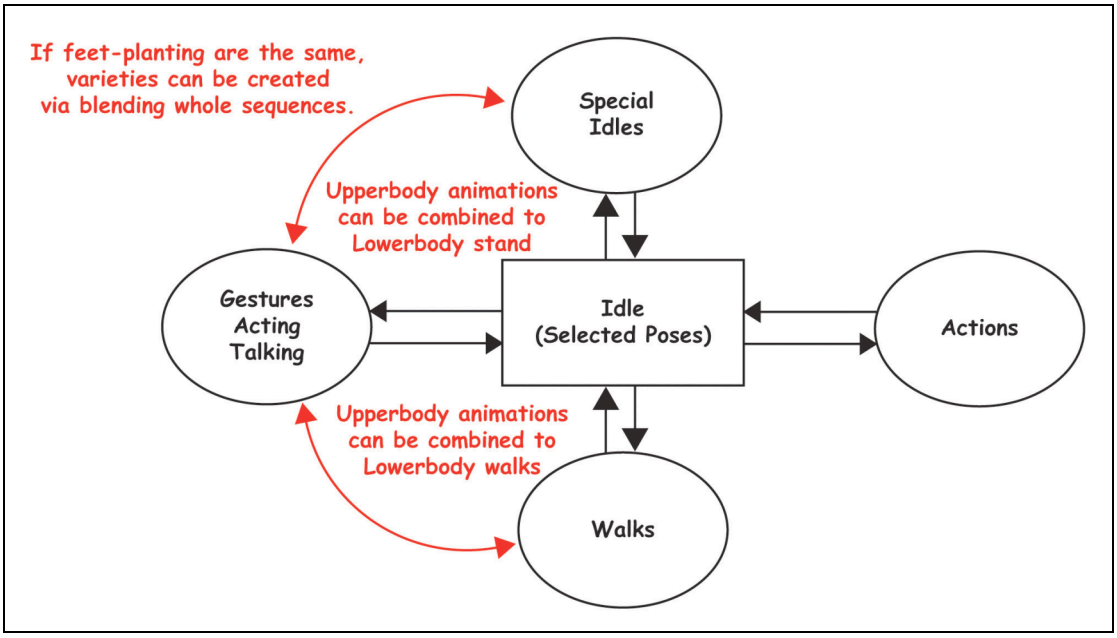

Figure 26. Basic functions, required animations and possible expansion for character animations

The two experiments in the game application had shown that the degree of interactivity of a game character influenced the complexity of the functions and animation structure of that character. Hence, I conclude, interactivity has led to the need for a critical Functional Design process.

In this Persona experiment, it was noted that animators had fewer practical constraints and more freedom to consider animation aesthetics when they worked with characters of weaker interactive requirement. The focus of the Functional Design moved towards how to maximise the aesthetics and creativity in character animations by exploiting technologies (see Figure 26), for example, selected and combined parts of the animation automatically by the game engine. This approach to Functional Design expanded personality cues and styles that engaged with audiences similar to how a narrative animator would practice. It had been suggested that emotions could be evoked in game-players from the sophistication of animation and its quality. These research experiments further suggested that game animators could enrich their audience's experience by striking a

balance between practical and aesthetic issues, and exploiting creative use of technologies. The use of a critical Functional Design process ensured that game animators made informed choices so that they could overcome limitations, create new possibilities with technologies and excite audiences with original work.

During the research interviews, it was noted that some game studios treated character animations differently (see Section 3.3.4.7). For example, animators were asked to produce a list of animations and were given no information about the role or the logical structure of the character's behaviours. Some animators stated that they would *just* animate while others would put rough animations in for the game play as quickly as possible and later, produce animations to suit. However, the initial lack of control and those semi-random iterations can readily lead to poor quality work. A game animator, who mentioned that animators would be blamed if animations failed to look good or perform well in the game, also reflected this argument. Although some game animators said that they would perform a degree of testing, such tests were usually evolved around the game play or in post-animation stage rather than focused on maximising technical and aesthetic integrations as shown in the Persona Design and Functional Design processes early in the production design.

The two game research experiments demonstrated that there were benefits in using a Functional Design process to plan and test animations in pre-production. It could provide tighter control over studio practices, reduce the need for workarounds or fixing works, and might even improve creativity as demonstrated in this experiment with exploiting the technology to aid aesthetic concerns.

4.5.4 Animation Practice - Influences by Interactivity and Games

I concluded in the previous chapter, that animators appeared to have more aesthetic freedom in creating character animations when interactivity became a minor concern. It was found that the degree of interactivity needed from a character had no significant influence on an animator's visualisation, Persona Design process, and animation production. Instead, the level of interactivity affected *integration* between a game and its animation – lower level of interactivity had fewer integration issues naturally. I therefore suggest that the Functional Design process is useful for creating complex game characters to identify practical limitations, provide possible solutions, aid validation and maximise technical and aesthetic capabilities.

Even disregarding the influence of interactivity, the nature of games is such that they still do not allow animators complete control. Simply put, a game is a real-time running program; hence, non-interactive and pre-choreographed animations are seldom used (apart from in-game movies to

deliver storyline such as in Final Fantasy). In these two experiments, the most frequently observed limitations were those of timing and the length of an animation sequence. 'Timing' here can mean the speed of the actual animation or the delay between a player pressing a button and the player's character starting an action. In games, there is always a tendency to have distinctly stylised, faster and shorter sequences *(see Menu: Mermaid ->Anim)* to cater for the action and reaction lags or to enhance the *thrill* of the game play using a non-uniform pace. In another words, game character animations have constraints on timing and style that can readily lead to 'unnatural' results. Convincing characters displayed in high quality animations are therefore harder to achieve for games.

There are another aspects that directly affect an animation sequence. The effects are subtle but yet the impact can be great. One may think that an animator can still decide the length of a sequence depending on either their creative skills or knowledge of the type of action such as an attack or a walk. However, I found that a game application still had other subtle restrictions on 'Timing'. If we take the walks in this experiment as examples *(see Menu: Persona ->Anim - Walks)*, the three characters had to have very similar walking speeds and gaits so that when they were all placed into the game, they would not lead or fall behind from each other. In the event of these characters following the player's character in the game, they also had to walk at a speed similar to that of the player's character. Some actions *(see Menu: Persona ->Anim - Actions)* might have to share similar sections of game play or duration with other characters and therefore, the choice of 'Timing' could be further restricted. These hidden relationships can extend further and may further limit the chosen speed or length of any animation sequence. These subtle effects can degrade the quality of an animation since rhythm is a powerful element in animation for communicating personality and style. The rhythm of an animation, another customisable features and broader range of available variations, allow for more varied impressions of a character. Therefore, when an animator loses control by having a set rhythm in multiples sequences or distorted by a game engine, it impacts the quality and the variety of animation, as was seen in this experiment. For example, in the walk animations, the characters were perceived as having little variety since the rhythm of the walks stayed similar. Hence, for yet another reason, natural and individual styles for game characters are difficult to achieve.

4.5.5 Animation Practice – for Character Personality and Style

The completion of this Persona experiment provided an opportunity to continue the study of animation practice, specifically for character personality and style. During review in the pilot study and interviews with animators (see Section 3.3.4.6), it summarised that a pose, a walk or a gesture might reveal more personality traits and style than an action or a reaction.

In the Persona Application, a variety of postures and applied animations were used to explore subtle differences between the three female characters. For example, a twist of the hip or the spine, a tilt of the shoulders or the head, the curves on arms and legs, gestures with the hands, the distribution of the weight, etc. were examined on those three characters who were required to exhibit different personality traits.

The postures designed by the animator were applied to the different characters and assessed for their suitability according to their Personae. It was demonstrated that the variety came from subtlety in the postures rather than from other technical factors (such as the finesse of their skeletons and the facial rig). The resulting postures also demonstrated that visual cues for a character were influenced by a variety of factors: the model, its accessories, the textures used to paint the character, and importantly, the character traits reflected by the posture *(see Menu: Persona->Design)* – the way they stood, looked, carried themselves, etc.

For animation design, I looked for contrast and variations among the three characters and disregarded their physical model and focused on delivering an impression of their personality and style.

Default poses were used as the basis for character animations and alternative (more elaborate) poses would enrich animations and transitions between different sequences as shown in (see Menu: Persona->Anim – Special Idles). The alternative poses consisted of elements that opposed to the elements in the default pose. For examples, if the default pose has a degree of muscularity to it, the alternative pose would have a feminine suggestion. If the default pose shows authority, the alternative pose would either take on a natural and friendly representation or a more flamboyant style to create some differences. (see Menu: Persona->Anim – Gestures)

At the technical level, if the default pose has the character leaning her weight on one leg, the alternative pose would have her weight on the other leg. If the body twists to one side in the default pose, it should twist differently or towards the other side in the alternative pose. These opposing elements ensure maximum variety and flexibility for animation to expand the perceived personality and style in production.

It is worth noting, after all this discussion, that a character's personality and style are subjective impressions formed by viewers and may not reflect the choices made by the animator. During observation, it became apparent that measures of personality and character style were governed by culture, society, mass media, fashion, etc. and therefore, cannot be studied in isolation and free of context. Hence, this experiment can only be used as a demonstration of the working process and

what result can be possible – it is not a demonstration to show that particular postures can deliver a certain personality or style. This insight is in opposition to the *common* practice in traditional animation in which animators suggest using *short-hand* and *stereotypical* postures that are identified with certain personalities and traits, for example, a proud person would puff his chest up, or a shy person would have a drooping head, etc.

The insights into character personality and style in this experiment led to a different concept in handling these illusive elements for character animation. The idea built on studies in psychology and sociology where categories, or so-called dimensions of style defined by Gallaher (1992). It was noted that animators could break down concepts to design character animations that conveyed different dimensions in personality or style. 'Expressiveness' is used to focus on the variety, complexity and energy level of a character when they act, communicate or interact with other characters. In practical animation terms, this governs the basic animation and its speed. 'Expansiveness' concerns how the character interacts with its own space, that of others', and the environment. The basic ideas are, for example, how far limbs are extended in relation to the body when acting; how much space an action demands from the environment and other entities when interacting, etc. This shaped the animation and the volume of the action. Finally, 'Coordination' looks at the relations between different body parts or with objects and other characters, and the quality of a performance – flow and skilfulness, for example, how well one acts to achieve a physical goal, the aesthetic and rhythm of an action.

In contrast to the Mermaid experiment, I found myself posing the characters and acting out their movements in this experiment frequently. Presumably that was because I was dealing with humanoid characters with whom I could perform their actions physically.

The different experiences between the two game experiments showed that acting technique was applicable to humanoid character animation, but might be less useful for fantasy characters. This may also explain why in the research interviews, not many animators reported the use of acting techniques whereas traditional animation texts tended to emphasise its benefits. The modern computer animation both in games and movies, allow a variety of characters and not limited to anthropomorphic characters as used frequently in the traditional 2D animation. This may be another reason for animators to choose other techniques to assist animation instead of acting, such as stock video of animals or observation as reported in the interviews. However, it was noted from the experiments that some aspects of acting were still important, for example, the use of mental rehearsal.

To develop character personality and style, it was noted in this experiment that drawing and sketching techniques were not as essential as described in traditional animation era. I surmised that

some traditional animation tools might have been transformed by the use of computers. For example, instead of sketching, animators reported to animate their characters directly on the computer and in my two experiments, I used "3D posing" and applied animations to evaluate characters and styles interactively. Whilst some methods may be reinvented itself in an altered form, new techniques may arise for the new medium. For example, the processes of observation and mental rehearsal, my personal action flow concept in a 3D space, led to the concepts of 'Pose Targeting' and 'Trajectory Visualisation' in this research (see Section 4.3.3) can be seen as newer approaches and may be useful for computer character animation and design.

4.5.6 "Practice as Research" – reflection & review processes

During the animation production in the Persona experiment, individual animation sequences were monitored by reflection-in-action and information was recorded for review purposes (see Appendix 40). The time records showed that there was no significant increase in production time when using "Practice as Research" in game application. Even in the previous Mermaid experiment when I was unfamiliar with the research process, the production of the game animations seemed to fall into an acceptable time frame of the industry. It was presumed that the case studies and reflection experiences gained in the pilot study and the tight pre-animation process meant that the extra time spent in recording and reflection was made up for by the raised efficiency of the production and overall process.

The two reflection processes - Involuntary reflection-in-action and Periodic reflection-in-action identified in the first experiment were used in a more natural and spontaneous manner. With a longer decompression after the production, it was found that Casual reflection-on-action using techniques, such as editing animations, revisiting records, third-party dialogues and Hypertext construction, yielded a detailed production record and clarified experiences during reflection-in-action. The quality of the material was valuable for critical assessment in the later Formal reflection-on-action.

Reflection processes summarised in the previous Mermaid experiment were examined in this second Persona experiment and were found to be irreplaceable within the "Practice as Research" model. Reflection tools and techniques, in particular, active recording, mindful practices, mental dialogues, reflective writing, and now Hypertext writing were concluded to be of value - a finding similar to that from the first experiment.

On completion of the experiment, character animations were sent to two professional animators for peer-review. Reviewer A returned the work with written comments as requested (see Appendix 41)

and Reviewer B managed to load the three characters into a game and confirmed their functionality. The report from Reviewer A turned out to be more technical and game-oriented than had been anticipated. Although the document identified problems and contributed potential solutions to a game application, it did not offer any critical comments on the topics such as animation and game processes, or comments that assisted me to re-think. Reviewer B purely assessed the characters as a product; hence, the comments were narrowly focused.

These phenomena had been experienced in the previous experiments, in the industry and also discussed by animators in the interviews (see Section 3.3.4.2). The content from both reviews implied that sometimes with a specialist level of knowledge, one could overlook the basics or fail to view things differently. As was shown in the experiments, such an informal method might be useful to assess a product quickly and again proved to be unable to yield rigorous discussions and satisfy a critical review. Also, the results contributed little to the advancement of the work or knowledge, and did not bring new challenge to the practitioner. Therefore, it was concluded that this type of review process, which lacked a tight procedure and a recursive structure was less useful than those used in the Mermaid experiment. Hence, simply and commonly used (product-oriented) review process that currently satisfied the industry, was definitely not able to assist criticality in my "Practice as Research" model.

4.6 Game Application Conclusion

The Persona experiment successfully validated the Persona Design and Functional Design processes to complete the investigation on game applications. It concluded that the interactivity requirement of a game influenced aspects of the processes but both processes were valuable for developing a character and its animations. Both the Persona and Functional Design processes were designed to be rigorous processes to ensure critical production for computer animation; therefore suited for the "Practice as Research" model.

During the production, new insights emerged about computer animation practices and character personality and style. It was noted that reflection naturally involved different aspects of the production and in this case, also different concerns about the research process. Reflection was found to be confused if the practitioner was unclear about its purposes or attempt to reflect everything at the same time. The experience in both experiments pointed to a similar finding - there could be different reflection focuses applied to a given piece of work; such as practical, technical, aesthetic, self and critical. If the reflection process can identify them early in the production, clarity may lead to critical analysis (see Section 5.3.7).

The two experiments in the game application demonstrated that when using "Practice as Research" model to understand processes and to clarify animation practices or animation-related questions at the same time, a researcher could also study oneself and develop different perspectives. Those questions centred on animation design and aesthetics, as shown in the Mermaid experiment, and on the character's personality and style, as demonstrated in the Persona experiment, could be of value to animators though they were not the main focus of this research. The "Practice as Research" model has the potential to extend to multi-contextual[25] studies or to limit a study on minute details, for example, various approaches for a walk cycle, as shown here. "Practice as Research" creates a research space for animators to explore a phenomenon or any *popular* discussion using experimental works and critical analysis. It trains an animator to develop self-awareness, critical judgement, management skills and multi-tasking[26] technique, which have not been promoted widely in the community. These two experiments showed that the skilful use of "Practice as Research" could benefit the development of an animator, possibly improve the qualities of work and increase efficiency, but did not affect production time; hence might also be suitable for studio practice and commercial use.

From these two experiments, a clear structure of reflection process and a more practical and critical review process cannot be confirmed for the "Practice as Research" model. This is because mindful practice did not extend deeply into the meta-cognitive process used during the production and the details were not recorded thoroughly as that lay outside the remit of the game experiments. However, these two outstanding issues are anticipated to be the main themes in the next round of the principal research – narrative application that is described in the following chapter.

[25] Of or involving several contexts or aspects of study from variety of standpoints
[26] A simultaneous execution of a few mental or physical tasks

5 The Principal Research - Narrative and Experimental Application

Overview

- This chapter describes the experimental narrative animation production.
- It presents findings of the experiment and compares them with those in the previous game applications.
- It describes the reflection and review processes used in this experiment.
- It demonstrates different levels of reflection and multi-tasking in both reflection and review processes.
- It concludes the Hypertext presentation and its utility for computer animation and practice research.
- It summarizes that the "Practice as Research" model is a multi-contextual study method and has values in experiential learning to encourage perspective intervention and transformation.

5.1 Introduction

From the principal game experiments, it was concluded that the proposed "Practice as Research" model could be successfully applied to an industrial project with little impact on production process and time. The "Practice as Research" model stipulates that production is performed with a mindful and critical attitude and requires its user to adopt a rigorous reflection and review processes. It is possible that diligent use of the model could lead to an increased level of creativity, a higher quality of work, intervention and possible transformation of the user's views.

It was noted that during the research process, practitioners might have the flexibility to perform multi-contextual* study, for example, on (computer) animation practices or its specific techniques, and animation aesthetics and functionality for games, etc. To further investigate this phenomenon and expand the use of "Practice as Research", an experimental narrative was designed for this second principal application. Although the research methods remained the same, this experiment used neither a goal-oriented approach nor common industrial constraints[27]. Instead, it focused on experimentation in a project and the creative development of a practitioner.

In this experiment, the multi-contextual* approach included the re-examination of Persona and Functional Design introduced in the previous game application. These processes that dealt with character creation and integrated animations and functions in the game application, were evaluated for use in this narrative application. A further point to study in this experiment, but not in the earlier experiments, was the use of an animatic. Finally, this experiment addressed a conscious exploration of *new* technology and *old* animation practice - mixing techniques to stimulate aesthetic sensibilities and challenge an animator's preconceptions.

This narrative experiment used intentionally limited* character animation and 'controlled' elements to promote character engagement, for example, facial animation, fluid 'natural' animation, and familiar settings and designs. The idea behind these choices is that animation is separated from reality. Thus, the use of realistic animation is a popular but not mandatory choice - realism is, one might argue, not necessarily the *best* way to negotiate with an audience.

[27] Such limitations might include production schedules, animation styles, technical limitations, and so on.

5.2 Ningyou Narrative experiment procedure

This experiment produced a narrative animation piece using a single character named Ningyou[28]. The research consisted of the complete process of animation creation, beginning with visual research, concept design, storyboard making, the pre-animation process, production of a 3D animatic, and finishing with production completion. The application of "Practice as Research" was examined during the process and the use of reflections and structured reviews was investigated at different stages.

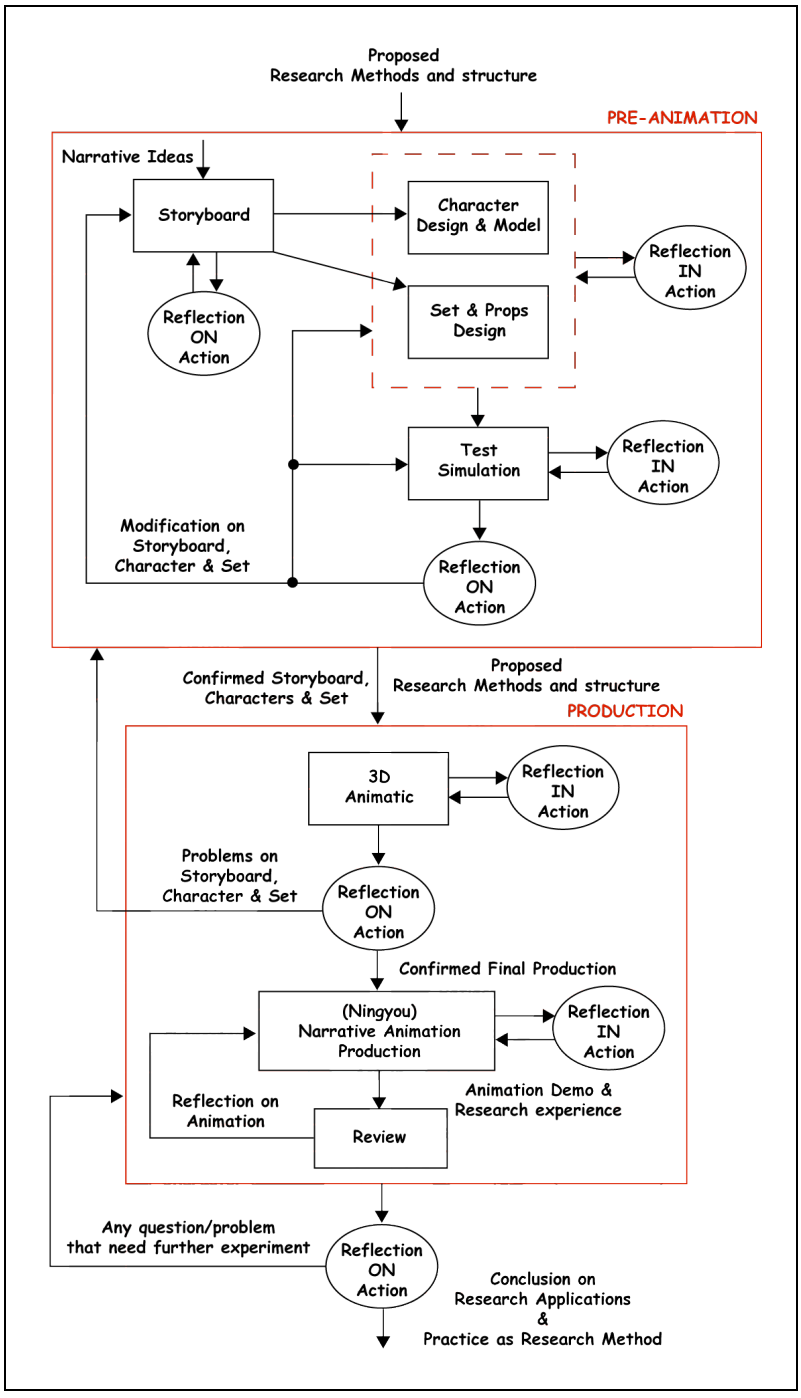

Figure 27. The proposed structure for the Ningyou narrative experiment

[28] 人形 - Ningyou or Ningyō - the Japanese word for a doll, sometimes applied to a puppet or marionette

Figure 27 shows the structure of the experiment and its two basic phases as I conceived it. Firstly, pre-animation consists of visual research, storyboard creation, persona/set design and functional simulation. The second stage consists of the production, including 3D animatic making, cinematography, animating, compositing, and editing.

The experiment generated both records of visual research and reflection notes on the concept design that are not repeated here. The reader can refer to the Hypertext *(Menu: Ningyou – reflection)* for details. Information about the inspiration behind the visual work and the story is also available *(see Menu: The Poem and Storyboard)*. Similarly, pre-animation studies, in particular character design, modelling, and texturing that demonstrate knowledge and practices articulated by an animator can be found in the Hypertext *(Menu: ->3D Design – reflection; ->Textures – reflection; ->Set&Prop – reflection)*. Despite the breadth of information and the complexity of the animation preparation, those details are not the main focus of this research, thus the artistic development and that part of the research journey is displayed only as Hypertext, and is not repeated here.

The Functional Design process introduced in the game applications was re-examined in this Ningyou experiment and generated a series of test animations for study. Reflection and review were performed during the process as both continuous assessment and verification of the concepts and the visual products. Test animations, reflection details, and various solutions can be found on the Hypertext *(Menu: Simulation -> Anim Tests; ->Dynamic Tests; ->Cloth Tests; ->Kimono Tests; ->Lighting)* and those details and findings, whilst not repeated here, may be used as examples in discussion.

On completion of the pre-animation stage, a 3D animatic (shown in Figure 27) was created and in this application, there was a conscious decision to explore "the new" - technology and "the old" - animation practice. Hence, while making the animatic, a variety of techniques were used and their artistic merits were explored. This stage of the experiment also provided an opportunity to examine the role of an animatic in computer animation and evaluate reflection and review processes at the animatic stage. These visual outcomes and their associated discussions can be found at the Hypertext *(Menu: Animatic; ->Reflection)*.

The Ningyou narrative production was commenced after the 3D animatic had been assessed. By then, many visual and practical issues had been examined and appropriate solutions or alternative ideas identified. Throughout the Ningyou production, the "Practice as Research" model, critical reflection, and review processes, were assessed. Production notes and visual outcomes were made and recorded in the form of Hypertext *(Menu: Production; ->Reflection; ->Review)*. These notes

assisted immediate reflection on the practitioner's activities and decisions and allowed others to explore the research journey. Since the artistic development was not the main focus of this experiment, I will not repeat those contents in this thesis.

5.3 Narrative Application, findings and reflections

Case studies and the previous experiments furthered the understanding about different animation practices and my personal strengths and weaknesses. In research interviews, I also gathered different experiences from a variety of practitioners to broaden my understanding of production processes and character animation techniques. Some of those collective data were evaluated in previous experiments and brought about new insights. Although visual research was not studied extensively in the previous experiment, it was proved to be useful in revealing a wide variety of concepts and performance styles for this narrative. The following diagram attempts to display the contributions from different research methods in this narrative experiment.

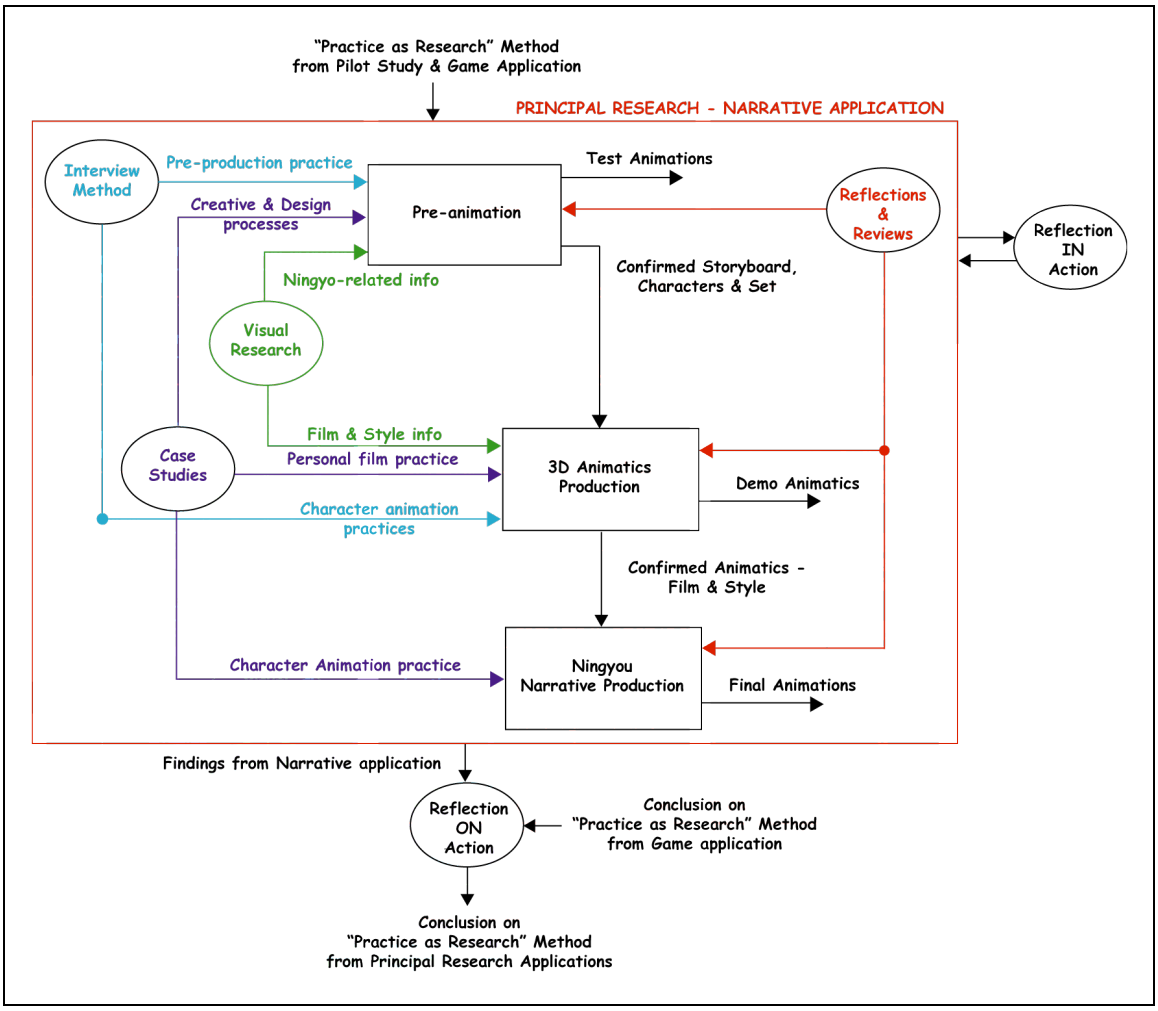

Figure 28. Data flow diagram of the Ningyou narrative experiment

As shown in the diagram, at every stage of the preparation and production, the "Practice as Research" model encouraged the use of the reflection and review processes. Different levels of reflections and reviews were introduced to perform continuous and explicit reassessment in the project. Different reflection focuses, suggested in the game conclusion were put into practice and were evaluated. On completion, further reflection and review were conducted. This approach provided a degree of criticality for "Practice as Research" as described in later sections.

5.3.1 Visual research and Concept design

Because of the nature of a narrative and experimental animation, the visual research activity and design concept in this experiment were less tightly constrained than in the previous game applications. Narrative filmmaking requires diverse knowledge in different visual aspects whereas game development focuses greatly on character animation, game design, and AI programming. For example, the fields of Noh theatre[29], Bunraku performance[30], Ningyou and Kimono[31] making/design *(see Menu: Ningyou)* were studied in this experiment whereas in the game applications, anatomy, personality and human and non-human animal behaviour, were the main focuses of study. Attendance of a live Kabuki[32] demonstration as a visual research also expanded the author's knowledge of performance styles and stage choreography. The loosely constrained and diverse nature of the visual research experienced in this application might have arisen because the "Practice as Research" model encouraged knowledge research and creativity expansion. Instead of performing goal-oriented visual research as shown in the previous application, the practitioner was able to explore more widely.

The pre-animation logbook records showed a lack of direction initially, and research materials were scattered among different fields, for example, film references, photographs, historical costumes, dynastic styles/fashions, etc. It was noted that the diversity and amount of data made the whole visual research process difficult to manage. Surprisingly, reflection naturally occurred in this experiment and led to continuous filtering that was only revealed when the logbook records were revisited. As the main character (Ningyou) developed visually (see Appendix 42), the visual research gained focus and the goal of the performance slowly emerged.

Because of my knowledge of 3D computer animation and the prior experiences gained in this research, the concept and character design accommodated some of the difficulties in 3D animation and exploited the advantages of computer technology. For example, in this experiment, Ningyou

[29] 能 – Noh is a major form of classical Japanese musical drama.
[30] 文楽 – Bunraku is a style of Japanese puppetry.
[31] Japanese traditional wear
[32] 歌舞伎 – Kabuki is a stylized classical Japanese dance-drama.

was chosen to be a low polygon-count model making use of the modelling advancement in the polygons' 'normals' calculation, texturing, and smooth-binding capabilities in 3D software *(see Menu: Ningyou ->3D Design – reflection; ->Textures – reflection)*. The animation controls and rigging were designed to ensure sufficient flexibility for animators to produce high quality animation (see Appendix 43). Although at the end, it was noted that the final production did not fully utilise that complexity, the exercise expanded my practical knowledge and provided a universal character rig for future development.

The exploration in the visual and design processes diversified the research and created extra possibilities for this project. For example, the stage design (see Appendix 44) combined features from typical Japanese architecture and furniture, used non-conventional stage elements such as domestic objects, children's toys and theatrical elements such as skulls, to dress the stage *(see Menu: Ningyou ->Set&Prop - reflection)*. Furthermore, the controversial idea of removing some of the 3D information from the production demonstrated potential for interesting results *(see Menu: Ningyou ->Toon Shader - reflection)*. The diversity in the designs provided training for different levels of reflection and sharpened the selection criteria for the concepts in this narrative piece. The outcomes, such as the design of the character and the story, inherited aspects from the materials collected by visual research method but also incorporated ideas that developed during the reflection and review processes *(see Menu: Ningyou; Storyboard)*. From a novice audience's perspective, those designs might be seen as truly novel or merely copies from another culture, but those who study the details in the Hypertext may find the creative reasons behind those chosen concepts.

5.3.2 Persona and Functional design and simulation

It was noted that the Persona Design process (see Section 4.2.3) was loosely applied in this experiment. One reason was that the narrative animation was not *completely* centred on a character, in contrast to the case in the previous game application. Besides, this narrative experiment aimed to reduce visual cues, and experimented with the audience's perception of personae. Narrative, almost by definition, deals with diverse visual imagery for storytelling, rather than solely creating character animation. However, since the Ningyou could inherit human characteristics and styles, loose Persona design was needed; differed from a fantasy creature that required anthropomorphic elements to convince and capture audiences. In particular, Persona Application was found to be important for experimenting and verifying the character *(see Menu: Simulation)* using applied poses and animations. The results indicated how well the character could be adapted to the story and such information was used to modify the character or story to resolve practical or technical difficulties for the future production.

In the previous game application, the Functional Design process was proved to be valuable for planning animations and functionality of a character (see Section 4.2.4). It was concluded that Functional Design ensured integration between animation aesthetics, and technical developments of a game and its game play. In this narrative application, it was noted immediately that integration with AI programming was unnecessary and one might conclude that a Functional Design process was therefore not required. From classical animation studies and the research interviews, there was no mention of *functionality* for storytelling and narrative animation production. Therefore, it can be assumed that Functional Design for a narrative production may deviate from that used for game animations or indeed, may not be applicable at all.

However, in the previous application, I did hypothesize that for narrative applications, the Functional Design process might deal with integration between characters and other visual elements as a priority and focus on aspects such as storytelling and the overall atmosphere, instead of integration with AI programming and game play.

On completion of the visual research and concept design in this experiment, it became apparent that many questions arose about the challenges of delivering those visual ideas with the capabilities of current computer technology. In classical production, animators would sketch out the sequences for testing but in computer animation, the procedure was found to be more complicated because of the variety and complexity of the constantly developing technology. For example, newer tools or algorithms might offer different solutions or allow different visual effects to be achieved but these would require the animator to understand the technology before they could make an informed decision. This experiment demonstrated the importance to perform Functional simulations to identify effective solutions for visual ideas and to exploit the technology. It was noted that simulations could lead to early warning of potential problems, for example, the requirement for different Kimono models *(see Menu: Simulation -> Kimono Tests)* in this case.

From the reflection notes, practical research and simulations, the use of Maya and special techniques to achieve certain visual concepts dominated the Functional Design process (see Menu: Simulation -> Anim Tests; ->Dynamic Tests; ->Cloth Tests; ->Kimono Tests). Therefore, my early hypothesis that Functional Design dealt with the integration between characters and visual elements, or the overall atmosphere of a narrative piece (Menu: Simulation; ->Lighting - Reflection), was demonstrated to be a secondary goal in the process. It was noted that the Functional Design process was not optimal for evaluating the storytelling; hence, a 3D animatic was called for in the experiment.*

5.3.3 Animatic purposes and application differences in computer animation

Animatics* are widely used in 2D classical animation to ensure that an animated character and the flow of a story and cinematography are well understood at the pre-production stage. In research interviews, some animators recommended the use of an animatic and it was revealed that most of the animators using 3D computer software would skip the animatic and immediately started to produce animations (see Section 3.3.4.5). Also, when asked about their personal practices, computer animators did not stress the use of animatics whereas traditionally trained animators would emphasize its importance. It seems natural that when computer animation has the flexibility to view *unfinished* sequences constantly while animating, an animator may decide not to make an animatic to test animations, unlike traditional animators. However, it was not clear whether an animatic was somehow not needed by 3D computer animators, or simply that the modern practice in animation did not benefit much from it. Perhaps, the advancement in computer animation tools had embraced the functions provided by animatics, for example viewing unfinished animation any time, so that 3D computer animators did not depend on the process to assess their works. However, during interviews, it was mentioned that some studios or directors had to reinstate the practice for management and review purposes. It was said that animatic making could lead to higher quality in animation. My previous experience and the current information returned from the interviews, showed that animatics might not be frequently employed by individuals in their 3D practice and yet, quality animation could still be achieved.

This particular narrative application concluded that the 'traditional' style of animatic was perhaps irrelevant, long-winded and uneconomical when applied to computer animation production. For example, the image sequence for Ningyou that consisted of sketches and sound *(see Menu: Simulation)*, did not translate the essence of the 3D concept in this production. One might suggest that more and *better-drawn* images could be produced for the animatic to fulfil its purpose. However, unlike 2D animation, drawings and sketches were not particularly reusable for a 3D production. Additionally the drawing process was time-consuming and the result would still inherit the problem of not displaying a 3D visual experience. This was echoed by a review comment that the image sequence required the viewer to imagine the 3D world whereas the 3D animatic *(see Menu: Animatic)* could show a clearer presentation to a novice audience.

It was concluded that sometimes we might focus on the *format* of an animatic too readily and not fully understand its concept and purpose. For example, according to the interviews, some directors and animators insisted that only poses of a character should be shown in order to assess animation (see Section 3.3.4.4). This approach faithfully followed the traditional pose-to-pose technique. When they viewed their production, they concluded that the pose-to-pose approach combined with an animatic could yield subjectively *better* quality in computer animation without any further

analysis of the subject. However, the absolute focus on poses alone meant disregarding the software's ability to interpolate between poses. In fact, some animators in the interviews praised this capability which assisted animation planning and allowed clients to understand the details. Interpolation was noted as saving time but could also introduce loose practice into animation, degrading the quality of work. However, this technological feature allowed animators to readily assess the flow of a motion and encouraged aesthetic considerations earlier in the animatic stage. If used properly, this, in my opinion, would raise the efficiency and quality of the final animation production.

In this experiment, an animatic was made for a narrative without constraints on its format or how an animator should approach its making. The process demonstrated that the content, complexity and style of animatic could be a free personal choice *(see Menu: Animatic)* for computer animation. It showed that using technical features of computer animation - in this case, interpolation, and not restricting it to poses only, along with full use of built-in dynamics - could improve the effectiveness and complexity of an animatic. Such an approach could aid the progress of a production and give early warnings of potential production problems. It is worth mentioning that the animatic combined the resulting animations from the Functional Design process *(see Menu: Simulation -> Anim Tests; ->Dynamic Tests; ->Cloth Tests; ->Kimono Tests; ->Lighting)* into a narrative to focus on storytelling and cinematography assessment.

The concept of an animatic and its use were concluded to be necessary for animators to gain full control of a production and give early warning of problems, disregarding whether the animation performed was classical or computer-based. The Ningyou animatic *(see Menu: Animatic)* demonstrated that a 3D performance could bridge the gap for viewers trying to visualise the final outcome from a 2D sequence. It validated the continuity and storytelling of a 3D narrative computer animation and significantly improved the ease with which composition and cinematography were executed. The 3D animatic shown in this research was noted to be the standard of a first-pass animation in the traditional sense. It gave a detailed representation of the final production; allowing its quality to be critically assessed. However, the complexity of that 3D animatic was governed by the available production time and personal preference. It was suggested that if more effort was put into the 3D animatic and its critical review, effectiveness and efficiency could be increased in the final production.

Although an animatic was not used in the game applications, it was noted that its concepts and purposes were effectively incorporated in the Functional Design and validation processes. Game animations centre around characters, allowing the Persona and Functional Design processes to successfully organize animations and track down potential problems. I conclude that an animatic is therefore of greatest use for the assessment of narrative content. This finding could explain the fact

that most of the interviewed game animators did not stress the use of animatics in their practices when they focused on character animation.

With the expansion of computer animation into different fields, certain *old* practices such as animatics in this case, may lose their apparent values and sometimes, the *original* format may need to be modified to incorporate *new* advantages as was found in this experiment. The concept of an *old* practice such as animatics may prevail in an altered form, as shown in the game applications, under the concept of the Persona and Functional Design. This *new* concept of Functional Design was also confirmed to be important in narrative computer animation as it expanded practical possibilities, identified and resolved technical problems, and aided the stage of animatic production. In the principal experiments, the extension and transformation of the animatic catered for a diverse range of applications and permitted early critical assessment in the computer animation.

5.3.4 Reflection and its nesting process in "Practice as Research"

This narrative application provided the opportunity to re-examine "Practice as Research" as well as the reflection and review processes. The main tools for this experiment were the author's logbook, mental dialogue, reflective writing, Hypertext presentation and critical assessment; which were all also used in the previous applications. During mindful practice in making animation, reflection-in-action in the form of 'Involuntary' reflection and 'Periodic' reflection were used at different levels in different stages of the production (see Appendix 45), and details are displayed on Hypertext *(Menu: Production; ->Reflection and ->Review)*. By this I mean that reflection could be performed at a variety of levels – certain degrees of detail or within certain periods of time, and then mentally one could step back to see how that context interplayed with the rest of the work. In this manner a 'nested' sequence of reflection was performed (see Appendix 46). In the following sections, I will explain the details of this approach.

5.3.4.1 Involuntary reflection-in-action

I found that 'Involuntary' reflection-in-action led to random inspirations that seemed to be both relevant and irrelevant to the production. At the beginning of the creative process, those relevant but 'Involuntary' thoughts appeared to be primarily related to practical issues and problem solving for the production. However, that phase of 'Involuntary' reflection was brief and somewhat shallow; sometimes the ideas did not even make sense on re-examination. The logbook records

showed that those ideas were often incomplete and reactive, and could deviate from the project. More importantly, those thoughts were fleeting and easily forgotten at the end of a working day.

'Involuntary' reflection-in-action provided an effective means of registering transient thoughts and decisions during a production, for example, what decisions had been made and on what grounds. It welcomed subjectivity, embraced preconceptions and bias from a practitioner, completely encouraged knowledge and practice to be articulated to capture both positive and negative experiences. Hence, that phase provided a starting point for reflection and critical assessment.

When the animations began to develop, it was noted that my 'Involuntary' reflections increased in their sophistication. For example, in this experiment after the initial registration of unconstrained thoughts, brief debates and alternative ideas would sometimes appear in the logbook.

At this stage, 'Involuntary' reflection-in-action was found to broaden the scope of possibilities, addressed foreseeable problems and was concerned about integration. This showed that a practitioner might need time to understand the contexts, master reflection skills and build up the momentum of reflection-in-action. Moreover, a project (or any production) required time to accumulate a body of records for reflection to occur.

5.3.4.2 Day-end Periodic reflection (-in-action)

'Periodic' reflection (-in-action) was scheduled for the end of the working day in this experiment and was performed more thoroughly than in the previous applications. It employed 'Involuntary' reflection records from a logbook to recall ideas and inspirations, to re-examine decisions made throughout the day, to study outstanding issues and seek alternative views.

'Day-end' Periodic reflection was a low-level[33] reflection process when practical or aesthetic issues about the production were still the prime focus. The outcome of this daily reflection could be a task list for the following day, some longer-term explorations or conclusions that might oppose earlier decisions and affected a wider aspect of the production. This process was found to be extremely effective since actions and ideas were still fresh in the mind and yet the practitioner was free from the immediate distractions of a production. Therefore, one could seek out answers from different resources and plan a forward strategy effectively and critically. It is recommended that a practitioner should allow as much freedom from intellectual intervention as possible in this stage of periodic reflection and aimed to understand one's preconception and clarify those decisions and reflections. A particular problem I encountered was the difficulty in maintaining the quality of the

[33] Focusing on immediate, obvious or basic issues such as technical aspects of the work

reflection. A novice practitioner may be not aware of the time needed and may rush through the process.

A general rule to ensure success and high quality is one's commitment - it is important to finish a production early and to allow time for reflection. During this experiment, it was noted that there would be times when the production (self-imposed) deadline was pressing and there was limited time and energy to reflect at the end of the day. In this case, 'Day-end' reflection should be re-scheduled to the next morning. If there are sufficiently interlocked, or 'nested' stages of the reflection process (as shown in Appendix 46), then the 'Day-end' reflection does not have to be *very* thorough, provided that the practitioner has revisited reflection notes and recorded issues to follow up later. Transient thoughts are then made explicit and permanent for further investigation. In this experiment, further investigation was built into the next level of 'Periodic' reflection which occurred at the natural breaks in the narrative and at other points triggered by the practitioner's particular concern.

5.3.4.3 Practitioner scheduled Periodic reflection

In this experiment, all the scheduled 'Periodic' reflections (shown in Appendix 46) lasted for a few days; much longer than I had initially anticipated. One explanation for this unexpected duration was that the generation of new/alternative ideas and their implementation or validation meant that 'Periodic' reflection had to incorporate additional experiments and assessments.

Reflection scheduled by the practitioner was found to offer some advantages. Firstly, it could be performed simultaneously with the work it was addressing – giving it the same power as reflection-in-action in delivering immediate results on the work. Secondly, the practitioner could expand resources, for example, requesting an expert's help, consulting texts and using further experiments, to assist the reflection process, encouraging new insights to arise.

This type of 'Periodic' reflection was found to be a high-level[34] reflection process and considered as having a high degree of rigour, especially if resources external to the practitioner were used to explore the issues. For example, in this experiment, I used an expert in the film industry and a novice audience to review simulations of a problem, its solutions and animation aesthetics. The periodic reflection re-assesses production issues as well as previous reflections, and in doing so it integrates problems and their analyses over a range of levels. It was found that such reflection was *better* performed after the practitioner had come to a natural break in the production and had ample time scheduled for the activity. It was noted that 'Periodic' reflection was naturally called for

[34] Focusing on broader issues such as storyline, planning or procedure, rather than simple technical aspects of the work.

whenever there was a particular issue that crossed different levels of reflection or when multiple aspects of a production troubled the practitioner.

I deliberately did not ask for any practical solutions from experts in any of the experiments. Any encountered problems were left to be explored solely by myself. Hence, this allowed a full engagement with "Practice as Research" where I could assess its advantage and quality to expand knowledge or practice simply using reflection and review processes on exploration, experimentation and outcomes.

Here, the filmmaker and the audience were consulted only to encourage reflection during the production revealed my preconceptions and diversify my perspectives.

It was found that 'Periodic' reflection provided an opportunity for the practitioner to consider the work from a variety of standpoints; leading to the multi-contextual* concept. Apart from practical and aesthetic considerations that were immediate to a production, the practitioner could assess the technical effectiveness and practical efficiency of different processes, and without these measures critical reflection could not be performed (see Section 5.3.7). Given time, the practitioner could also assess their *self*, using mindfulness, introspection and retrospection to aid future production activities.

Casual Review with experts as used on completion of the game applications, was performed intermittently during the production in this experiment. Such input was found to be useful in assisting the practitioner to learn and understand different perspectives of the work. Both positive and negative comments were found to be *equally* important to the progression of the project. Although there was no obligation to take onboard those suggestions or views to modify the production immediately, the information encouraged the practitioner to reflect upon previous decisions and experiment with new ideas. Through discussion with others, the practitioner also re-examined their own reasoning and arguments, and so created extra information to reflect on. The quality of critical reflection is, I believe, improved not only with the use of third party views but also by perseverance to learn differences and scepticism towards personal decisions. Notable points of criticality are therefore, the efforts to understand different choices and to make explicit and informed decision, the process of continuous reflection, and the need for openness and scepticism to previous knowledge and new possibilities.

The refined attitudes for "Practice as Research" using reflection and review in-action, allowed the practitioner to perform perspective intervention and to undergo conscious transformation during the process. Not only ideas and inspirations can be expanded creatively and then, assessed critically

but also a practitioner's self understanding and preconceptions can be clarified. Such changes, I feel, can encourage a higher quality of work and psyche engagement.

5.3.5 Review process in "Practice as Research"

In the previous game applications, a Hypertext presentation successfully displayed research details and illustrated the practitioner's mental journey and was found to assist peer-expert reviews. In this narrative experiment, reviewers were asked to explore an on-going production using the visual materials and reflection records in the Hypertext. It was found that this type of log aided review preparation due to the explicit record of ideas, intermediate decisions, analysis and visual outcomes.

In this narrative experiment, peer-expert reviews were organised in a different manner to that used in the game experiments (see Section 4.3.5) due to the difficulties to achieve critical review. Here, peer-reviews were not only conducted upon completion of the project but also during the production to aid the reflection process. It was noted that *peer-review-in-action* provoked debates that had different qualities to the previous *peer-review-on-completion*. For example, the 'in-action' reviewers had much less information to take in; they had more time to discuss interesting concepts and were able to question finer details about different aspects of the production. I will describe these two review styles in the following sections.

5.3.5.1 Review-in-action

An expert review was conducted halfway into the production after the pre-animation work had been documented and a significant quantity of the final animation was available for examination. The expert had a background in film production and was familiar with computer animation as a commercial and artistic medium. The expert led the review in this case and discussed a variety of topics, suggesting ideas for exploration and comparing the work with projects in the film industry. The reviewer was forthcoming with comments but it was noted that the focus was biased towards the production process and visual aesthetics – such a tendency is natural, given the expertise and interests of that particular reviewer.

Personal qualities and professional interests of an individual were registered as factors that could influence criticality and the efficacy of a review process. It was noted that the review-in-action took a narrative approach, which was in contrast to the peer-reviews conducted in the previous experiments. This narrative style might have arisen because the work was less product-oriented and more loosely structured, and allowed extra room for exploration within the review. In this

case, the expert reviewer intended to learn about the different stages of development and understand how the visual product arose before making comments. Such proactive involvement perhaps came from the realization that any contribution would influence the outcome in an on-going production. The review process passed from one focus to another - a process that was found to be enjoyable and very rewarding for the author. Because of the unexpected questions and the depth of the debate, critical comments emerged during the review and found to provide extra material for reflection.

Apart from the expert, novice audiences were also consulted in the review-in-action process during the production of the Ningyou experiment.

It was noted that viewers from outside the field of film or animation studies could also provide substantive reviews of this project. The comments and views of those individuals were found to be different from those of the expert in this case. For example, instead of focusing on the process and the animation, the novice reviewers were more interested in how and why the animation research was performed. Through dialogues, those individuals could resolve their questions, and there was a general agreement about their roles in the review process and the values of their comments.

Since the novice reviewers had fewer preconceptions about (computer) animation or techniques, they tended to ask more general questions about the practical side of the production, instead of giving specific or focused comments (see Appendix 41) as were found in the previous experiments. When compared to the expert review-in-action, these discussions were broader and angled towards more basic topics, asking questions on fundamental aspects that could be easily taken for granted by the professionals. Although a novice reviewer might not be skilled in animation studies or review process, their comments could still be critical. Here, I mean that some audiences (like the novice reviewers in this case) could perceive qualities and details; their questions could stimulate others to think differently and address overlooked aspects of the work. In this experiment, one novice reviewer discussed the aesthetic qualities of a stage performance and the believability of certain animations and special effects *(see Menu: Ningyou Production -> Review)*. Evidently a naïve audience can have "an eye for detail" and the ability to reason and express themselves - the very qualities required to assist a review process. These qualities were found to be not correlated with the expertise of the reviewer or their experience of viewing or assessing animations.

5.3.5.2 Review-on-completion

On completion of the Ningyou experiment, reviews were conducted using reflection-on-action (self-review) and peer-review. As in the previous experiments, decompression was found to be valuable for practitioners to distance themselves from the ownership of the work and obtain

different perspectives. The decompression period allowed reflection notes to be re-examined in a relaxed and almost playful manner. The experiences of the production could be clarified and created new thoughts.

This experiment demonstrated that during the decompression period, a practitioner could still perform certain work-related activities that did not interrupt the purposes of decompression. Such tasks included rendering and editing animations, revisiting reflection and review-in-action (audio) records, and building Hypertext. Casual self-review during decompression was found to be much simpler than that experienced in the previous Mermaid and Persona experiments. This might be because in the Ningyou experiment, the reflection-in-action was conducted with explicit focuses (see Section 5.3.7), was carefully nested and repeated (see Section 5.3.4), and was assisted by expert review-in-action. Those types of reflection and critical review during the animation making, could create a much clearer mind-set for practitioners and allowed them to work on broader quality considerations before the production was completed.

I constructed and studied the Hypertext presentation during the decompression period. The activity was found to assist reflection-on-action as well as to create an opportunity to view the production and the research differently. By having to present the work explicitly to a reader/audience, I unconsciously changed my perspective and broadened my appreciation of the work. With that attitude change, I feel distanced from the work and was open to critiques.

The main difference between peer-review-on-completion in the Ningyou experiment and the earlier experiments was that practitioner-researcher was not directly involved in organising the review and did not attempt to pre-establish specific review focus. Reviewers were given complete freedom to examine the research prior to the session using information available in the Hypertext displayed on the Internet. However, to ensure criticality and assist later analysis (from the researcher's point of view), a monitoring system was embedded into the Hypertext (see Section 5.3.6).

The initial review-on-completion involved four reviewers. I used both review meetings and text communication in this review experiment. It could be argued that the supervisors of this research might not be the most appropriate reviewers but a counter-argument was that they had not been closely engaged with the project for a year and a half when I worked independently away from the university. A benefit of having supervisors involved in the reviews was that they could afford the time for review process and might have the willingness to explore deeper concepts of this research. However, a significant disadvantage might be that they would be unable to distance themselves from their roles as supervisors. By including other reviewers – a practice-based researcher, as demonstrated in this experiment, this potential drawback might be offset somewhat.

Three reviewers in the first review session requested an oral presentation of the work. As the individual reviewers might have explored different areas of the research with different degrees of interest, this presentation was found to be valuable in allowing the team to reach a similar level of understanding. Besides, this was a good exercise for the practitioner to conceptualise ideas and the research work in an explicit manner to initiate the review discussion.

It was noted that one of the reviewers appeared to be poorly prepared and was reluctant to be involved in discussions. The embedded monitoring also reflected that individuals might not have examined the research thoroughly prior to the review meeting (see Appendix 47). The reviewer with practice-based research experiences failed to respond on time for the review meeting to contribute thoughts or discussion focus.

It is possible that there was a general misapprehension about the need for preparation before a review of animation or other visual work. Evidence for this explanation came from my previous experiences in the industry where reviews were organised with little forethought and were seldom well prepared. Interview data also showed that the professionals in the industry did not tend to prepare for review or evaluate the quality of a review (see Section 3.3.4.2), leading to some animators reporting that review comments were rarely coherent and often useless. From different review experiences in this research, the lack of understanding of general review processes or lack of preparation for reviews from either the researcher or the reviewers, reduced the rigour of any debate and the value of review comments. Hence, it decreased the creditability of the peer-review. Therefore, clear understanding of a project and a careful preparation for a review by both the researcher and the reviewer, along with a robust review process that also assess its own quality, are vital for rigorous review of a practical subject like animation.

To compensate for certain deficiencies in this peer-review, I conducted two additional reviews via text communications - with a lead artist and a novice reviewer, mainly to investigate whether the Hypertext presentation could assist them to understand the research, encourage discussions and make thoughtful comments (see Appendix 48).

As planned from the beginning, I also conducted a review in person with a novice audience to conclude the review process for the Ningyou experiment, in contrast to the peer-review. The format of the review followed that of the peer-review, in which the reviewer was allowed to explore the research via the Hypertext on the Internet and a short presentation was given prior to the session. This particular reviewer was not able to perform a full exploration of the research but was sufficiently keen to ask questions during the review presentation to compensate for that drawback. It was noted from the audio recording that later in the discussion, comments from this novice audience could be as critical as those obtained from professionals.

The commendable discussion with the novice reviewer about production process and quality of the work, for example, the comments on the distinction between the 2D image sequence and the 3D animatic, aesthetic aspects of theatre performance and animation styles, echoed similar findings from the review-in-action. "An eye for details" and the ability to reason and make critical judgement, are not the solely preserve of individual with expertise in animation or experiences in assessing production. The discussion raised by the novice reviewer on how to draw a critical assessment in a field that lay outside one's expertise, might imply that this individual did not feel positive about being "too critical" - the words used by the reviewer. It also showed that this reviewer concerned and questioned about the critical process and its quality. Therefore, I could argue that perhaps this reviewer had unconsciously reduced the degree of rigour, knowing that one might be considered outside the field. I conclude that if criticality and honesty were the goals, the practitioner-researcher *should* encourage novice reviewers to be open and assist them to achieve stringent criticisms within the review process.

5.3.6 Hypertext presentation and monitoring

A Hypertext presentation was previously found to allow readers to explore practice-oriented research close to the research journey (see Section 3.3.2.2 for research access and navigation), and such a facility could also aid in the preparation for peer-reviews. In the Ningyou experiment, it was found that the benefit of Hypertext extended to assisting oral presentations about the work, and acting as a document store during a review. The act of writing a Hypertext presentation was itself reflective and naturally broadened the viewpoint of a practitioner. This change of perspectives could enable a richer level of reflection and critical review.

In order to understand the usage of the Hypertext presentation and so assist critical analysis (from the researcher's point of view), a monitoring system (Google Analytics) was used to track viewers' activities during their exploration of the research via the Internet.

The system tracks which pages were viewed, and for how long, but also from which country and area, when the page was viewed, and with which browser, etc. This system does not automatically track individual IP address and I did not put in any additional trackers so visitors to the Hypertext presentation via the Internet were essentially anonymous. I believe that the system followed the ethical and privacy codes of this research. However, since the selected reviewers would be using the Hypertext, I either informed them prior to their visits or dealt with the issue in the debriefing session if I needed accurate reflection of the Hypertext usage.

The ability to assess the quality of a review comment may lead to the possibility of a critical assessment. When the Hypertext was used to aid the exploration of the research and as a preparation for the critical review in this experiment, the embedded monitoring system provided information to discriminate these qualities for analysis.

For example, if the monitoring system shows that nobody viewed a page, the comments from the review panel about the contents on that page must be treated as that of an audience being introduced to subject for the first time. Any remark cannot be considered as being reflective (but reactive or reflexive, as defined by this research).

The task of weighing-up reviewers' comments is more difficult when the panel members visited the Hypertext from the same location, using the same service provider and browsers. In this experiment, some individuals were willing to give out extra information to clarify the situation. If a reviewer did not visit a page or use the Hypertext, the viewing history from unique visitors would be less than the number of reviewers on the panel as in the case of this experiment (see Appendix 47). And if, subsequently, two reviewers made opposing comments about the same topic and the monitoring system showed that a particular reviewer did not explore that topic properly, in this situation, the researcher might want to use the monitoring information to differentiate between those comments.

If some of the review questions happened to require prior understanding from the Hypertext presentation, for example, in this experiment, the experience and usage of Hypertext to demonstrate animation research, or the discussion about the research journey and practitioner's reflection, the researcher might want to disregard comments from those who did not explore the Hypertext and give weight to those who did. In this case, the monitoring history would be extremely important to any critical analysis.

The monitoring revealed that the use of Hypertext presentation could be extensive especially for the preparation of a critical review. Data (see Appendix 47) showed that a reviewer was free to explore and examine the research at leisure, a multiple number of times, without being constrained at all, for example, by their location or by the researcher. Prior to the review session, the time spent on the Hypertext for one individual was noted to be as long as a review - eighty minutes (see Appendix 47) over a span of weeks. However, there could be some uncountable errors, for example, a viewer might leave the Hypertext open, but in most cases, errors would be apparent if browsing activities were checked carefully.

Data from the viewing history (see Appendix 49) also revealed that with the ability of Hypertext and the Internet to display reviewable information, there was a possibility that some individuals

could pay much more attention to the details of the research. In this case, two captured individuals (not selected as reviewers and unknown to the author) explored this research in details and records showed that there were three visits with nearly one and a half hours spent within a day, reading an extensive portion (61 pages in total) of this research. It proved that the Hypertext presentation of this practice research contained interesting information that captured two viewers' attention and was able to provide extensive and detailed contents for in-depth study. The flexibility of Hypertext on the Internet has significance for demonstrating research but is *still* inconclusive for demonstrating, in particular, animation practice research, a practitioner's research journey and the deeper reflection process.

I wish that I could request these two unknown individuals to review this practice research and then ask them about their experiences on using the Hypertext presentation. Saying that, information on the Internet will always be available somewhere. Although the monitoring system (Google Analytics) hides the IP addresses, they could be acquired by other means if I really wanted to. At the moment, I consider that this is outside the scope of this research. With the noted extensive studies from the monitored records, these two individuals, I believe, could be the 'perfect' reviewers for my work.

5.3.7 Reflection focuses and Multi-tasking in "Practice as Research"

In the principle applications, it was noted that "Practice as Research" could be a multi-contextual study method and because of the complexity involved, a researcher might experience confusion and difficulty in performing reflections and analysing reviews. It was suggested that the quality of reflection depended on, for example, how well one could handle multi-tasking during a production and how one could explicitly focus on a given context for reflection. Additionally, a multi-contextual approach (involving different criteria for the research or from other artistic fields) enlarged the review process that might require different review sessions and reviewers with different expertises or multiple backgrounds to address issues effectively.

The need for five different categories of reflection - technical, practical, aesthetic, self and critical - *(see Menu: Ref Tools)* was hypothesized during the previous game application and they were used in this experiment consciously during the production. The following sections describe and analyses these categories in detail.

5.3.7.1 Technical reflection

Technical reflection is defined as the assessment of effectiveness and efficiency in achieving a goal; the analysis of specifications, procedures and their implementation.

As demonstrated in the Ningyou experiment, the pre-animation and the final production process were well defined and structured (see Figure 27). Re-examination and validation were carried out thoroughly at every stage of the production. For example, in the pre-animation phase, character and functional simulations followed visual research and concept design to verify that ideas could be achieved in 3D computer animation. Different implementations for the same goal were tested to ensure effectiveness and efficiency for the final application. A 3D animatic provided an effective demonstration of the final outcome and identified potential problems, leading to a smooth production process.

Technical reflection was noted to occur in a relatively later stage of the production in this experiment, for example, after the pre-animation stage and the completion of the 3D animatic. It was also noted that technical reflection seldom occurred during 'Involuntary' reflection but instead arose during 'Periodic' reflection especially when there was a significant body of work to be assessed. Technical reflection tends to require a degree of formal, almost clinical and critical thought to analyse a chosen quality or procedure, and is difficult to perform effectively during a predominantly artistic-creative stage.

Apart from assessing implementation and production procedures, technical reflection in this research also focused on the application of the "Practice as Research" model to different fields of animations, namely games and narrative. It was carried out on completion of every principal experiments. "Practice as Research" was concluded to be an effective approach by which a practitioner could understand and examine a practical subject such as computer animation. Its utility was apparent because "Practice as Research" imposed a structure for collecting implicit knowledge of a practice and assessing the practitioner's experiences systematically. Additionally, it enforced the use of reflection and review processes *before*, *during* and *after* a project, and the use of meta-cognitive* processes to study the quality of these processes. In this experiment, it was found that different levels of reflection (see Section 5.3.4) and specific reflection focuses could contribute to the diversity and criticality of the "Practice as Research" model. More importantly, with different and well prepared critical reviews performed at different levels of a project, every view or decision could be challenged and assessed, leading to openness and reduced preconceptions from implicit knowledge.

5.3.7.2 Practical reflection

Practical reflection is defined as the analysis of the means required to complete a task. This also involves studying the rationale and assumptions in a work and how they relate to the outcome.

The animation techniques or reflection tools described in this thesis and the rationale in creating animation experiments were classified under this reflection category. They were presented in the Hypertext presentation *(see Menu: Persona->Ref tools; Principal->Ningyou)* and are not repeated here. It was noted that practical reflection occurred in every pre-animation and production stage. Initially, there were many assumptions on what constituted practicality in terms of the choices of techniques and aesthetic design for the production. Practical reflection was found to be valuable in identifying preconceptions, modifying those assumptions and creating effective solutions to complete the task. As the project progressed, unexpected problems would continuously appear and practical reflection was frequently found to be useful not only for resolving problems, but also in refining techniques and clarifying understanding. It was noted that when the project drew to its completion, the role of practical reflection diminished.

During this experiment, practical reflection made use of logbooks, reflective writing and the interlinked documentation of the Hypertext presentation. It was shown that the simple logbook provided the most effective means for collecting ideas and recording problems during a production. Transient thoughts were best captured by the simplest and quickest method and brief logs aided later recall. Since those records were frequently found to be brief and incomplete, reflective writing or journal keeping was useful for tidying up those random ideas and encouraged a higher degree of clarity. During reflective writing, the practitioner often challenged their initial thoughts and internal debates might yield new insights. Keeping a journal was often a difficult task and a practitioner might find that this exercise interrupts their normal tasks and it is recommended that any significant writing period should be scheduled outside the production work. It was noted that if such journal keeping was treated as purely a recording process, it lost much of its value if those records were not being re-examined. Therefore, in the "Practice as Research" model, there was emphasis on revisiting the work and making constant reflections using a logbook and reflective records to aid continuous improvement of a production and transformation of a practitioner. Finally, the writing of the Hypertext was found to be a good tool for reflection in this experiment *(see Menu: Ningyou Production->reflection)*. It was concluded that this activity enabled a practitioner to view their work from a different and distant perspectives and allowed critiques to blossom.

5.3.7.3 Aesthetic reflection

Aesthetic reflection is defined as the analysis of artistic inputs and outcomes. It is frequently taken to be a subjective measure, therefore reflection should focus on the assessment of creativity and not simply on novelty[35].

Due to the nature of computer animation, and its dependence on both the theoretical and practical aspects of computer technology, aesthetic reflection could sometimes be confused with the technology used to create meaningful artistic outcomes. The use of algorithmic lens-flare in the early 1990s is a classical example. In this experiment, technological assessments were dealt with as practical reflection. Aesthetic reflection was therefore used to reflect on the creative aspects, for example, the meaning of an animation, its artistic development or overall composition, etc.

It was noted that aesthetic reflection also occurred in virtually every stage of the pre-animation and production processes. In fact, such reflection played the main role in the early stage of pre-animation, especially during visual research and concept design when creativity could emerge. When simulations and the animatic were constructed, practical reflection was found to rapidly take over and aesthetic reflection appeared to dissolve into the background. However, once practical issues had been overcome, it was noted that aesthetic reflection could drive variations and different techniques to articulate the same idea to improve creativity. The Ningyou experiment demonstrated that aesthetic and practical reflections could support and influence each other therefore, it is important to have different levels of reflection at different stages of the production so as to maintain equilibrium between them. Analysis of the results showed that by switching between those two focuses one could challenge preconceptions, modify previous assumptions and decisions, and so encourage diversity and creativity. Because the practitioner persevered in improving the work's aesthetic qualities, it was found that aesthetic reflection led to an expansion of practical knowledge and encouraged different techniques to be explored outside the original scope of a project.

5.3.7.4 Self reflection

In the proposed "Practice as Research" model, especially for this Ningyou project, self-reflection was carefully defined to focus on the study of the presence and the position of oneself.

For some artist-practitioners, the study of oneself may lead to insights about one's creative output, conversely, by examining one's own work, the artist may gain insights to their inner self. In this

[35] In this research, novelty means that it does not necessarily demand expertise in a subject and a degree of cognitive sophistication.

research, self reflection did not focus on introspection from this romantic point of view – the practitioner did not set out to attain deeper inner knowledge or emotions. However, introspection was carried out to obtain better models of what creates preconceptions from one's position and from previous experiences or how and why one would choose to do given tasks in a certain way, etc. It was an inductive study and as the project progressed, self-reflection was used to monitor and then provoke changes. The decision to employ different experiments within this research arose from the idea of using different scenarios to allow introspection to progress. Patterns of working and schemes of thought were then compared and studied, allowing a partial model of *self* to evolve. Self-value and self-confidence were obtained by discovering one's limits and scope of flexibility. The course of one's own work and thoughts could then, potentially be intervened with, leading to self-transformation by deliberately exposing oneself to different experiences and un-chartered territories and so counteract one's preconception in a reflective manner.

At the end I should mention that one can over analyze oneself and try to justify the self and one's experiences unnecessarily. The presence and the position of a creator, by nature, influence every perception and because of that, our experiences are not objectively accurate. It was noted in this experiment that because of mindfulness, the awareness of *self* and its position, it led to questions about other possible experiences or positions. Hence, the practitioner was more readily to question their old *self*, and enjoy new experiences and follow wilder exploration.

5.3.7.5 Critical reflection

Critical reflection in this experiment was established by following a self-disciplined reflection process that developed and refined by the previous applications. Namely, 'Involuntary' reflection was performed during different stages of the project without intellectual constraints, 'Periodic' reflection at the end of the working day to clarify experiences, and a high-level scheduled 'Periodic' reflection at the natural breaks of a project, or whenever called for. As described in the analysis of reflection, diversity and criticality were seemingly improved by using different levels of reflection with overlapping contexts (see Section 5.3.4) and the identification of reflection focuses.

It is useful to summarize the variety of reflection performed. 'Involuntary' reflection mostly consists of collecting ideas and notes using the simplest and most effective methods whereas 'Day-end' reflection is an explicit examination of low-level decisions during the day and the organisation of those disordered thoughts and new experiences. These reflections deliberately preserved preconceptions, positive and negative experiences for further study. Scheduled 'Periodic' reflection is a meta-cognitive* process that examines, for example, production and research processes in this case, and deliberately, modifies previous thoughts and expands possibilities. It

emphasizes re-examination of prior 'Involuntary' and other types of reflections in a systematic manner.

With these ideas in hand, it is useful to formulate critical reflection as employing different styles of reflection and nested different levels of reflection processes (see Section 5.3.4) to perform assessments. Imposed reflection focuses provide clarity and often, with third parties' views (see Section 5.3.5.1), preconceptions can be challenged and new perspectives emerge. This cognitive process resurrects and filters old thoughts and encourages further examination in an iterative manner to generate novel possibilities. It was noted from this experiment that a truly critical process is one that can be applied to itself, find shortcomings, be modified, and be cycled again.

5.4 Narrative Application Conclusion

This Ningyou experiment successfully demonstrated the application of "Practice as Research" in narrative and experimental animation production. Its application was shown to encourage (experimental) animators to approach artistic and creative works with rigour and criticality. It was seen that with an explicitly described approach that was vigorously applied, creativity could evolve and prosper. Through exploration and self-understanding, the diversity of views could be achieved. "Practice as Research" was also shown to be a multi-contextual* study method and encouraged perspective intervention during research.

This experiment clarified an outstanding issue - whether a game application naturally led to the use of Functional Design or was that design process necessitated by computer animation itself. I concluded that Functional Design was also required in a narrative project as demonstrated in this experiment, with its concepts similar and its practical mean different to that in the game applications. The process provided production control and integration, focused on practical research and simulations to ensure that visual concepts in a narrative could be effectively delivered by computer techniques. It was noted that Functional Design also extended to exploit computer technology to improve aesthetics and capture potential problems in advance, as noted in the requirement of separated Kimono's model *(see Menu: Simulation ->Kimono Tests)*.

The process of Animatic making was found to preserve its merits in verifying continuity, storytelling and cinematography for narrative productions. However, it was noted that in the computer era, the format of an animatic could be modified to exploit the use of technology and reveal new advantages. The new format, a 3D animatic, takes advantage of the flexibility of computer software and encourages complex animation assessments and early aesthetic considerations. This aids the progress of a 3D production, increases production efficiency and gave

early warnings of potential problems. Thus, animatics for use in different fields of computer animation have transformed into a general concept rather than being locked into one physical method. For example, its concepts have evolved into the Persona and Functional Design processes in games as shown in the principal experiments.

The narrative experiment also demonstrated that critical reflection could be achieved by the nesting of different reflection processes at different stages of a production and the use of multi-tasking to examine the work with clear explicit focuses and overlapping contexts. Criticality and quality of reflection would be improved by employing third party reviews, decompression to yield openness, continuous re-examinations and self-perseverance to acquire new views and perspective intervention.

In the "Practice as Research" model, the practitioner is the centre of the study; self-reflection embraces the contribution of one's implicit knowledge and personal qualities. The model accepts that there are qualitative measures of practical and aesthetic knowledge that can never be completely understood. The use of critical approaches and integrated studies on a body of knowledge does allow experiences, practices and a practitioner's thoughts, to be clarified and refined. This encourages mindfulness, creativity, critical thinking, perspective intervention and transformation, as was apparent in this research. The model allows the possibility of any extension of knowledge and it is in itself critical by virtue of its recursive and self-assessed nature. "Practice as Research", if performed diligently and mindfully with attention to critical reflection and reviews, can encourage validity in practice research and qualitative assessment of the project outputs.

6 Conclusions and Lessons learned

This research has identified that there is a need for academic and practice research conducted by animator-practitioners in computer animation. A "Practice as Research" model differs from the style of previous research in animation studies and most of the current technical research in computer animation. This model was introduced specifically to aid animator-researchers in conducting their studies, putting animator at the centre of the research process, differ to product/design-oriented or technique/technology-focused approaches. In this research, the model was successfully applied to a commercial project and an experimental work, and provided possibility for self-development.

This novel research also evaluated different research methods and demonstrated a structure for "Practice as Research" that can be applicable and made critical for (computer) animation studies. Animation experiments were used to create a research space in this model and they allowed *real-time* examination of the research process and different animation practices, and addressed animation-related questions to bring new insights into critical practice and thinking for animators. The flexible approach of "Practice as Research" not only allows animators to select different combinations of research methods but also allows modification of the study's structure itself as the research progresses. For example, in the initial stage of this research, animation experiments, reflection and review processes, case studies, and interviews and visual research were used in parallel. In the middle of the project, animation experiments, visual research and interviews were the main focuses. In the final phase, reflection and review, and case studies on the animation experiments were employed.

Because of the flexibility of the model, a variety of research methods can be combined and the complexity of the process can be varied according to the research interest or unexpected findings from the experimentation; hence, the "Practice as Research" model may also be applicable to other disciplines.

6.1 Research methods

The pilot study in the initial stage was designed as a trial run for the "Practice as Research" model. However, it was found that since this model is an animator-practitioner centred research style, the pilot study was also suited to preparing a practitioner to become a reflective and critical researcher by clarifying their preconceptions, previous experiences, weaknesses and strengths, etc. For "Practice as Research" to develop in computer animation, it was seen to be necessary to broaden an animator's focus away from the usual fields of artistry and production. The original aims of the

pilot study were also fulfilled, in which, the research methods structured in the "Practice as Research" model were evaluated.

6.1.1 Case Studies

Case studies on previous experiences were proven to be effective for understanding preconceptions, personal practices and other's experiences and situations. They could provide explicit records for (self-) reflection and for other animator-researchers to repeat, examine, and improve. Case studies on animation experiments as shown in this research, encouraged animator-researchers to critically reflect their assumptions, practical approaches and ways of thinking. It is hoped that such reflection can lead to new insights and changes in perspectives.

6.1.2 Animation Experiments

Animation experiments were demonstrated to create an immediate and dynamic research space for investigating practices or other animation-related questions. Such works can bridge the gap between knowledge and practice, in which using the "Practice as Research" model, an animator-researcher can articulate a body of knowledge in a critical process with no separation between knowledge, practice, the practitioner, and the visual product. The process can train mindful practice and encourage perspective intervention in the form of designing new situation to cultivate different experiences. The generated results (reflection notes, documented processes and visual outcome) can be explicitly detailed for further reflection and/or review by other researchers.

6.1.3 Interviewing Animators

The interview method is an effective means for obtaining information directly from animator-practitioners, especially in this research. It was noted that animators seldom had the chance to document their experiences explicitly. This method showed great potential for filling in the gaps identified in animation texts as described in Chapter 2. It also allows effective investigation of the changes in animation studies or of an animator, due to changes in fashion or the technology of computer animation. Interviews can create a non-invasive space for animator-practitioners to open up their psyche and recall their experiences. It was noted in this research that being interviewed could encourage animators to self-reflect, which was not found to be a well-promoted practice for animators. Besides, when the interviewer is also a practitioner, the interview method can provoke exchanges between the parties leading to diversity in thinking, possible extension of knowledge and empowerment. Interviewer-practitioners may also find that conducting interviews can yield other unexpected results. For example, one may naturally reflect during discussions with different

animators, and so clarify implicit area of one's knowledge, and by leading participants to examine their psyche, one may learn to examine oneself. The knowledge gained from organising interviews was shown to be valuable in aiding the review process for animation. I found that this communication skill is one which animators generally lack.

The quality of an interview depends on the experience of the interviewer - their knowledge of animation topics, interview structure and interview skills. It also partially depends on the personality of the interviewee and their willingness to talk about their experiences and deeper feelings, for example. Animators and senior students can conduct interviews as a training to assist their practices and review skills. The activity can:

1) Bring out their personality and confidence
2) Train them to be open about their practice, work and thinking
3) Help them to articulate their knowledge not only in production with clarity but also with clear explicit dialogues
4) Assist them in their own self- reflection process
5) Prepare them for a mentoring role to assist their peers and improve the quality of critical review

It was noted that interview data might encourage false insights or unthinking use of knowledge and practice. For example, unskilful interviewers or inexperienced students may latch onto 'fashionable' discussions and without critical thinking, certain use of animation style or techniques are imitated directly. Interviews may easily provide the illusion of research for practitioners and sometimes, researchers can be driven to similar data sets or popular animation ideas in this case, leading to false evidence or self-fulfilling prophecy. Therefore, I recommend that the aim of the interview for novice users/students should not be focused on data collection but as a training of non-judgemental dialogues, exchange of experiences and ideas, openness of one's psyche and receptiveness of differences.

6.1.4 Reflection - Reflexive and Reflective Studies

Introspection and reflection were revealed to be unclear and least appreiated by animators in the industry, according to the data gathered from research interviews. Initially, in the research experiments, these activities were noted to be confusing to perform during (computer) animation production. The reflection process was suggested to be a convergent cognitive process. It can be argued that if reflection is practiced loosely and unskilfully by the animator, it may act against creative processes that require freedom and divergence in thinking. In the principal research, the confused and unfruitful reflection process was overcome by conducting reflection-pre-action,

reflection-in-action and reflection-on-action before, during, and after the animation production in the "Practice as Research" model. Reflection-pre-action is a concept similar to a case study in that it consolidates the research and experiences before the next stage of the work. In the intense and stressful heart of a production process I recommend the use of Involuntary reflection-in-action, where spontaneous or transient ideas can be captured effectively with the simplest methods with little concern about validity. Later, one may use Periodic reflection-in-action where ideas and doings can be reflected upon and modified at the next immediate opportunity, and again in later organised intervals. I concluded that reflection-in-action required a variety of levels – different degrees of detail and/or periods of time during a production. The process is therefore, a 'nested' sequence of reflection processes sufficiently interlocked with overlapping contents. As a general recommendation, it would be beneficial to define clear reflection focuses such as technical, practical, aesthetic, self and critical reflection.

One of the principal experiments proved that third party comments could encourage animator-practitioners to reflect upon past decisions and experiment with new ideas while a production is ongoing. With both positive and negative feedback, the work can gain momentum and extra information can encourage critical reflection. The quality of critical reflection is, I believe, improved not only with the use of third party views but also by perseverance to examine the personal views with a sceptical eye. Notable points of criticality in a practice are therefore, the need to understand differences, make explicit and informed decisions, the process of continuous reflection, and the need for openness and scepticism about previous knowledge and new possibilities.

Reflection-on-action (also named self-review in this research) was identified to be *better* performed in two phases. Firstly, casual reflection-on-action focuses on decompression, organising materials, and expanding perspectives not necessarily included intellectual judgment. Secondly, formal reflection-on-action focuses on criticality and validity. It was noted that both phases of reflection-on-action could benefit from third party comments and exercises that encouraged reflection whilst not interrupting decompression. The success of reflection-on-action was influenced by the quality of the records from reflection-pre-action, reflection-in-action cycles, and preparations during decompression, as well as self-understanding, openness, and the application of different reflection techniques. In the principal research, some reflection tools were identified and evaluated. Different tools yielded different qualities of reflection and some are more effective than others in certain situations. For example:

1) In Reflection-pre-action, we require understanding and clarity so methods such as descriptive, reflective and critical writing, mental dialogue, and in-depth discussion are useful

2) In Involuntary reflection-in-action, we need the simplest method that does not interrupt an animation production - this can be a logbook or audio records

3) In Periodic reflection-in-action, we require reflective writing or dialogues and sometimes, can involve a mentor's assistance or experimental simulations.

4) In Casual reflection-on-action, we need to preserve decompression, so revisiting notes, constructing a Hypertext document, viewing animation outcomes, and journal writing (descriptive) are more appropriate

5) In Formal reflection-on-action, we need detailed examination such as reflective and critical writing, mental dialogues and peer-expert reviews that focus on validity and criticality.

It was concluded that the quality of reflection is influenced by the reflective skills and attitudes of the animator-practitioner, and the choice of reflection techniques used during different stages of the "Practice as Research" more so than the type of tools.

6.1.5 Critical Peer-review

The peer-expert review process that was reportedly used in the industry showed several shortcomings in the general format used by many animators and some studios. That *popular* model of review failed to assist critical animation production or bring new challenges to this research. This form of review process was also reported to be unproductive and was not enjoyed by animators in the interviews. Data showed that review processes and their qualities were not critically assessed in the industry or by individual animators. Specifically, the method generally failed to move the focus from the visual products and rarely maintained clarity between opinions and critiques from both the animators and peer-experts. The principal research and the styles of peer-expert review trials demonstrated that by imposing a structure on the process and making clear preparations before the review could improve its qualities especially when reviewing a practice research. It was concluded that a *good* practice also required a process to examine and review its own quality.

The review process can be further defined into two types.

1) Review-in-action which provokes change during a production and allows finer examination when the body of work is less overwhelming.

2) Review-on-completion where materials for examination can be well prepared, studied and critically assessed. Individual peer-review allows members to familiar with the critique

process and the review interests, and encourages reflections before critical review. Group-review brings experts together and focuses on particular research interest where critical debate and diversity can blossom.

I conclude that clear understanding of a project and careful preparation for a review by both the researcher and the reviewer, along with a robust review process that also assess its own quality, are vital to the rigorous review of computer animation or its research assessment. In this research, it showed that different styles of review process might provide different qualities and/or suited for different research interests.

Reviewing the principal experiments with peer-experts and general audiences revealed that the quality of a reviewer's comments was independent of both their expertise, and their experience of viewing or assessing animations. Instead, "an eye for detail", patience, the ability to reason, express and make critical judgements, were desirable qualities for assisting a critical review process. These are not the sole preserve of any one individual or group of peer-experts. I conclude that if criticality and honesty were the goals, the animator-researcher *should* encourage novice reviewers to be open and help them form stringent criticisms within the review process. In the event of expert-reviews, I would recommend mentoring attitudes from the experts and the presence of an observer to ensure the critiques are fair and non-judgemental; hence criticality of the review process can be improved.

There are certain difficulties associated with reviewing a practice research even though a critical review process is in place - the disjointed complexity of a practice research, the intertwinement of knowledge and practice that is almost impossible for anyone to capture fully, and a long winded and time consuming process for critical and rigorous debates. I conclude that research reviewers may need to have experiences similar to the practitioner- researcher. Particularly, they should master the artistry, and have experience in performing practice research and critiques, all before a critical review is possible. It would beneficial if two researchers simultaneously conducted different aspects of a practice research where they can act as mentors/reviewers for each other through the process. In that respect, the review on the research here did not fully satisfy my expectations of seeking critical debates from reviewers. Challenging a practitioner-researcher and assisting development and transformation, surely are the roles of the research reviewer who *should* equip with interdisciplinary knowledge and views.

6.1.6 Hypertext as a bridge between knowledge, practice and animation

The pilot study revealed that presenting "Practice as Research" in computer animation was more difficult than performing such research due to the intertwinement of knowledge, practice, the

animator-researcher, and the visual results. The most unexpected outcome from this research was the creation of a Hypertext presentation and the concept of using the Internet to attempt to bridge the gap between knowledge and practice, and recreate the research journey for other researchers to explore and examine. The Hypertext also aided the preparation for peer-reviews and during reflections, it acted as an explicit data store of the research and assisted my oral presentations. The act of writing a Hypertext document is reflective and can broaden the viewpoint of an animator-researcher. Hence, it can enable a change in perspectives and encourage a richer level of self-criticism. The drawback of using Hypertext to display practice research is the non-linearity of the exploration. On one hand, the flexibility allows the user to explore the research freely and provoke different perspectives but on another, this approach may undermine the coherence of the research. Unless the users are clearly shown a chronological path, such a site can poorly reflect the practitioner's research journey. Therefore, the Hypertext presentation should not be the sole means of demonstrating practice research but as a display of the research framework and supporting materials.

6.2 "Practice as Research"

The "Practice as Research" model embraces the presence of a practitioner at the centre of the research experience. It allows research to be performed with no separation between knowledge, practices, the self and the outcome. Implicit knowledge and personal qualities are both valuable to the model's success. This model promotes a structure and systematic approach to organising practice research and uses critical assessments to filter experiences and to integrate knowledge and practice. Central to the research model are mindfulness, creativity, critical thinking, perspective intervention and transformation. The model has the flexibility to combine different research methods within itself to explore different research questions. It also allows its own structure to be modified as the research progresses, as was shown in this work. The power to design situations and re-create problems and intervene preconceptions in animation experiment is one of the flexibilities of "Practice as Research". I envisage that the model could have a broad impact on animation and not only on its artistry and production. The possible extension of knowledge is noted and the method's quality comes from its critical nature and ability to modify itself recursively. "Practice as Research" I conclude, if performed diligently and mindfully with attention to critical reflection and reviews, can encourage criticality turning experiences in a practice into possible knowledge or explicit understanding.

"Practice as Research" creates a research space for animators to explore a phenomenon or clarify (computer) animation studies using experimental works and critical analysis. This research demonstrated that the model was effective when applied to both commercial game project and

experimental narrative work. When used, it did not seem to affect production time as shown in the game applications, so it can be recommended to studio practice. All three principal experiments showed that when using "Practice as Research" model, one could clarify personal practices, explore animation-related questions, study preconceptions, develop different perspectives, and exercise critical thinking and mindful practices. It demonstrated the possibility for comprehensive multi-contextual study or a more focused study of minute details as needed. The whole process can train an animator to develop self-awareness, flexibility, critical judgement, management skills, and multi-tasking techniques, which have not been promoted widely in the animation community. Documentation and other records from a "Practice as Research" provide a high degree of transparency to the research, demonstrate articulation of implicit knowledge and allow further analysis and reflection of the psyche of the practitioner-researcher. These are valuable materials for other researchers to consult, re-examine and improve upon.

This research concluded that the "Practice as Research" model satisfied doctoral research criteria, in that the work should be novel, systematic, rigorous, critical, reflective and communicable. It is an example of work that can also satisfy Frayling's concept of "research *through* art". It is worth noting that doctoral submission using the model required a written thesis and the artworks, in this case, animations. However, in this research, the final computer animations from the principal experiments - the published game and the narrative film - were deliberately not submitted with the thesis to test the submission criteria, but was showed in the viva to prove their existences. This approach seeks to validate that the creative product of a doctoral research is a process to enquire knowledge and not the evidence of knowledge, and that the award of a PhD in arts/practices is about the 'practice of research' rather than the 'practice of artistry' or the production of original artwork. Having said that, the process of making in a doctoral research was noted to increase the originality and creativity of the product in this research.

"Practice as Research" may provide an illusion of research if one is not persistent in having a self-disciplined critical approach. Similarly, the method may fail if one is unable to articulate knowledge and practical skills, or if one does not perform mindfulness and critical thinking during the practice. It is easy for a novice researcher to fall into a delusion and submerge themselves in what appears to be research without demonstrating clarity of work, extension of knowledge or perspective intervention and transformation. The animation production and its visual results sometimes can diffuse the focus of the research and a practitioner may find it difficult to move away from those superficial aspects to become a diverse and critical researcher. Misconceptions about technology, artistry and knowledge in computer animation may lead to inappropriate experiments being designed to examine a specific research question, for example. This defect may not be apparent for novice researchers, and may lead to *wrong* insights. In the "Practice as Research" model, the animation is no longer a product but is instead a process that creates

possibilities and a research space. However, this does not mean that creativity or artistic merits are missing from the final visual outcomes, as proven by the animation outcomes in this research.

It is worth noting that "Practice as Research" can be used as a training activity to improve research skills and the attitudes of a practitioner, or just to explore one's artistry and knowledge. It can assist in the understanding of self, one's limitations and strengths. It can prepare one to embark on changes, and challenge one's own preconceptions. However, the purpose of using the "Practice as Research" model should be clear before the research starts.

There are a few limitations noted in the "Practice as Research" model. As presented in this research, "Practice as Research" is a process and not a method, in that I mean, researchers are required to identify research methods, such as data collection or analysis methods within the model. To increase the validity of such model, mixed methods are preferred to compensate subjectivity of a lone method. Because the model is self-evaluating and self-modifying, it can be confusing for some researchers when it is used as a methodology, as shown here. As mentioned before, this model is designed for practitioner-researchers to conduct research and therefore, requires the users to have a certain level of competency in articulating their knowledge, artistry, and technical skill in a subject. Depending on their level of competency in those areas, the quality of the research would vary. When employed as a training tool, the user should not mistake the results from "Practice as Research" as having broad impact and should always be sceptical about the acquired insights. Initially, this model of work can be off-putting and confusing, especially as it may reveal no clear productive outcome. However, this kind of feeling is not exceptional to any type of learning process that requires persistency and continuous exploration from the person. The model can be taught but like any learning process, the person needs to have the *right* attitudes for study and experiment. I fear that with the current obsession about results in our educational system, including doctoral research, students would find tremendous pressure to produce "expected" results using this "Practice as Research" model.

In this research, it is apparent that there is a major difficulty in assessing or even analysing research conducted in the "Practice as Research" model due to the intertwinement of knowledge, practice and the researcher. Because of this experiential learning style, it was noted that certain personality-types might feel more at ease with the model. These people may be born with a higher level of sensitivity, and be more observant, curious, or empathic. Similarly, those who are more tolerant of ambiguity, discomfort and uncertainty may be more at home with this model – for it offers no fixed rules for its use nor a clear path to a goal. I also recommend that practitioners who wish to employ the "Practice as Research" model, should consider how well their characteristics may share the following:

1) A willingness and readiness to expose their psyche, feelings, and weaknesses
2) A degree of confidence and security for themselves and love for others
3) Their success in coping with discouragement, disempowerment, and hardships
4) Their acceptance of changes and their resourcefulness
5) Their openness to insecurity and skepticism

Because of the novel appearance of the research model and the noted problematic reviews of this research, I recommend that more effort may need to be put into analyzing practice research models and the research funding bodies may need to provide support to staff and researchers who may not have adequate experience in conducting practice research themselves. I foresee that these requirements would have to come first before the "Practice as Research" model can be considered helpful to practitioners.

One of the major results in using the "Practice as Research" model is that it naturally provokes changes; in the recognition of preconceptions, differences in practices or the modification of perspectives. These experiences and changes within a practitioner-researcher may not be immediately apparent but may appear when one continues in the practice and do research. I conclude that only with new research or applications, can we then re-examine and evaluate those changes, turning experiences into possible knowledge, as was demonstrated in the three continuous experiments in my principal research. Changes always lead to positive and negative events and both can be valuable since they provoke thinking and force one to reflect. In the "Practice as Research" model, we cannot describe whether the positive and negative events are *good* or *bad* for the research; they are just different! A negative event may actually be more beneficial to the practitioner-researcher because it forces them to reassess their old assumptions/experiences and makes them move on. A positive event may resurrect older experiences and bring new insights and confidence. Irrespective of the type of result, I recommend scepticism towards new experiences. Beware of the unconscious preconceptions, and recurrent patterns of thoughts. I conclude that mindfulness, critical thinking, observation, and intervention are what we need to deal with the changes provoked by the "Practice as Research" model. The type of outcome is not as important as the process of change.

Knowledge about how to invoke change in a practice and in a mindset, the challenge of being in the dark and learning from experiences, the critical methods and attitudes needed for lifelong learning and research, are what emerged from this "Practice as Research" and are the things that I wish to share with others.

7 Future work

"Practice as Research" was demonstrated as having great potential to be a research process or training standard for a practitioner-researcher to conduct investigation in a practical topic such as, critical computer animation. This research used two formal applications – a commercial project and an experimental work to evaluate the model. Although those experiments may suggest the model's wider use, there is no evidence for that generalization till the model is applied in other disciplines, such as art and design, education, architecture, product design or performance arts. Because the model centres on a practitioner-researcher, it is also important to have a wider variety of individuals who use and examine this model further.

Preparing a flexible structure and modular approach for the "Practice as Research" model and demonstrating its possibilities, was time-consuming. To validate those research methods, reflection and review techniques required by the model became an important focus for this research. I speculate that other research methods can be built into the model, and these need not be limited to case studies, interview methods and visual research, as was demonstrated by this research. Depending on the research question and different fields of study, other researchers are encouraged to employ different combination of research methods to examine the flexibilities of the "Practice as Research" model. Validation of the model in this research using two applications from different fields left me with little time to concentrate on *pure* computer animation investigation or on aesthetic issues. In my opinion, I have not yet stretched the "Practice as Research" model in (computer) animation studies as far as I would like to. For example, animator-researchers can focus their investigation on the transition between traditional animation to computer animation, conduct critical study on the integration of art and technology in computer animation, narrow their research on particular animation technique and its development, or concentrate on aesthetic studies of computer animation style, etc. These can be tasks for future investigation on my part or challenges for other researchers.

While building and using "Practice as Research", I noticed that many tools and techniques – mindfulness, critical thinking and writing, reflection and review, for example - were useful to animation students and researchers. But currently, many of these activities are not vigorously promoted by the community or by industrial professionals. Perhaps this is because of the widely held belief in the division between academic research and professional practices in the field. Therefore, I recommend that creative individuals or professional animators incorporate into their professions some of the concepts from this research model and attempt those mental techniques and reflection tools to examine their impacts in the creative industries. The "Practice as Research" model can also be used as a training activity to broaden (computer) animation students' skills and understanding, which in turn would help them to become a more diversified individual. The model

encourages receptivity to new experiences, critical assessment and can invoke both a sense of self-worth and an appreciation for the mentoring process. The concept of "Practice as Research" can assist students in overcoming the mental blocks created by the use of technology and techniques in animation production, and increase their confidence as a reflective and critical practitioner. I suggest that the use of the model may make students aware of interdisciplinary concepts in their studies earlier than would otherwise be the case. Thus, I would like to see the model being introduced to undergraduate or post-graduate students to encourage them to conduct their research with critical attitudes.

The difficulties found in conducting critical reviews and in taking up the role as a reviewer, revealed many questions that this research could not answer. The analysis of review generated a few different styles of review processes which were noted to improve criticality in this research. Some qualities and skills of the reviewers were identified to be needed before critical debates could satisfy the "Practice as Research" model. It was noted that to enable further research on these topics, we would need joint efforts from both researchers and reviewers to study the process and determine what might be required of them. I envisage that with the experiences I gained in this research and the mentoring support I wanted from reviewers, I may be able to frame reviews more suitable for practice research. Therefore, I would like to play the role of a reviewer one day and examine the review process from a different angle. The noted lack of critique knowledge among animators and review participants in this research also pointed to a need for promoting critical review (on computer animation) within the (animation) industry and University studies. I envisage that (animation) educators and students can employ those different styles of review process found in this research and together, examine and refine them to suit their disciplines. I would also recommend that professionals in the industry examine the current review model and contribute to the study of the different styles of critique.

As a professional animator, I would like to take the knowledge I have gained from this research back to the industry to share with my colleagues and to re-examine "Practice as Research", as the model was shown to be effective and efficient in this research. I would recommend researchers to apply this model to other areas in industry, for example, by conducting practice research on animated character/narrative creation, computer game design or special effect projects. It would be interesting to explore the values of practice research in disciplines related to computer animation and study their dynamics during production within the industry. I suggest that a studio and industrial-based practice research would extend my commercial game experiments in this research, since the researcher would have to deal with different teams and a non-academic environment, which may provide different insights to the "Practice as Research" model. It may take some time to convince studios and individuals to change their mindsets about practice research or for self-advancement in the industry when the animation industry is obsessed with time and cost.

However, with the reported dissatisfaction and perceived lack of progress from some animators in the interviews, I feel that what we lack is a model of work that can marry together the industry, academic work and self-satisfaction within the animator. "Practice as Research" was proven to be a possible answer – because it was a powerful and yet flexible model. Since the model is centred on the user who can vary the complexity of the model according to their discipline and work-style, studios can incorporate the model easily into their existing practice. This research demonstrated that the shift from a product-centred model to a (animator) practitioner-centred model caused no penalty to the production. Such a shift of perspective was noted to enable knowledge extension, critical practices that could offer more possibilities, and increase the creativity of the user. I would recommend keen researchers to experiment with the model by integrating academic research with applied research in industry. As a researcher, I would like to share my experiences from this research with academic peers. In particular, using this research as an example, to contribute to the debate on practice research in art and design, and discuss ways of ensuring critical assessment of such research. For me, nurturing a new breed of practice researchers with critical attitudes and mindfulness for tacit knowledge in a practice is very important for the future development in the area. I foresee that if more practice research were to be conducted with the "Practice as Research" model by different disciplines, the value of the intertwinement of knowledge and practices will be noted and valued. Such a change in the domain of thinking would liberate artists and designers from the shackles of the visual outcome of their work and the chains of the techniques that they use, and truly engage them with interdisciplinary research. They would embark on a journey to once again fuse art, technology, and science together into their fields of study, and seek for a higher level of knowledge within human activities that is not bounded by institutionalised thinking.

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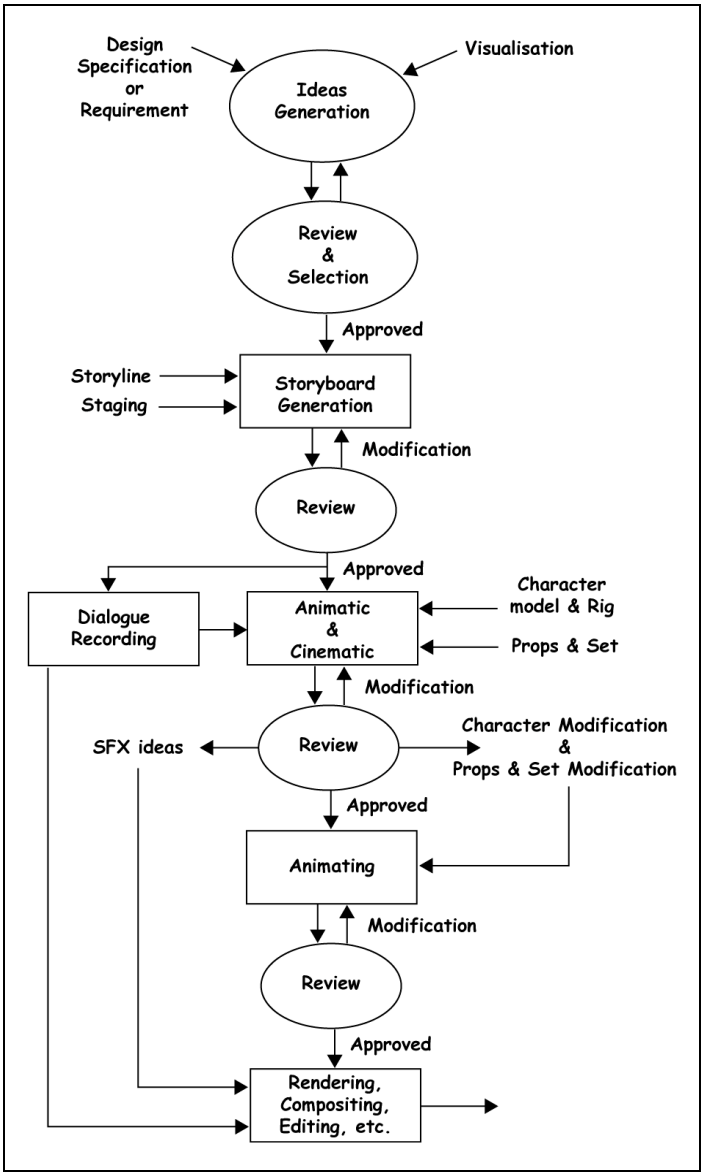
Appendix List

Appendix 1 A model of the narrative animation production process.

It demonstrates a process from generation of ideas, visualising the story to production, review and completion. This production process was detailed by the first case study carried out in the pilot study.



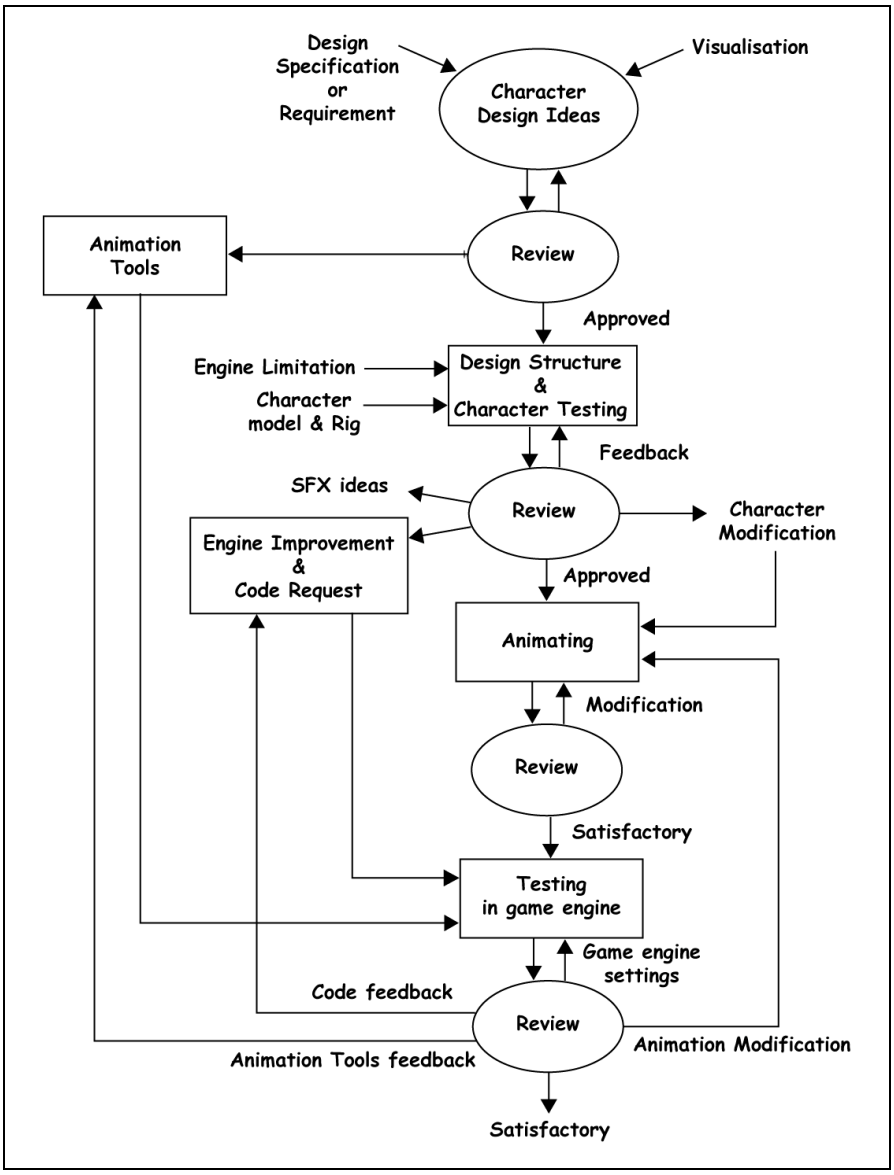
Appendix 2 Identified steps in narrative animation production

Step 1 : Information Gathering
Step 2 : Storyboard and Scripting
Step 3 : Audio Treatment
Step 4 : Animatic
Step 5 : Characters, Props and Set Review
Step 6 : Breakdown and Management
Step 7 : Animation
- Extreme Key pose creation
- Animating Process
- Lips Sync and Facial Expression

Step 8 : Post-production – SFX and Rendering

Appendix 3 A model of the game animation production process

During the case study of a narrative production, it was noted that there might be differences in comparing to a game project. Hence, it led to a case study on game animation where the following diagram was generated to clarify the stages of the production.



Appendix 4 Identified steps in game animation production

Step 1 : Character design and Review
Step 2 : Character and Rig Testing
Step 3 : Posing – Personality and Style
Step 4 : Animation Structure Design
Step 4A : Animation Structure Design – special character behaviour
Step 5 : Animation

- Extreme Key pose creation
- Animating Process
- Lips Sync and Facial Expression

Step 6 : Evaluation and Game Testing
Step 7 : Interaction and Integration

Appendix 5 Preparation documents for interviews

Explanatory Statement

Project Title : Critical computer animation production
Project date : September 2007 – August 2010

Doctoral Researcher : Yasumiko Cindy Lo Garry, engaged in practice-based research under the supervision of Dr. Steve Bell in the Media school at Bournemouth University.

The aim of my study is to gain a better understanding of different practices in computer animation production. I hope that it will enable us to explore and compare the working practices in the animation industry. This research will also provide information for reflective study of my own practice and for other practitioners in the field.

I am looking to interview people from a wide range of backgrounds and occupations, covering, for example, studio-based animators, lone artists, and scholars of animation studies, etc. The selection criterion is that the subject would have knowledge of, or will have worked in, computer animation. To enable me to gain a full understanding of my own animation practice, I will also include ex-colleagues who worked closely with me in the past. The interview should take 20-30 minutes and will be conducted in a semi-structured format. It will be audio-taped with the participants' consent.

Participation in this research is voluntary. Subjects may choose to avoid answering questions or withdraw at any stage during the interview.

Findings from these interviews will be published, but individual participants will be given the choice of being anonymous or not. The anonymity of the interviewees is assured by the informed consent form which is signed prior to the interview. For those participants who choose not to be anonymous, their names will be acknowledged in the project and papers when their contributions are published.

All participants have the right to an electronic copy of published materials and information about the research progress and its findings. If debriefing procedures are needed during the research period, the participant should contact me immediately.

Since this research forms a part of my PhD, data will be stored with the thesis and remain in the University's library and the British Library for future academic study.

If you have any queries or would like to be informed of the research finding, please contact:
Researcher : Yasumiko Cindy Lo Garry at yasumikolo@hotmail.com

OR
Supervisor : Dr. Steve Bell at SBell@bournemouth.ac.uk

Participant Informed Consent Form

I agree to take part in the critical computer animation production research project. I have read and understood the explanatory statement. I am willing to :

- Be interviewed by the researcher – Yasumiko Cindy Lo Garry
- Allow the interview to be video/audio recorded
- Allow the video/audio to be edited in cases of sensitive content or ethical concerns
- Allow the researcher to use the information for further study and publications

I understand that any personal information (age, occupation details, etc.) I provide is confidential, and that no such information will be disclosed to another party. I understand that participation in this research is voluntary. It does not mean that I can claim intellectual property or credit from the university and the researcher.

Please tick the following statements as appropriate

- ❑ The information I provide cannot be used by other researchers without my permission
- ❑ I allow the video/audio to be stored with the research project to indicate my contribution
- ❑ I allow the researcher to quote my name together with my opinion
- ❑ I want to be anonymous (no name will be recorded in the research or shown in any published materials)

Participant's name :

Signature : Date :

Researcher's name :

Signature : Date :

Appendix 6 Interview Questions (guidelines)

Interview Questions

General

1. Age, current position in the studio
2. Animation study or Any Training?
3. Starting position in the industry & years of experience
4. Tell me your thoughts on animation?
5. How did you move into computer animation?
6. What is your general opinions between traditional and computer animations?

Studio Practice

1. Is there any standard animation practice in the studio? Are you free to employ your own?
2. What is the communication like within the studio – modelling, animation, programming?

Animation Practice

1. Tell me about your practice – how do you get ideas?
2. Tell me about the things you do when you get a new project/animation?
3. Any other tools to help with the animation? Do you talk to people?
4. When do you start animating? How do you approach it?
5. Is there any particular things you obsess about in your animation?
6. How do you know when to stop (animating)?
7. Can you tell me how you judge your own animation? How do you get feedback?
8. Do you feel your fellow animators work in similar way? Can you describe any differences?
9. Do you have any opinion on visual language or critical language in animation?

Character animation – emotions & style

1. Tell me the kind of character animation you like?
2. What do you see important in character animation?
3. How do you tackle emotions in animation?
4. What is your approach to create a character? And his/her actions?

How do you feel about this interview? Do you think this approach can gain information about animation practices? Can you suggest any improvement?

Appendix 7 Examples feedback from participants of the interview

One of the participants commented on the interview-discussion style of approach. The casual discussion seemed to open up the participant and the exchange seemed to make the interview becoming useful for the participant.

The following shows the extracts of some of the comments from the debriefing session of the interviews. Generally, the participants seemed to enjoy the interview process.

Interview Feedback

GA-1>5:
They are good questions, quite thought provoking.
I like this kind of thing because you don't normally get chance to analyse how you work. Do you?

CA-1>10:
It is nice for someone to wonder what animators are doing. De-mystify it.

MA-3>10:
Day to day, you don't think about anything but doing the work. You don't think about the process you going through. After you work for a while, you kind of disengage yourself and just work to achieve this and that. So it is quite cool to chat about things and make you stop and think; without thinking whether I can change that or be better here.

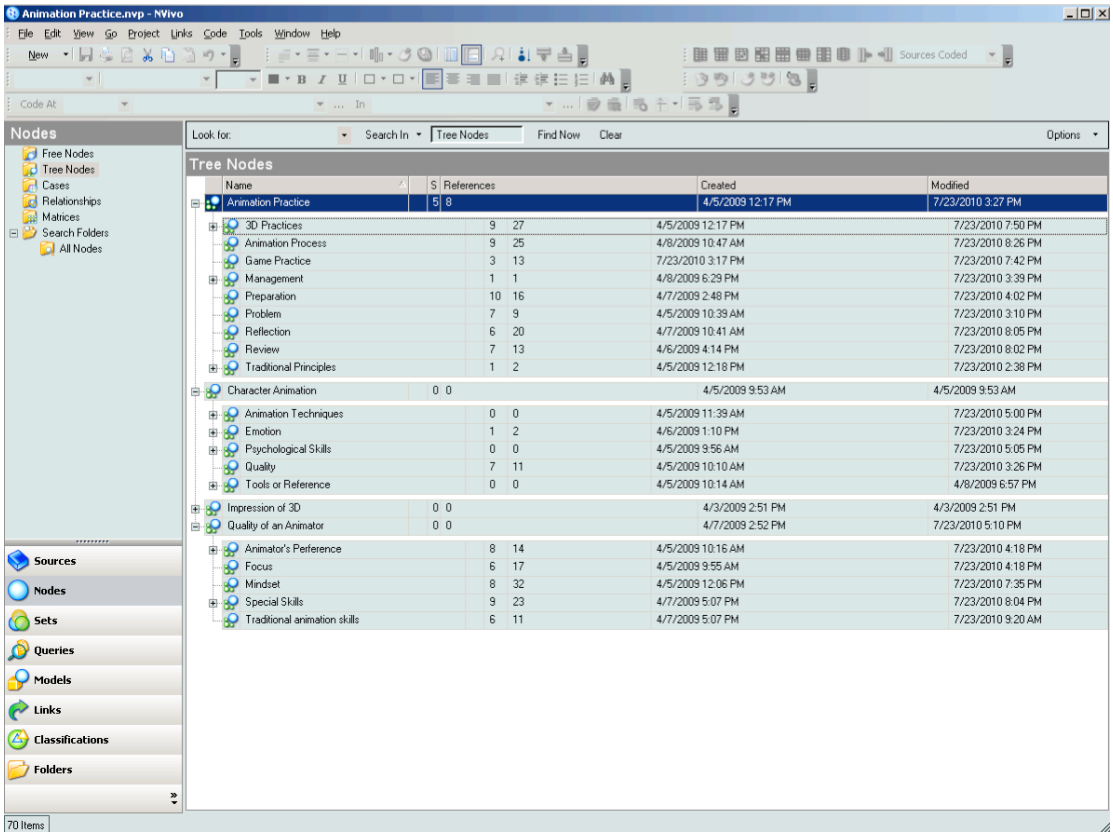
MA-4>15:
It is good about sharing of information.

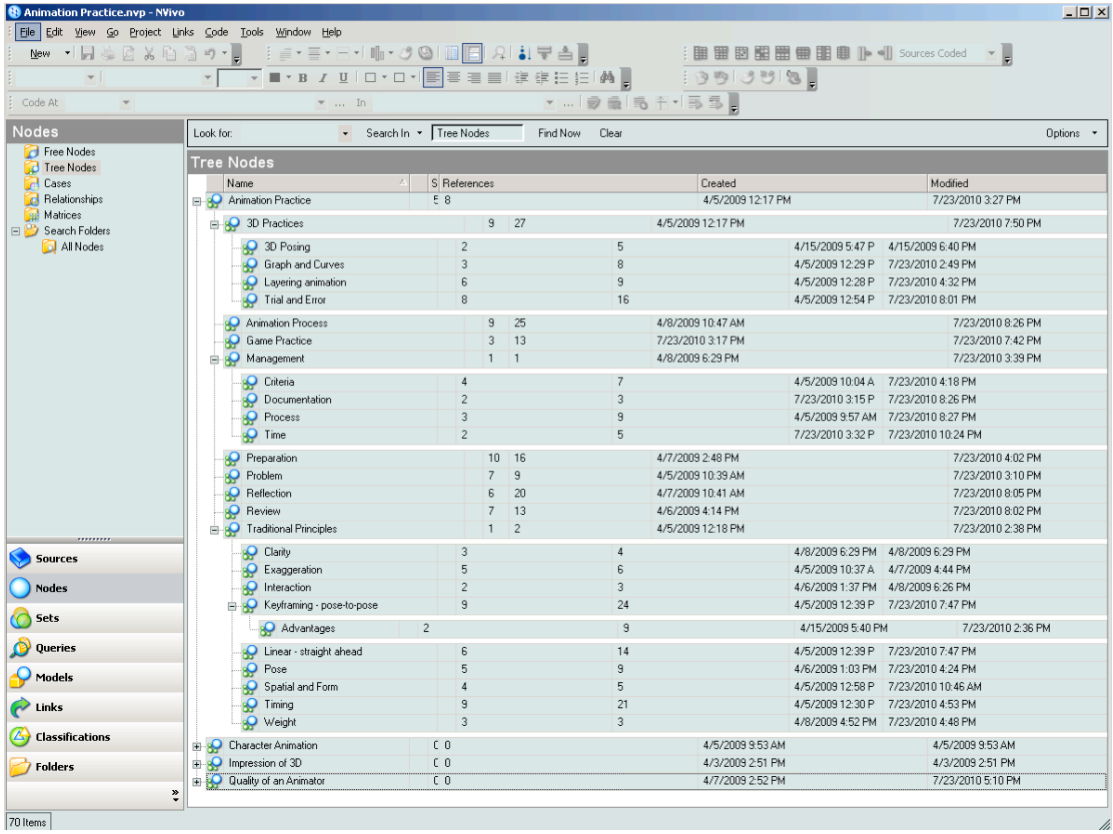
CA-2>5:
I think it is really good. It is interesting. It makes me think about stuffs. You are giving me feedback and saying things that allow me to think about. I argue more about the things I said as well.

CA-3>15:
I enjoy the interview. You have cover most of the things.

Appendix 8 Interview themes as seen and organised in CAQDAS

The following shows the layout of the software, in particular how themes are displayed and provide rough counts of the data.





Appendix 9 Interview Extracts on Animator's Qualities

GA-1>5:
If you want to do an animation of a character opening the door, don't just do that. Think about the first thing comes to your head and throw that way because everybody else would think about that as well. You want people to remember it. It got to be entertaining. It can only be entertaining if it is not something people has seen before. So it is got to be original and believable as well. It can't be crazy for the sake of it.

The main one is the work looks good and you got it on time. And also that your work flow allow changes.

Usually the way I work is quite structured. Everything I do, I will have a reason. I am not doing it because I feel like.

I think the workflow thing is really important. I do that all the time. All the time, I am trying to improve the way I work.

TA-1>15:
…..It is much more stylistic approach to movement. Imperfection allows much more to artistic license.

I can be the witch and I can be a real bitch. I can be the innocent character cos' if they are in my character, I can find them in myself. It is very nice to imagine yourself into the story.

MA-3>10:
When they finally take off the fixation of ultra-realistic stuff, it will leave us with a lot of technology than we can put in artistic stuff.

You were always sought to be better, be better prepared, to do more research, think more about poses but not to the expense that you didn't finish your work.

CA-3>15:
There is no easy formulas to get all ideas going, sleep on it and see what happen, detach yourself and do other things.

I try not to think about different problems at the beginning. I can study the feasibility and if there is a problem, I will rework the idea.

You need to know the Plumbing of the animation. It is great to know the theory but without plumbing it is not going to work.

For 3D, there are constant adjustments to make things work. We have to focus on the foundation and keep true to our criteria.

TA-2>15:
I only put extra creativity into the piece of work if I really liked it personally or else it would be a job to meet the requirements.

I usually focused myself on looking at character animation alone disregarding whether it is 2D/3D.

MA-2>15:
I think people unwilling to jump the gap more so than unable. They have to make the jump from 2D to 3D but they have advantages of the 2D skills.

Quality for animator is simple – friendly, open-minded, patient.

CA-2>5:
I think it is going to help to raise the level and make people aware of what we do need and that s/w is just a tool. The tool is not going to get you anywhere and you have to get there yourself.

MA-4>15:
Animation is all about taking something to the point that it works and beyond and to create something really exciting, very visual and engage the audience a lot more.

CA-5>?:
I know there is no "right" way to animate a character... but there's got to be a formula/process that saves time and produces good results.

CA-6>?:
If animation had a formula then it would be the same boring style done by everyone, and there is no originality in that. If you follow a formula, then your animation will be exactly the same as any other animator's who followed that same formula. Do you really want that?

CA-9>?:
…..With that said, however, I usually Don't go by the rules.

Appendix 10 Interview Extracts on Reflection

Don't do reflection
MA-2>15:
I tried to analyse my practice but I can't. I am too random.

CA-2>5:
As I said before, we are not really aware of how we work. They are not aware of how other people go about their work. You look at the end result but you don't look at the process.

Do reflection (form action, impressionistic)
CA-3>15:
I sleep on my idea and thinks about it…..
(My annotation:
His explanation and description about his way of working was very clear and structured as if he had thought through that long time ago. He examined different aspects through the process, sleeping on the idea, reworking the idea, flashing out the idea etc. implies his strong reflective working practice and his planning skill.)

GA-1>5:
It is like when you get to a point that you can't think; not that you think yourself is brilliant but you can't see how yourself can get any better. You get to the point that you ask how I can get better.

Appendix 11 Interview Extracts on Review

Don't do review - Difficult/Useless
CA-2>5:
There is a problem getting feedback randomly. Sometimes, you have several clients and you have people arguing what they want. And if you also have animators coming to you and comments, who do you follow?

I think it would be really good if everyday people can look at each other shot and give feedback. That is something I have never seen in animation in London.

…..People feel threaten. I have experienced that people looked at you as if they asked who you think you are.

Sometimes, the director hopes to have some sparks from the animator but the animator prefers not to invent something for the director.

CA-3>15:
Some people try to move forward quickly so whenever they got the first second done, to them, it is perfect.

TA-2>15:
…..Some comments may be too general and would be of no use.

GA-1>5:
Not at all. As long as the work looks good at the end.
(My annotation: This is when I asked about studio practice)

MA-4>15:
The studio I worked in was excellent but I was one person doing a lot of things.
(My annotation: There is no way to do review with other peers)

CA-1>10:
What happened for big show is the lead, the supervisor and animation director will review themselves and leave the artists to get on their work which is not great because you don't get to see everybody's work.

MA-2>15:
Review by the director.

Do review
CA-1>10:
What we came up with at the end is every week or every 2 weeks…..

Daily can be a bit hit and miss depending who your producer is and who your supervisor is. It can drag on a bit, if you got 15 animators all looking at their own shot. It can take a while; you get bored and you get frustrated.

Appendix 12 Interview Extracts on Studio practices

Organised Studio practice
GA-1>5:
There is the kind of professional training – business communication and presentation skills.

CA-1>10:
What we came up with at the end is every week or every 2 weeks…..
(My annotation: This is when I asked about review)

TA-1>15:
Every week, I went to different area to learn about different aspect of animation.
I learn from animator and director.

Not Organised Studio practice and other problems
GA-1>5:
Not at all. As long as the work looks good at the end.
(My annotation: This is when I asked about studio practice)

TA-1>15:
…..The director can be very temperamental.

CA-2>5:
Most of the time, there is no pipeline and no pre-production plan…..I think it is down to management and make the moment of a day. It got to be a studio practice.

It varies – some people are very vague and you have to keep on asking…..
As I said before, we are not really aware of how we work because we don't have that much of interaction.

MA-1>15:
There is not a lot of communication between animation and coding.
..…there is always a little friction.
(My annotation: This is when I asked about game)

In my experience, CG animators would not talk to each others.

CA-1>10:
The trouble is the company is traditionally an effect-based house…..
But here, because it has been a TD based, they are really reluctant to move because it means the riggers have to do what we want them to do. Traditionally, the riggers have been the authority. We don't do it like that, but it will make animation easier if you do it like that, but we don't do it like that.

It is very much them and us which is horrible. …..I email the lead TD and asked if the file is too large. He was stunned; he said animator shouldn't ask question like that; animator don't care. Actually we do, we aren't completely ignorant.

I have noticed the British animators will just work with the rubbish; put their own locators in, move things around so that they can get going.

MA-3>10:
There is animation and animation - Art and technical side of animation though everyone comes under the same umbrella of animation.

MA-4>15:
…..we will get storyboard but normally terrible.

MA-2>15:
You are a few steps from the communication….. I never really see a storyboard provided. I made them but was never given on. It is always words of mouth. The animatic or not.

CA-3>15:
In film, there is no choice but to fit into the pipeline. In industry, for example, as a modeler, they don't want you to step outside modeling. Big company will not encourage across-disciples…..

Appendix 13 Interview Extracts on self development

GA-1>5:
It is like when you get to a point that you can't think; not that you think yourself is brilliant but you can't see how yourself can get any better. You get to the point that you ask how I can get better.

CA-2>5:
I am doing this animation mentor course and in the 2 weeks, they explain how you have to plan the animation, really understand what you are doing and you are in control of every single frames. Usually, computer animators allow the computer to do the in-between and they give away the control so you are not animating as good as you can.
(My annotation: The participant was excited by the new course and what they teach about animation. For someone with more than 5 years experience in the London film industry, it does show that the concept of self-development is perhaps need to be introduce a bit earlier)

Appendix 14 Interview Extracts on traditional and computer techniques

MA-3>10:
Not doing Pose to pose like the 2D drawn. It is still a way of thinking….. The pose wouldn't be on one frame (the physical shape) and it would physically spread out over 10 frames. …..I am doing that with straight ahead as well.

We have 2 different directors and 2 different approaches. One guy was very key poses heavy and using step keys and then when you are ready, you do your breakdown and switch it onto curves, and do your polish. The other guy was very much use curves but both not forceful. You have to kind of take the good bit, the thing you like and you don't like, provided that the end product satisfies the director's need, it is not a pressure that you have to work this way.

Mocap data get you when you are in a time constraint and get you a bit chunk of stuff done.

MA-4>15:
If you need to layer your animation for walk cycle, working pose-to-pose on particular sequence that is fine. But if you work straight ahead, then, it is fine.

MA-2>15:
Like Pixar, they use Pose to pose, lead to a certain style of animation. You can't knock it because it works but it is not the only way.

CG is easy to do straight ahead. Personally, that is how I started. If you haven't gone through key frames and taught that way, straight ahead seems to be a natural or the only way of working.

Mocap does what a face does and not allow any room to expend and take pass the limit.

CA-1>10:
I animate in a complete different way after Eamon started. I used to do straight ahead animation and kind of hope they work for the best. He is the advocate for pose to pose. I do that from scratch now and it is so much easier. You spend your time homing that pose…..

Mocap is a great reference but we didn't use most of it because we have to clean it.

CA-2>5:
The course I am doing now encourage me to pose it to the end of the shot. Work out the timing for each poses too.

I am a bit embarrass cos' I start animating straight away in the software.

Usually, computer animators allow the computer to do the in-between and they give away the control so you are not animating as good as you can.

The times I worked with Mocap was horrendous. You have to clean up and clean up the details. The thing is it is supposed to save time because you don't have to animate. But the amount of time you spend cleaning it up, you may as well animate it.

GA-1>5:
I like Mocap. The different between Mocap and keyframe is they offer different things.

You get natural poses from it which can be quite good. The main thing you get from Mocap is the subtlety in motion.

CA-3>15:
Animator would find Mocap quite dull but for technical director, it does the job to put everything together. No analytical work in Mocap and animator seems to be fixing.

TA-2>15:
With computer approach, it makes it very easy to forget what you are doing and the essence of the character.

CA-8>?:
The more I animate the more I use pose to pose less I'd say. I find pose to pose looks pose to pose and I'm having to unpose everything.

CA-10>?:
I'll go in and animate everything straight ahead, then go back and scrap entire portions of animation, reanimate them pose-to-pose.

Appendix 15 Interview Extracts on Acting techniques

GA-1>5:
We tend to use video camera. Sometimes, you record yourself or if it involves more than one person, everybody helps out. We all get up.

MA-1>15:
Not a lot of animator get up and act the action.

CA-1>10:
They are very fond of saying you do it in front of a mirror and you should but getting that film as reference is not great unless the animator is a dancer or a performer. Some of us are a bit kind of stiff…..

…..you go and get yourself filmed doing your bit; no question just do it. I didn't like it. …..we got the camera setup. I didn't feel like I could do it without being embarrassed or self-conscious.

TA-1>15:
I am quite a shy person so I act in privacy. We are expected to do animation on paper so we are more of "wounded actor".

MA-4>15:
I think acting course is absolute invaluable. Acting course can bring it out of you but also acting principles can be utilised in animation performance.

(My annotation: Acting is mentioned in a rather detached manner)

CA-2>5:
I took an acting class….. the moment, I was in class, I hated it. It was horrible.

CA-3>15:
I always ask people to get up and show the characters….. On the whole, students don't like to stand up and embarrass themselves….. I act all the time but will not video.

Appendix 16 Interview Extracts on Drawing and Sketching

GA-1>5:
So I just spend 6 hours just drawing.

TA-1>15:
I experience in my drawing that I can play with my feeling.

TA-2>15:
I visualise camera and draw the movement into my key frames

CA-1>10:
2D is slightly out of practice, it takes a long time to do it.

MA-3>10:
If they can't draw but they still can animate, it is not a bad thing.

MA-4>15:
I got a lot of friends work in the industry who do very little drawing but they got their own way to record data

CA-2>5:
I am struggling at the moment since I do not have a 2D background.
(My annotation: the participant did not say the problem of struggle but somehow, believe the cause is related to 2D experience)

Appendix 17 Interview Extracts to demonstrate Inconsistency

GA-1>5:
…..you record yourself or if it involves more than one person, everybody helps out. We all get up. …..people helps me and I help them. It is good and it is fun because you can also talk about how the animation is going to work.

I don't actually empathise with the character.
(My annotation: the participant showed the enjoyment in acting, using video recording his own actions and playing out the character but he seemed to believe that he did not empathise with the character at all.)

Appendix 18 Interview Extracts about observing and motion study

GA-1>5:
I usually use ideas from thing I have seen. People I met and animals like pets and stuff.

MA-3>10:
Studying movement is good.

MA-4>15:
…..we encourage students to record through close observation study. The students get a lot out of it by watching the actors and they are studying that performance.

Appendix 19 Interview Extracts on emotion handling

MA-1>15:
In CG, you can have fully facial rigged so may be they don't have to concentrate too much on the physical movement to convey a mood

CA-1>10:
Handle emotion just with poses. If you can't express it in the pose, then you won't be able to do it on the fly.

MA-3>10:
The easy way is the face to convey emotion where you get the bulk of information. The posture is equally important and you can probably get more.
It is like mime, it is selling it with pose and rather rely it on the face.

CA-2>5:
I convey emotions through facial and body movement.

CA-3>15:
Body is the reflection of the emotion.

Multiple characters are more difficult. How they interact? If you are given a shot, you need to read everything up to that moment and beyond so that you know how they get there.

TA-1>15:
Get the little traits

Appendix 20 Interview Extracts on computer and games specific problems

General
GA-1>5:
You can't really grab the keys and scale it. You can but it wouldn't look good.

MA-1>15:
I found it became more animations by typing in number, dealing with function curves. It further reduces free flow and creativity.

There is a temptation of keep tweaking and tweaking.

They will work without thinking about how long the movement takes and then compressed the timing.

People buried their head to listen to headphones. Not a lot of animator get up and act the action.

TA-1>15:
3D is a bit more clinical.

People are so aware of the character model but they are not aware on screen timing.

CA-1>10:
Deadlines are tight. The animators taking up the slack, working with bad rig, bad tools and making the best of it.
I have noticed the British animators will just work with the rubbish; put their own locators in, move things around so that they can get going.

CA-2>5:
I think that there is a problem with schools at the moment, they are so focused on teaching Maya and Softimage and rendering.

MA-2>15:
In the real world, you don't have a lot of time. A week to do concept, a week to build character and hopefully 2 weeks to animate. Studio put a lot of pressure on things getting done on time.

CA-3>15:
In film, there is no choice but to fit into the pipeline.
Big company will not encourage across-disciples.

CA-7>?:
…..my main issue with animation mentor.....the work coming out of AM is real quality but it does just seem like the animators are being cloned.....95% of the anim I've seen coming out looks EXACTLY the same (all be it good).

Game specific
GA-1>5:
Generally how we work is to get a rough animation into the game as fast as possible. You can never know anything about that animation before it goes into the game.

The game play is the most important and that is why you do that first but not many people do that. They just go in and make nice looking animations but it may not blend well with other animations. It doesn't necessarily play responsively.

It may be you realise that you need ten more animations that you haven't anticipated before or the original ideas was not even working.

You get animator coming from traditional background and animator from programming background. You are working on the same character and ending up have different approach and different way to work. It is difficult esp. in a team trying to maintain a style across.

MA-1>15:
Game studio is very restrictive. The company is rigid and it is tightly structured. Artist will do the texture, animator will skin them.

Interaction in game is a coding issue.
There is not a lot of communication between animation and coding.
Animators have no input to the logic of the code.

There is no freedom to choose which character to animate. They have set list of movements and they just work through those.

MA-3>10:
We got limited time frame, you have to hit the ground quickly and do it.

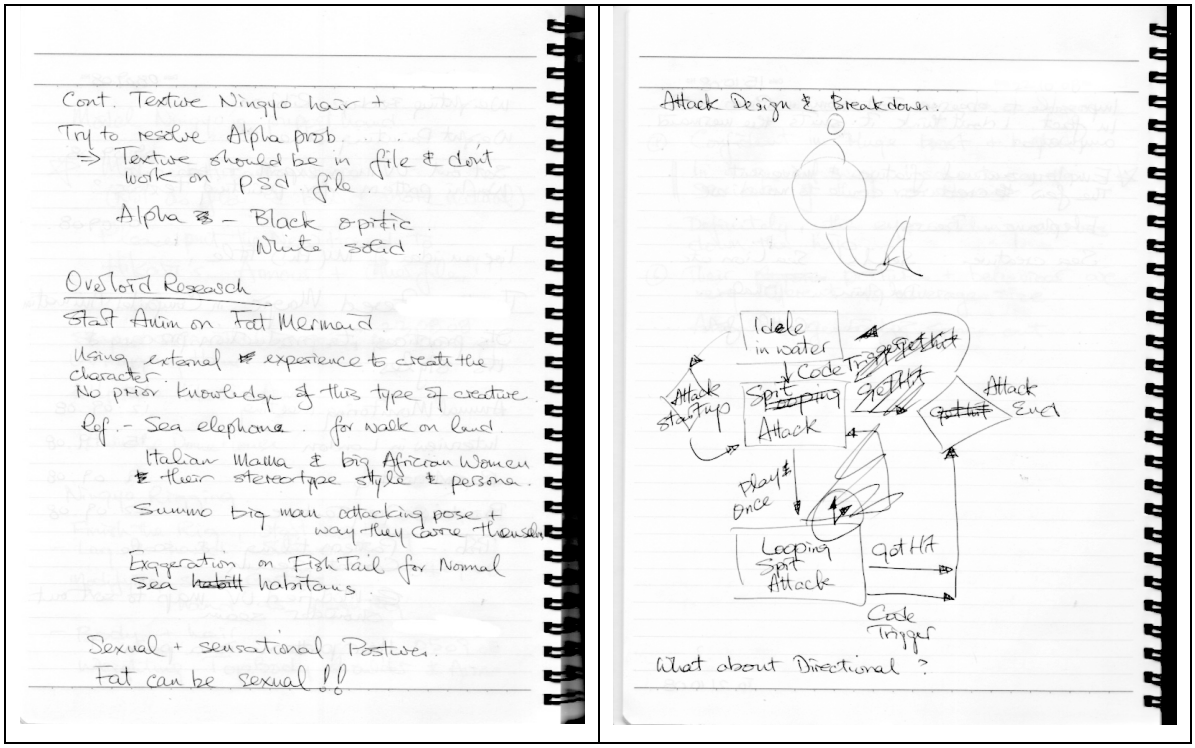
There is animation and animation. Art and technical side of animation though everyone comes under the same umbrella of animation.

Get it into the game engine as early and then you layer the information up.

Appendix 21 An example of character design sheet and quick expressions

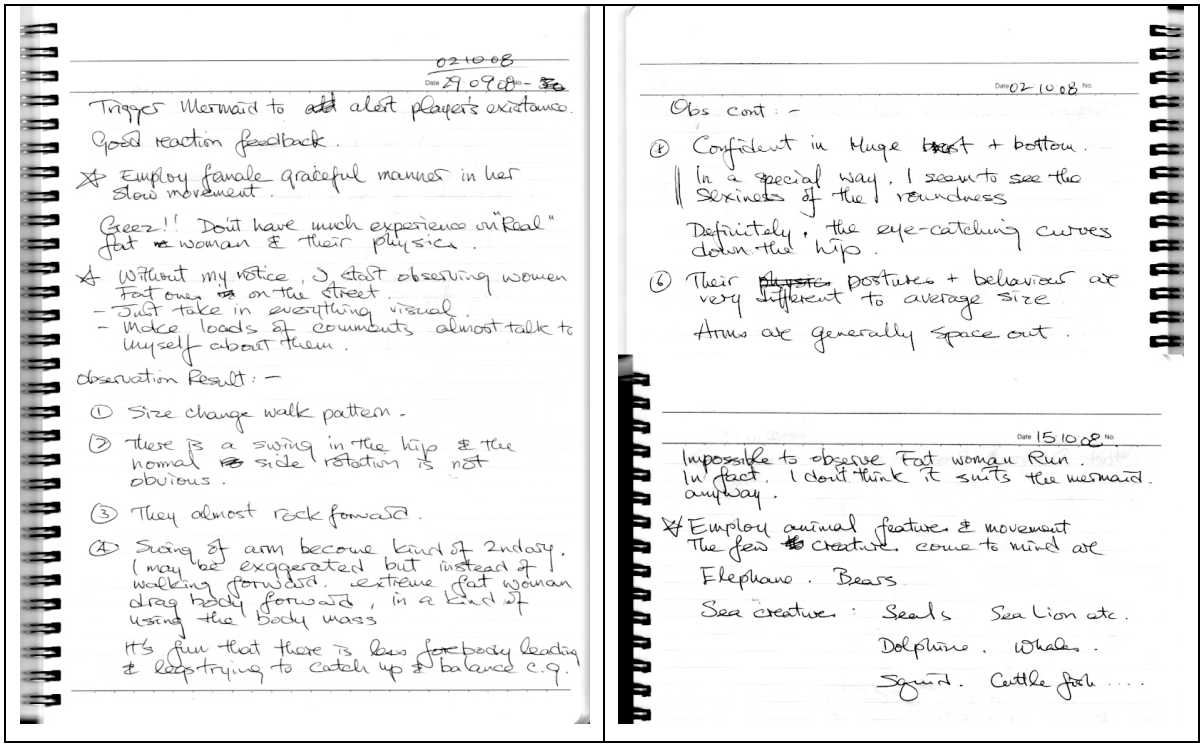
This is an example of what information an animator may get from a character sheet. Usually, there are characters in different poses or outfits; colour representation and most of the time, close up shot of the character. Expressions (as seen at the top left corner) are usually in separate sheets.

Appendix 22 Brainstorm notes on the Mermaid

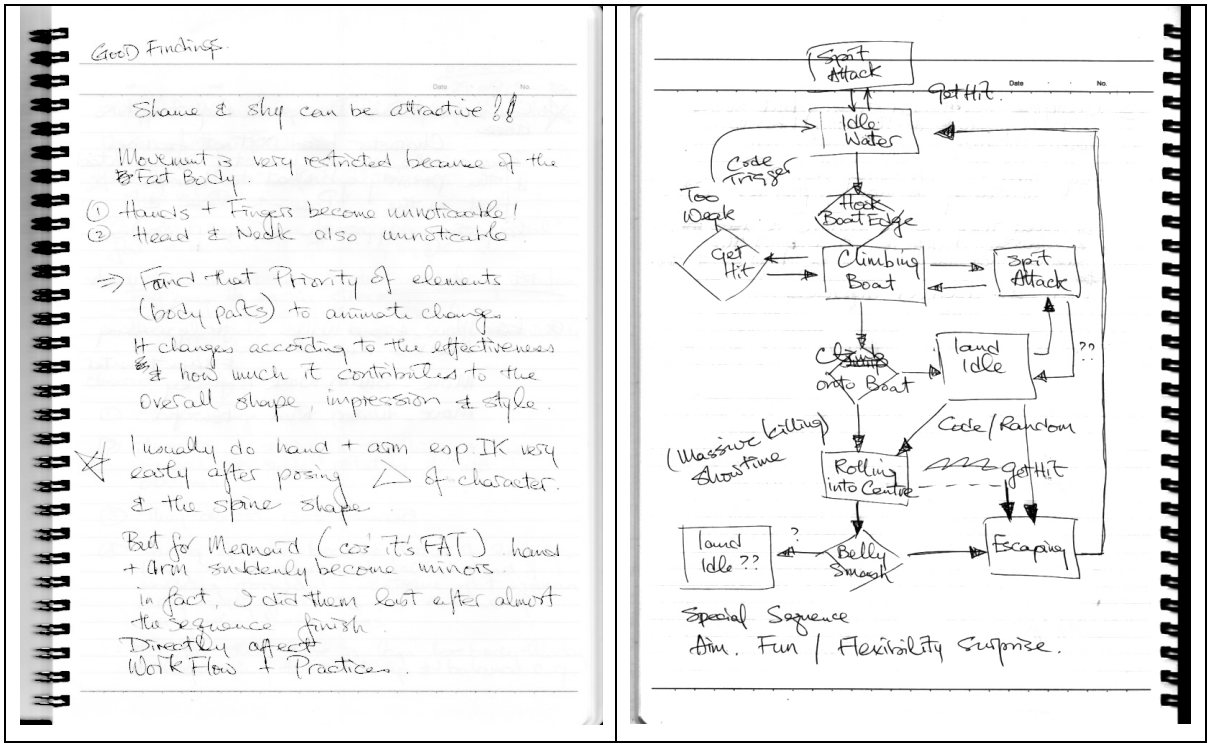


From the record, it shows that even in the initial planning stage, there were rough ideas concerning the functionality of the character.

Appendix 23 Observation notes on the Mermaid



Appendix 24 Testing notes on the Mermaid



While testing the Mermaid model, I was concern about its flexibility for animation and it led the consideration of the most complex functional requirement of this particular game character.

Appendix 25 List of animations for the Mermaid

State	Animation to make
On Land	Idles, walk, run, turns, get hit
	Transition from land to sea – moving and leaping off the shore
At Sea	Idles, swim fast & slow, dive up & down, attack, get hit, die
	Transition from floating in water to hanging onto the ship
Climbing	Idle climbing, attack, get hit, retreat back to sea, die – drop back to the sea
	Transition to get onto the ship – a leap
Onboard	Idle, rolling, attack – wrack the ship, get hit, die, escape back to sea

The above animation sequences were made for this research and displayed at *Hypertext menu: Mermaid -> Anim* where reflections on individual sequences could be found.

Appendix 26 Production log for the Mermaid experiment

Task	Work/Problem	Hours
Mod Climbing Sequence	ClimbOnBoat_start, ClimbOnBoat_end, Idle_HangingOnBoat, Death_FromHanging	4.5
New Spit	I reuse the same spit attack from the water & detach mermaid from the boat	
SpitAttack_Hanging_Start_NEW	but it looks strange when she let go with boat movements	
SpitAttack_Hanging_Loop_NEW	So we have to have complete new design	
SpitAttack_Hanging_End_NEW		7
GetHit_Hanging	These are missing from the original list	2
GetHit_InWater		
getHit_OnLand		
Idle_Land1	There is no eye so it is hard to animate gaze. Polish should include all eyes animation	
Idle_Land2	**Add texture for polish?**	
Idle_Land_Combat	Re-animate Tail & include some pushing forward movement	
Walk_OnLand_NEW	Sorry she hasn't got hip bones and A bit sharper centre rotation may imply the hip??	
	Otherwise improve her steps and speed (~30%)	
Run_OnLand_NEW	Add 2 pauses between hops hence has to re-animate tail.	
	exaggerate the wobbling	6
Swim_Slow	flip 180. Extreme wobble	
IdleWater_To_SwimSlow	Re-animate. new move, flip 180	
SwimSlow_To_IdleWater	Re-animate. new move, flip 180	7
Dive_Up_NEW	**Animate the underwater curve and surface up as we can see more**	
	Suggested weaving head would not be as good	
Dive_Down_NEW	**Animate the underwater cos' apparently we see through quite deep, hence longer**	
ClimbOnBoat_Start	**Animate the underwater hence longer**	
ClimbOnBoat_End	Touch up at the end and speed up the end portion etc.	8
SpitAttack_Hanging_Loop_NEW	Since she is lying on the ship, blowing up her body can only be done on the back side	
	Very bad deformation on the body. Upgrade the skin in Polish or else she can never blow up nicely	
	If this looks strange in the game, we should think of something else or keep the previous version	
SpitAttack_Hanging_End_NEW	Did keep the break and speed it up 30% in the 2 breaking ranges	
	Personally, I like the distinct breaks and if you feel that it is not smooth, we have to take away the breaks	
Escape_FromBoat	Tighten anticipation	
Belly_Smash_NEW	**Very bad deformation on the body. Upgrade the skin in Polish or else she can never blow up nicely**	
		7
	Next time if you do similar character, instead of stretching the skin with Translation of controller	
	Please use scaling so that all deformation can be balance and save time on animating individual controll	
Belly_Smash_NEW_short	If the initial bounce is still too long, we can cut frames 40-180	

As shown above, apart from problems, there was also a time log for the completion of the individual sequence.

Appendix 27 Questions used in the Reflection-on-action by the researcher

On character animation

1. How did you think about the character in the pre-production stage?
2. Any problems in pre-production? What were they? Did you resolve them? How?
3. Did the character pleasing for animations? Did the character work/behave as you expected?
4. Any difficulty in the production cycle? If so, how did you resolve them?
5. How well did you expect the character to work in the final product?
6. What do you not like about the character? What do you like?
7. On viewing the results, what do you think?
8. What improvement do you think the character needed? And what would you do differently?
9. How did the integration/testing go? How did you feel about the comments from your colleagues/experts?
10. Technical/outside animation problems, what can be improved or expand etc.?

On animation practices

1. What do you know about your own practice? Any strengths or weaknesses?
2. What do you think about the creative/design process? Animation production?
3. Any difficulty that affect animation design or your usual practice? Or facing in this research?
4. How did you feel about your practice within the production cycle?

5. Did you do anything differently (this time or for this research experiment)? Any improvement you can see?
6. How did you integrate practices and knowledge and the unexpected?
7. Did anything else affect your practice or changing your previous views?

On research methods/process

1. What did the case studies do for you? On reflection, will you do it differently? If so, how?
2. How did you feel about the animation experiments? Using character animation?
3. What is the self-reflection within a production like? Any difficulties? What records did you generate?
4. How did you use those records? Are they of any good?
5. How did you examine the practice and the production/animation?
6. What is the reflection like after the production? Can you compare with the reflections before or even from the case studies? Any difference?
7. Given you have the choice, would you use reflection in your work?
8. Can you tell me about the experience with the peer-reviews and their comments?
9. What do you think about interview as a method? Any difficulties? How do you resolve them?
10. Any factors you experienced that affect the research or the methods you chosen?

Appendix 28 Instructions for peer-review to assist reflection-on-action process

Can you give me some comments on the Mermaid first of all from "for work" "for the game" point of view? And then...

Can you give me some comments on her "Aesthetics" (artistic beauty) and "from Audience" point of views on my animations? Think like you are the player!

It can be really random; any thought occurs to you while watching the Mermaid. Individual experience and preferences in the animation is what I wish you to focus on. Apart from professional judgement, I want to study different aesthetics comments from different individuals. Animators will always be too close to comment on technical and visual side of things instead of a deeper layer of aesthetics or appreciation, personal like/dislike.

I am hoping to obtain some positive and negative comments so that I can use to compare with my own comments for critical analysis. It would be nice if you can pick one or two actual animations to comment or as example. It is good for me to have data to do new version of the animation in a much later day so that I can study the differences with visual demo if I choose to.

Appendix 29 Comments on Mermaid from reviewer/colleagues who are experts in game development

From: [redacted]@triumphstudios.com)
Sent: 11 November 2008 08:25:27
To: Yasumiko Cindy Lo (yasumikolo@hotmail.com)
1 attachment
Mermaid_H...jpg (85.3 KB)

Hi Miko,

In general, all animations look cool and most of them work in game already. However, there are a few things which I think should change after I experienced them in-game a few times:

1) The animations where the Mermaid hangs to the border of the ship need to be more off-pivot. Currently, the model's pivot is in between her elbows when she hangs, this makes the model clip through the border of the ship. The model should be moved to the back so the pivot is in front of the model. I made a screenshot to show you where the pivot is when she hangs at the ship so you can she how far she should be moved back in order to hang properly at the border. This should happen for all hang-to-side-of-ship animations: ClimbOnBeat_start, ClimbOnBeat_end, Idle_HangingOnBoat, Death_FromHanging & the spit animations as described next.

2) The spit animations while she hands at the side of the ship are a bit confusing because she detaches from the ship and moves back. Especially when the ship is moving this looks a bit strange, as if she's flying. It would be better if she performs the spit-attack while she keeps hanging at the side, so it looks more like the idle hang-animations.

3) The death-from-hanging animation should throw the mermaid back completely off-pivot so she falls back into the water. This means she needs to fall at least 2 meter backwards and 3 meter downwards so she really disappears beneath the water level. Right now, she 'floats' next to the ship.

The answers to the questions in your last mail:
- About the escape animation: that would be cool. Note that it should, just like the death-from-hanging animation, move the mermaid a few meter backwards (at least 4 meter so she jumps off the deck(and 3 meter downwards so the lands in the water.
- There are no hit poses indeed, it would be nice if there was a hit pose for land, water & hanging.

Cheers!
[redacted]

Idle_Land1	There is no eye so it is hard to animate gaze. Polish should include all eyes animation	For polish ill send you the final model.
Idle_Land2	**Add texture for polish?**	
Idle_Land_Combat	Re-animate Tail & include some pushing forward movement	Movement OK
Walk_OnLand_NEW	Sorry she hasn't got hip bones and Abit sharper centre rotation may imply the hip??	
	Otherwise improve her steps and speed (~30%)	Good
Run_OnLand_NEW	Add 2 pauses between hops hence has to re-animate tail.	Forward movement is to liniar, More slow do
	exaggerate the wobbling	
Swim_Slow	flip 180. Extreme wobble	Good
IdleWater_To_SwimSlow	Re-animate. new move, flip 180	Good
SwimSlow_To_IdleWater	Re-animate. new move, flip 180	Good
Dive_Up_NEW	**Animate the underwater curve and surface up as we can see more**	The ending doesn't feel as strong as the be
	Suggested weaving head would not be as good	
Dive_Down_NEW	**Animate the underwater cos' apparently we see through quite deep, hence longer**	Good
ClimbOnBoat_Start	**Animate the underwater hence longer**	Good
ClimbOnBoat_End	Touch up at the end and speed up the end portion etc.	Good
SpitAttack_Hanging_Loop_NEW	Since she is lying on the ship, blowing up her body can only be done on the back side	Good
	Very bad deformation on the body. Upgrade the skin in Polish or else she can never blow up nicely	
	If this looks strange in the game, we should think of something else or keep the previous version	
SpitAttack_Hanging_End_NEW	Did keep the break and speed it up 30% in the 2 breaking ranges	Good
	Personally, I like the distinct breaks and if you feel that it is not smooth, we have to take away the breaks then	
Escape_FromBoat	Tighten anticipation	Good
Belly_Smash_NEW	**Very bad deformation on the body. Upgrade the skin in Polish or else she can never blow up nicely**	Sorry, Merijn preffers the short one
	Next time if you do similar character, instead of stretching the skin with Translation of controller	
	Please use scaling so that all deformation can be balance and save time on animating individual controller	
Belly_Smash_NEW_short	If the initial bounce is still too long, we can cut frames 40-180	Good

Appendix 30 Agenda and procedure for individual peer-review

Website URL : http://www.yas-studio.net

Prior to expert/peer-reviews and discussion, the researcher/animator should have conducted self-review following the process listed on the website (see Mermaid->reflection). I have carried out casual and formal self-reviews (see also Mermaid->review1) on the mermaid experiments and the outcomes. Three experts in the field of animation/game development were consulted. One of them preformed visual review on the quality and aesthetics of the animations alone; another preformed technical and game play review on the character, its functionality and animation quality within the game and the third acted as a normal player giving general and casual comments. I received 2 written and 1 oral reports from them. Furthermore, a member of the public, who did not know anything about animation/game production, was also asked to review the mermaid animations and comment as contrast to the experts' feedback.

Using data from my personal review and the others' feedbacks, I gained a more objective opinion about the mermaid and anticipate having a clearer focus about the agenda for formal peer-review and discussion. Since all 3 experts did not focus on research methods, purposes and the design of animations & the experiment, I intend to make these issues the priority in the coming peer-reviews. This does not mean that animation aesthetics, functionality and technical issues are not on the agenda. The review focus greatly depends on the expertise of the peer who reviews this research. Experts/practitioners with academic and research background and knowledge about animation would be the suitable reviewers.

The format of the review session will follow the structure listed on the website (see Mermaid->review1). Individual peer-reviews are to carry out and according to the expertise of the reviewer, agenda of the review session could be different. During the review, peer is encouraged to question as well as to comment on the materials/animations that had been studied extensively prior to the review. (Peers who are in the research supervisory team should focus on research methods, and the design of the animation experiments) Peer-review will take on an open approach though I have imposed an agenda (i.e. the main topic of the discussion or focus around the expertise of the peer). This is encouraged peer to question the ordinary or to take the review from a different perspective. The session should take form of a debate in order to understand the research and comments-made for both parties.

Then, a group discussion involving all reviewers will be conducted with an agenda about the collective ideas and comments from individual review sessions. Again the main focus of the discussion is the research process, review process and the interactive presentation. Animation-related issues will be included in the agenda only if individual sessions revealed contrast and opposing points that need further discussion or on reviewers' request. An open and interdisciplinary dialogue is encouraged between the reviewers while the researcher should take on a passive but listening attitude.

Preparation and information for reviewers

Reviewers for individual session and group discussion are encouraged to have some basic understanding about the research prior to attending reviews. Extensive information about the research, animation experiments, visual outcomes can be found on the website http://www.yas-studio.net Research section (if unsure, contact Miko)

Topics required reviewer to understand and then comment or discuss during the review are :-
Different research methods studied and used in this research
Animation practices / working style
The purpose of the pilot study and (mermaid) animation experiment
Understand the research journey and reflections during the journey

Preliminary findings about the proposed research methods
Animation aesthetics on the visual outcomes of the research
Web presentation

Review Topic/Agenda for reviewer to choose or focus on are:-

1. Research methods

- The purpose and difference of the methods
- The structure of mixed methods approach
- The methodology – comparison between methods and findings
- Case studies and animation practices
- Animation experiments and its design (mainly the mermaid)
- Reflection processes (as reported on the website)
- Review structure and process (as planned and practicing)
- Interview and analysis (in Transfer report)

2. Web-based presentation

- The purpose – as reflection activity and as a mean to make the research explicit
- Degree of transparency about the research journey and personal reflection
- Integration between the research and visual outcomes
- Interactivity & usability
- General visual design

3. Animation production & outcomes

- Animation experiment, purposes and outcomes within the context
- Pre-animation processes – creative, persona and functional design processes
- Integration between visual design, function and animation aesthetics of the character
- Research quality vs animation aesthetics
- Animation aesthetic categories (for review)
    1. Stimuli based – how it captures attention surprises viewer/player.
    2. Perception based – how viewer perceives action, character/personality; how animation/character engages with viewers.
    3. Abstract, symbolic or imaginative – purely artistic and require high degree of interpretation.
    4. Simulation – representation of machines/characters behaviors etc., for example, game, dynamic simulation…

Before the individual review session, an agenda should be agreed between the reviewer and the researcher. For the sessions with academic and research experts, all 3 topics are included with the prime focus on research methods. To ensure critical and rigor discussion, reviewer is encouraged to note down questions and comments prior to the review. If the web-based presentation in any way poses serious obstruction to the understanding of the research and animation experiments, the reviewer is encouraged to clarify with the researcher prior to the review.

Finally, the scope of the coming review is on the mermaid experiment which should be well presented on the website, and also the pilot study which was described and discussed in details in the Transfer document.

Appendix 31 Clarification for individual peer-review procedure

There seems to be a general anxiety about the peer-review and what I was expecting the reviewers to deliver. To be honest, I expect nothing although I wrote a long process. The document is really for you and the industrial persons whom I asked for reviews, to digest the concept of review and try to diverse the focus. Imagine, if we do it like the industry (is it good for game? Is it telling the story?) or like the current educational structure - tutors looking at visual imagery and comment, I question what is different in this PhD. On the 2nd page of the document, I also bullet pointed topics or focus to assist reviewer to understand the scope and consideration. May be that was Why Steve thought that I am expecting every details from everybody. The answer is no. They are there to assist you when you view the work and what you may think about. On the last page, I gave a list of example questions not for you to ask me but for you to understand what I have been asking myself in the review process. This hopefully will be some questions you also like to know or enable you to ask more thought provoking questions.

This type of anxiety has been reported by tutors in higher education esp. in soft science subjects when there is no black and white result. Tutors find it difficult to handle diversity of different projects their students attempt to do and understanding all aspects of it to assess it. Another reported issue is the role reverse model of teaching which not many tutor can adopt well. Student-centred and self-learning project is particularly troublesome for people when they fall into the trap of teaching and learning ownership; traditionally all come from the tutor. Students asked question about what they need to do to pass exam and when they are asked to lead their own project, they are stuck. Tutors also feel uncomfortable in losing control of the direction and not having confidence in the student and focus on the result rather than assessing student along the process etc. I think it is not a surprise to find similarity in PhD. There are plenty of surveys and papers by tutors to present findings but not many analyse the problem and make suggestion for improvement.

Anyway, you may now understand where the idea come from and why the review session should be open in my eyes esp. for practice research. I hope you are not too disappointed that the main focus of the review sessions are not to gain your opinion or advices to continue/improve my research but to almost experiment this new idea and let the review take its own course. I fully understand that it actually put burden to the reviewer since he/she may require to understand a wider picture and combine different thoughts in order to discuss the topic. At this stage, I don't think we should be too concern about how valuable those results will be. But if you ask me, I am sure, we will see something whether it is holes in my research or simply different perspectives. One last word is I suspect different people will interact with the research website different and different aspect of the research will attract them. Thro' conversation, we will know what takes people's liking. When we have a review driven by reviewer's interest and expertise, the discussion will be fruitful, critical and effective, so my thinking goes...

It is suppose to be the secret so that I can compare with the previous reveiw by industrial people. But well... may be I need to be clear in the first place. HaHA It is now not even single blinded test.

It may be too much to take in at once but I really looking forward to see how it will turn out. Any comment about such review idea, let me know before the session starts.

Appendix 32 Individual peer-review Report – Reviewer 1

Reviewer1 pointed out a few questions in the review document
1. The term 'self-review' - which he believed that reviewer should review themselves. The definition in this context is - the practitioner/researcher have carried out personal review after any practice or animation experiment (in this research) before going through the peer/expert review.

2. Reviewer1 noted that the document is slightly confusing with 3 categories for reviewer to choose from and it was suggested that perhaps, the document should be tailored to target the expertise of the reviewer.
However, I think although individual expertise may be obvious, it should be made open to the reviewer that they are expected to go beyond their expert area and to assess areas which they found attractive or related closely to their expertise. For critical discussion, I would like reviewer not only restricted to assess research/artwork separately but also the body of knowledge (i.e. animation practice, technical skills, aesthetic idea and animation interwovened together). In the less familiar topics to the reviewer, general discussion can also take place which cover opinions as observer or questions that challenge the practitioner/researcher's perspectives.

3. Reviewer1 identified 2 areas - research methods & web presentation to comment which he said they were closely related. This evident some elements of the research cannot be studied/commented separately.

Web
Reviewer1 targeted the functional diagram of the mermaid to discussion; an idea which he thinks would work well with designing game. In fact, he said he had taught game student similar technique before. (I remember Susan found it a bit difficult to navigate within the interactive diagram to get into the animation).
Reviewer1 & I discussed about the realistic use of such diagram and the current design of game character which is pretty linear and follows an uniform model (e.g. action-reaction, spawn-attack-die, etc) We talked about the flexible design of the mermaid and the vision of making extra layer in her character so that animator can expand animation style, hence the functional diagram is extremely important to animator rather than in general concept game designer etc.
Reviewer1 suggested that in each behavioural state of the mermaid, it would be nice to see all animations with a click of a button instead of going into separated page. I think it also would be useful if we can somehow embedded tiny players to displace the sequence within the functional diagram.

'Reflection' tag somehow attract viewer and sometime, it may distract the main theme of the page. Reviewer1 sees them as second layer in the research and a record for the practitioner/research.

We also discuss the left hand side 'Menu' system - list-like and may be confusing.... Perhaps we can attempt something like a map of the research and allow viewer to entre different area from there. (depending on time to develop such idea. Reviewer1 agreed that the research is not web design)

Methods
Reviewer1 questioned about the list of questions document in the review procedure. We discussed 1 or 2 example and he said that some of the questions are those he would ask his students. I had used those questions in my self-review prior to this peer-review.

We discussed the 3 main methods - case studies, interviews and animation experiment - designing, making, reflection & review process. Reviewer1 seemed to be fine with the mixed method approach. Reviewer1 had no problem with whether the research will follow traditional method or is practice-based or not. :p The study and comparison of methods or I may not able to prove

anything (e.g. this method is better than that one) did not seem to alarm him. He stressed that sometimes, it could be valuable to prove negative and positive result.

There was a brief discussion about creative and design processes which I used in the animation experiment. It was noted that the information on the web at the moment (not at all in the Transfer) was not enough for reviewer. In my reflection report on the mermaid, they were being discussed in greater details so I should think about filtering those information onto the web or incroporate those in the thesis. Umm.... still struggling to see how thesis-animation can be linked seamlessly..... However, purely from this research pov, the defined creative & design processes will only form additional finding/conclusion. As they are within the animation practice, they are just one simply data point for others to repeat/modify/comment.

Review structure and process seemed to attract no negative comment from Reviewer1 apart from a few points mentioned above. He was trying to organise a group review session later on. Reviewer1 fully understood the review document and followed the suggested direction as closely as he could. He marked down issues to be discussed. During the review, he actively steered our focus and not drifting to unrelated topics. In this sense, individual review evidently improve the control and so as discussion comparing to our previous attempt reviews.
I dare to suggest the reason why the review format following how industry do animation review didn't work for research is, mainly due to lack of organisation and care. Those review style generate visual impact comment/suggestions that may be opinionated rather than critical since the peer group normally turned up to view the product. Most comments are made without full understanding of the issue/application, given reasons of why reviewer made such comment in the first place, alternative suggestion to the problems or improvement etc. Comments that nobody can follow up is not going to assist research. Besides, through our review, it demonstrated that animation and its practice/research were a body of knowledge rather than defined elements that we can isolate to discuss (for example, the technique we choose to use, individual experience, new learnt ideas from others and constraints all contribute to different practice and different visual outcomes) Therefore, review is extremely difficult to conduct as we require reviewers to have patience to make sense of the body of knowledge.

Animation
Reviewer1 questioned whether there was the need to complete all the animations I want to do. I admitted that it was purely personal choice and might not bear weight to this research. We agreed that provided that the animation experiment repeated the research methods and could be used for analysis together with the previous experiments, I should do my master piece afterward. :(Sad but Reviewer1 was right.

Obviously due to the research focus, this review is not as visual orientated as we would have in animation review. However, Reviewer1 said that the mermaid made him smile at one point. Though it seemed that we had not discussed the outcomes and we cannot judge from the outcome and in turn judge the research process and method, I anticipate that the visual products can be an evident that the practitioner/research had gone through the proposed methods and created sequences for others to study.

Appendix 33 Individual peer-review Report – Reviewer 2

Reveiwer2 preferred me to take her through the review document. She said she wanted to be absolutely clear though Reveiwer2 had already read the document. Anyway, it was found that she missed out the last page of self-review questions. It took some time to explain the self-review process and the pre-tests of the peer-reviews with 3 industrial persons to structure this formal peer-review processes.

Individual peer-review with Reveiwer2 started with the website. She felt that we could not divide topics to comment since some of them are inter-related. At the end, we chose animation experiment and the web.

Reveiwer2 pointed out the followings:
The layout of the research website esp. the menu system on the left can be different although she understood that reason why I put it in connological order. It was suggested map may work better for visual people.
Reveiwer2 found the map on the mermaid a bit confusing and the presentation seemed to lack depth. I agree since I still haven't decided how I should split the research content between the thesis and the visual.
Certain language on the web is not critical enough. Reveiwer2 would like to see more detailed explanation being put there.
Reveiwer2 mentioned also a lack of reflection in mermaid and she felt that the reflection in the pilot study area was comparatively better. I explained there were 3 levels of reflection - initial messy logs while animating, re-visit and notes making and finally a formal report information gathered from reflection. They had been done and it is a matter of selecting data from the report and present them on the web if reviewers found the web presentation is useful.
She felt that it was interesting to read into a practitioner's thinking and would like to see reflections with certain mermaid animation. The current display of animations alone from the map didn't serve the full purpose of the research.
Reveiwer2 suggested to really think about the structure of the web presentation since she saw it as an important part of the research as well.
We discussed the possibility of having more than 1 animator within the same context of a research may be useful. Reveiwer2 suggested that different animators may employ same method and test the process etc. I think that having a peer who work on similar area may provide different insights and assist peer-review in a more critical and diverse direction.
Reveiwer2 felt that the web presentation did assist the review process. She was not sure whether it will present the research sufficiently for other people to understand it completely. The thesis and the web may at the end present different part of the research but there may still be a gap showing the close relationship between them.
According to Reveiwer2, animation outcomes are there to show that the practitioner had been through the testing process. Comments on animations may not be as important now the research direction is slightly different.
We discussed the difference between the inital research idea - practice-based and focus on producing a piece of animation, and the new direction - practice as research which sway towards evaluate the 3 research methods and detailed approach using animation experiments.

Reveiwer2 felt that there might be a misunderstanding between interviews and reviews in my Transfer and she also felt that the examiners hadn't spent much time of the web presentation.

Appendix 34 Group-review procedure and agenda

Group-review is conducted after individual peer-reviews had completed. The interval between individual and group review should be short (for example within 1-2 weeks from the first individual peer-review) to ensure that the participants are still familiar with the topics and the process.

Researcher/practitioner should have fully understood the review focus of individual reviewers and contents being discussed. Revisit the peer-reviews via audio recording and using reflection process are both recommended. Researcher should write a minute or report that include further discussion or ideas generated from the peer-review session.

Depending upon the research questions and (emerged) focus for the group-review, researcher will select members from the previous review participants to form a group-review. The idea of the group-review is to encourage interdisciplinary discussion and expand the perspectives of the researcher in looking back to his/her research methods/questions/animations etc. Therefore, the main criteria for the selection is overlapping interests of the reviewers or overlapping contents being discussed in the individual peer-review. The group-review should consist of at least 3 people – 2 reviewers and the researcher to enable dynamic discussion. It may seem that more reviewers may improve the quality of a discussion but bear in mind that it would be difficult to organise focus/critical discussion with more participants with diverse views. Besides, group dynamic will certainty influence the outcome of a discussion.

There may be situations when individual reviewers focus on completely separated issues and a group cannot be formed for this 2nd stage review. In this case, researcher may need to perform more individual peer-reviews or return to the previous peers to seek a slightly diverse view from the individual. Such problem can be avoided if researcher encouraged reviewers to cover wider topics when conducting the individual peer-review.

There are 2 ways I can see how to take group-review to a different level of discussion. First, the researcher can prepare the group reviewers for interdisciplinary discussion by providing information about individual reviews. Minute and the reports can be sent to the group prior to the review so that members can understand what had been discussed separately and form questions or even critical argument. This method has some pros and cons, for example, it may generate prepared discussion, which may lead to fruitful results, but it may influence the reviewers to focus on overlapped interest/focus without considering other implicit issues. My second method is withholding information so the reviewers turn up at the meeting only knowing what they had commented about their area of expertise. The pros and con are, for example, it may create natural and honest response from the reviewers, generate dynamic/heated discussion on the overlapping area of interest/expertise, hence fruitful for interdisciplinary but the drawback can be a chaotic discussion and difficult to control. (In this case, we can attempt the second method since the reviewers know each other and they are pretty sensible so I do not expect chaos. :p)

Debriefing may be required and allows the participants to raise question about the review process. It can be short and conducted after the group-review. However, I foresee if researcher is using the second method above (withholding information) a different debriefing may be needed. It is important that at the end of the day, reviewers can have access to the reports of individual peer-review. This will make the whole process and also information more transparent and it will assist the reviewers to understand the wide concept of the contents being discussed, hence expand their own interdisciplinary view and not only that of the researcher.

Scheduled Group-review Tuesday 6th Sept 2009 @ 10:00-11:00

Time	
10:00	Quick question about the group review document Time keeping? Chair?
10:10	Group review starts
10:40	Debriefing
10:50	Question from reviewers
11:00	Group review completed

Researcher should prepare a plan to lead the discussion, for example, questions and points being discussed in individual review or collective ideas. Researcher should take on a passive but listening attitude during the review. Reviewers can ask questions but should concentrate on saying their opinions/thoughts. There is a defined questioning time at the end of the review.

Appendix 35 Questions for group-review

1. In term of research content/display information, how do you find the web presentation?
2. How do you compare it to essay description or visual animation display?
3. Does the web assist your understanding of the research? What about animations? Experiments?
4. How do you find the case studies? Does it provide any practice details?
5. How do you find the reflection details described during the animation production?
6. Does reflection data assist you or useful? If so, in what sense?
7. Do you think information from case studies and reflections give different picture of my animation practice?
8. Anything in the reflection you think is missing?
9. Would you say the pilot study is valuable? How do you find the tests in the pilot?
10. Any comment about the design of the animation experiments?
11. Do you think we can just study the animations without going thro' the process of making?
12. Any comment about the animation outcome? Technical or Aesthetics?
13. Does the web offer benefit for you to do reviews? Disadvantage?
14. What is your experience between reading the Transfer document and the exploring on the web presentation?
15. Any question you expect me to ask but didn't in your opinion?

Appendix 36 Debriefing notes

The purpose of the individual reviews targeted

1. Discussion driven by reviewers – forced them to think and integrate information. (I have given you hints of those questions I asked myself in review)
2. An idea that any review need to be well prepared by reviewers as much as the practitioner who seeks feedback – rather than in the previous model, everybody get together and comment on animations
3. Time for the researcher to explain details and have spontaneous discussion (hence, fully prepare the reviewers for later review)

Of course, comments are valuable to the research but they are not to fulfil the main purpose of the review – Can web presentation aid peer-review process? Can it fill the gap between practice (or any research question) and visual outcomes? Re-create the research journey in practice-orientated research? These are for the group-review to answer.

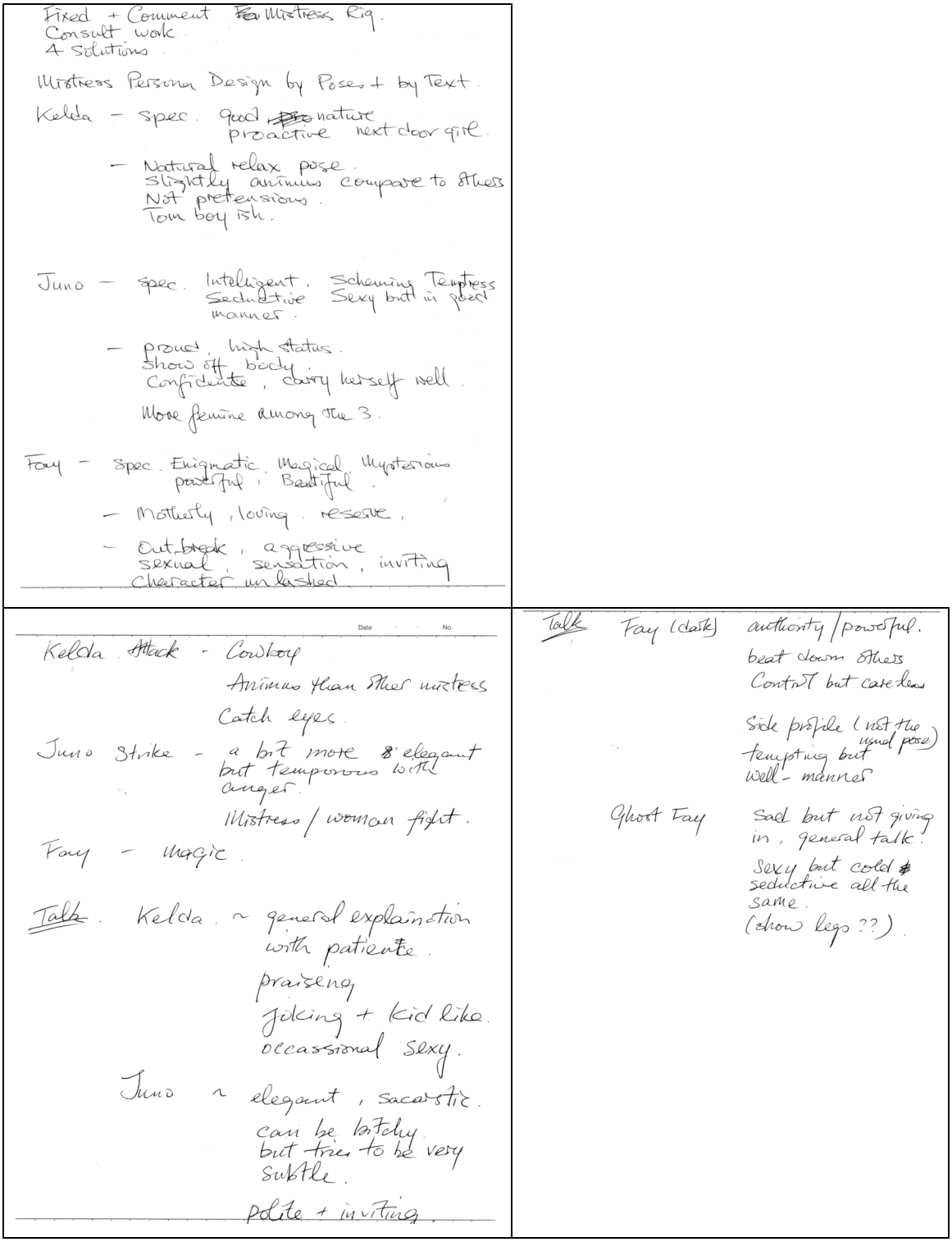
The purpose of the group review

1. Driven by the researcher's interest and the research questions
2. Prepared with interview type of questions to focus reviewers
3. Long winded discussion rather than to ask the simple question of whether web presentation can play a part in this research or useful for peer-reviews. However, it also generates other valuable data which may be useful for assessing different part of this research.

Questions

How do you find the review process? – First, individual review to allow questions and spontaneous discussion, reviewer's focus driven. Any difficulty? Second, group-review to have a pre-organised focus and more control feedback. Comment about structure/approach?

Appendix 37 Quick notes on the three female characters



Fixed + Comment ~~Fea~~ Mistress Rig.
Consult work
4 Solutions

Mistress Persona Design by Poses + by Text.

Kelda – spec. good nature
proactive next door girl.

– Natural relax pose.
slightly animus compare to others
Not pretensious.
Tom boy ish.

Juno – spec. Intelligent. Scheming Temptress
Seductive Sexy but in good
manner.

– proud, high status.
Show off body.
Confidente, carry herself well.
More femine among the 3.

Fay – spec. Enigmatic. Magical. Mysterious
powerful, Beautiful.

– Motherly, loving. reserve,

– Outbreak, aggressive
sexual, sensation, inviting
character unleashed.

Date No.

Kelda. ~~Attack~~ - Cowboy
Animus than other mistress
Catch eyes.

Juno Strike - a bit more elegant
but temperous with
anger.
Mistress / woman fight.

Fay - magic.

Talk. Kelda. ~ general explaination
with patiente.
praising
joking + kid like.
occassional sexy.

Juno ~ elegant, sacarstic.
can be bitchy
but tries to be very
subtle.
polite + inviting.

Talk Fay (dark) authority / powerful.
beat down others
Content but careless

Side profile (not the usual pose)
tempting but
well-manners

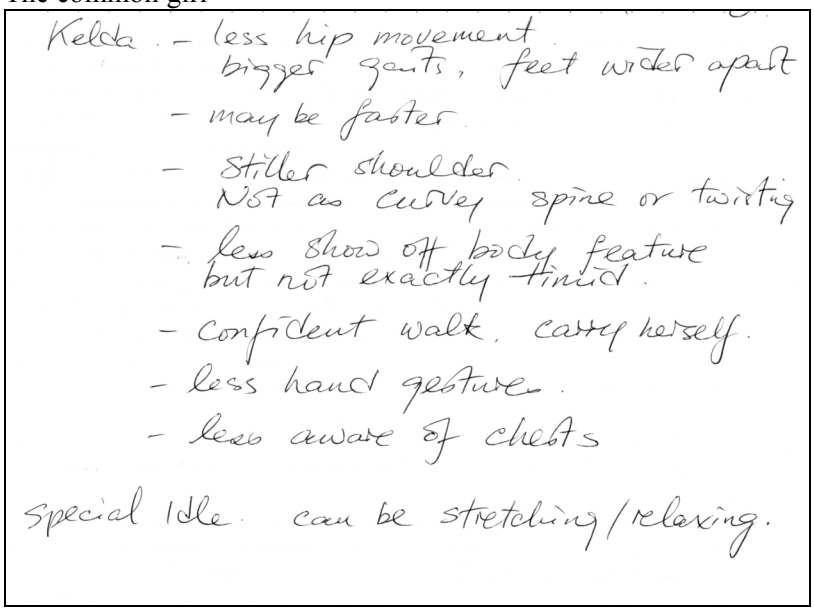
Ghost Fay Sad but not giving
in, general talk.
Sexy but cold &
seductive all the
same.
(show legs ??).

Appendix 38 Example of the results from Persona selection

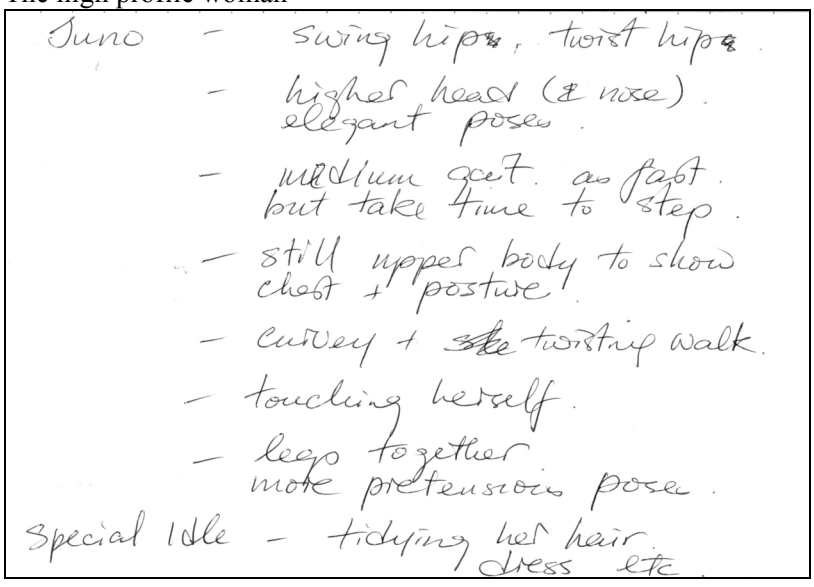
Characters	Chosen keywords
Common girl	Good-nature, Proactive, Positive, Next-door neighbour type of girl Natural, Relaxed, Fond of life, Happy go lucky, Honest, Tom-boy ish...
High profile woman	Intelligent, Scheming, Temptress, Seductive, Sexy but Well-mannered Proud, Confident, Show-off, Carry herself well...
The Queen	Enigmatic, Elegant, Powerful, Beautiful, Motherly, Loving, Reserved Outbreaking, Aggressive, Sensational, Inviting, Duo-personality...

Appendix 39 Animation notes for Persona experiment

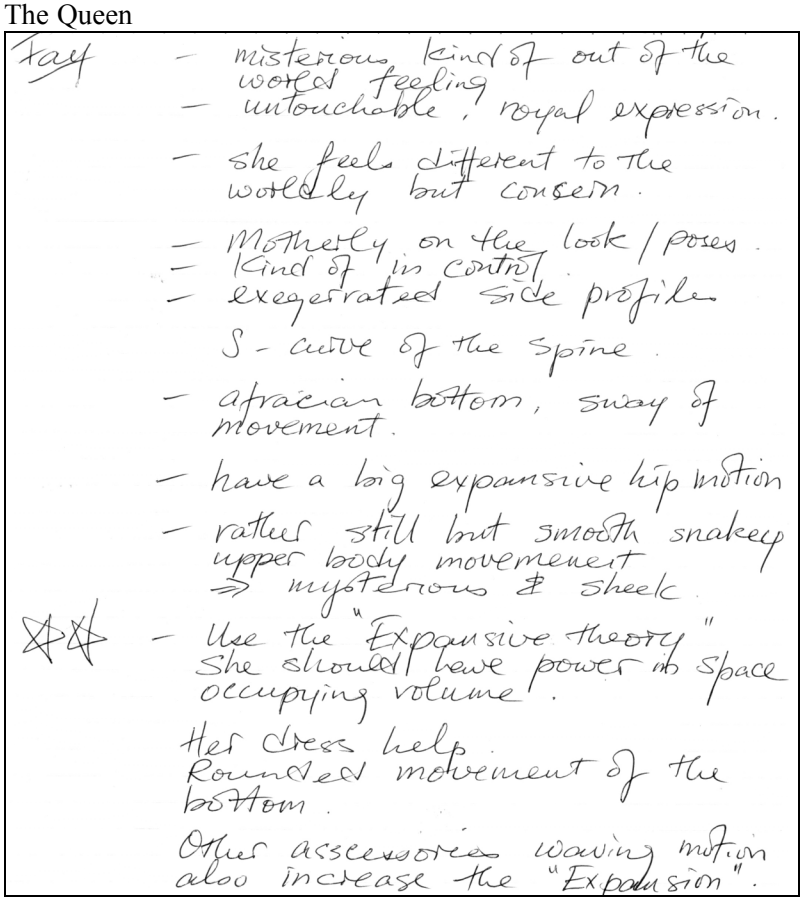
The common girl



The high profile woman



The Queen


Fay
- misterious kind of out of the world feeling
- untouchable, royal expression.
- she feels different to the worldly but concern.
- Motherly on the look / poses.
- kind of in control.
- exegerated side profile.
S - curve of the spine.
- afraician bottom, sway of movement.
- have a big expansive hip motion
- rather still but smooth snakey upper body movement
⇒ mysterious & sheek.
- Use the "Expansive theory" She should have power in space occupying volume.
Her dress help.
Rounded movement of the bottom.
Other assessories waving motion also increase the "Expansion".

Appendix 40 Time record and notes from reflection-in-action process

Juno_Idle_Basic2 (cont.)	70f return to idle basic pose1	4
Juno_Move_Walk	**Really twisty spine, swaying hip, elegant steps**	4
Juno_Move_Walk (cont.)	60f	8
Fay poses	Curvey bottom, not as twisting spine as Juno, african bottom, floating pose	1.5
Fay_Idle_Basic	150f gentle smooth movement	
Fay_Idle_Basic2	70f changing pose	6.5
	Repaint Fay's BackFlap (the root area) of the skirt to the back decoration bone only	
	currently others are pulling and deforming this flap	
Fay_Idle_Basic2 (cont.)	second 150f gentle movement	
	70f return to idle basic pose1	4
Fay_Move_Walk	**Back & Forth rocking on hip, less sexual comparing to Juno & with stiller upper body**	5
	60f	
Fay_Move_Walk (cont.)	**I prefer the one with the arms and hands at the front showing the rocking bottom**	
Fay_Move_Walk_SwingHands	**and giving her a different posture to the other mistress**	5
Fay_Idle_Floating	150f	
	Fay's dress can do with a bit of re-weighting cos' some area are not smooth	
	Best to use this anim as a reference to re-paint	3
Fay_Idle_Floating (cont.)		3
Fay_Move_Walk_Floating	**Keep it the same distance as all other mistress' walk 1.3 Maya unit**	5
	However, needs to have 2 cycles (120f) so that the dress can float smoothly	
	Dragging & Rock the dress	
Fay_Move_Walk_Floating (cont.)	animate asscessories	1.5
Fay_Idle_Subdued	Employ slow motion timing to exggerate subdued mood…. 300f	
	300f	5

Kelda_Idle_Special	290f - stretching & relax	6
Juno_Idle_Special	sexy gesture	2
Juno_Idle_Special (cont.)	290f	5
Fay_Idle_Special	**Use only at certain place - gusty stairs may be??**	3
Fay_Idle_Special (cont.)	230f	3
Kelda_Talk_Basic	240f carefree attitude	4.5
	All Talk anims need expression if you are not using Face FX or other automations	
	If not, polish needed later to suit the dialogue	
	If fingers are not re-skin properly, please ensure they are done cos' it will make gesture better	
Kelda_Talk_Great	200f praising/comment, tomboy gesture	4
Kelda_Talk_Sexy	310f slightly sexy pose quite the unusual for Kelda	4
Kelda_Talk_Sexy (cont.)		2
Juno_Talk_Basic	300f elegant, talking with brain cells	4
Juno_Talk_Inviting	polite & inviting	2
Juno_Talk_Inviting (cont.)	240f	3
	I don't like the kiss, I guess we may need to redo it with a bit of subtlety like a blowing kiss instead of the bold posture	
Juno_Talk_Bitchy	bitchy but subtle	4.5
DarkFay_Talk_Basic	Comment places/people, a bit of authority	4
DarkFay_Talk_Tempting	Unusual of Fay but seductive 250f	4
DarkFay_Talk_Tempting (cont.)		1
GhostFay_Talk_Basic	240f commenting places/people	4
GhostFay_Talk_Disappointed	240f Extra anims cos' of the entry to the tower	3
GhostFay_Talk_Seductive	270f	5.5
	Use Talk according to Mistress' name. Or else, please animate the extra controls across different mistresses	
	Although talk anims has certain gestures derived from the cut-scene script, please don't use them without care	
	Also, if used, please ensure expressions to be animated	
Mods	Need some final touch up and adjustment to previous anims eps. Special idle, those gestures.	2.5
	I don't intend to spend time to render & review the mistresses cos' I suspect I may do more than you may require.	
	Time is not allowed at the mo so I will leave you reviewing all anims inside the game. OK?	

Appendix 41 Example of review comments on the female humanoid animation

Hiya Miko,

I tried to do make you a list as you requested. It's in fact detailed, and raw, so don't be offended. Sure you're not, but Len told me to be more 'polite' and try to act more in the 'English' style of writing. ;P.

Aesthetics:
- the face expressions add a lot
- have normal maps for the extreme poses to blend in. For as well the face expressions as the gestures. Example: The neck muscles when being stretched, the sixpack, the muscle contraction in the shoulders
- have the cloth more fluid. To make it dynamic with some sort of cloth system, the movement will be much more fluid
- no more stretching in the cloth
- have cloth move slightly over her skin. Makes it realistic and can increase the sensuality of a character
- make more use of the clavicles (as the bitchslap of juno doesn't have that much). Add a joint for the shoulder plates to it.
- the back needs more joints for better deformation.
- give her joints in the breast to make it look if she actual breaths
- the arm twist isn't there. This makes it feel extremely artificial.
- have separate movement in her bottom.
- add shadows to the character to make her blend better in the surroundings.

Gameplaywise:
- Have her cloth react to the surface (wind in an open field, rest in a closed area)
- Have the cloth anticipate between the blending in different behaviors. (when she finished turning and goes back in idle, the cloth should still have anticipation)
- Extend the walk cycles. We now use the motion bone, so she translates in -Z. Instead of letting her walk in 1 cycle, make it a few. So it doesn't look this repetitive.
- Make her kicks less slow, and have variations in it. (different idle aggressive poses to blend to, for both left as right kicks)
- The more animated turns, the better. Avoid 180 degrees turns with 4 times a 45 degree turn
- Floating doesn't looks good without an random offset in Y
- Have the females react to the angle of walking. Show her it's hard to walk straight up a mountain.

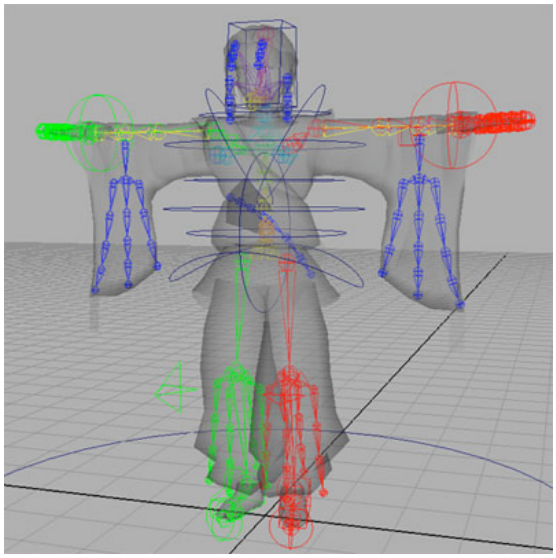
It's hard to give comments to the character's separately, cause it's also very a combination with current techniques used. I can say the cloth isn't that well, but that's not about animation. The wrist turns ugly, that's also a choice in the rig. etc. etc. I hope you're able to use some of this

Cheers,
Review A

Appendix 42 Ningyou final visual designs

The simple sketches of Ningyou were created using Japanese washi (special paper) in PhotoshopCS to simulate the concepts and different textures for the final design.

Appendix 43 Ningyou final 3D model, Rig construction and Animation controls



Here, on the left shows the lit and rendered model of Ningyou, and on the right the rig and control elements for the same model. Note that more control elements are needed for the clothing and hair than for the actual figure itself which is currently hidden for easy reading.

Appendix 44 The stage design for Ningyou experiment

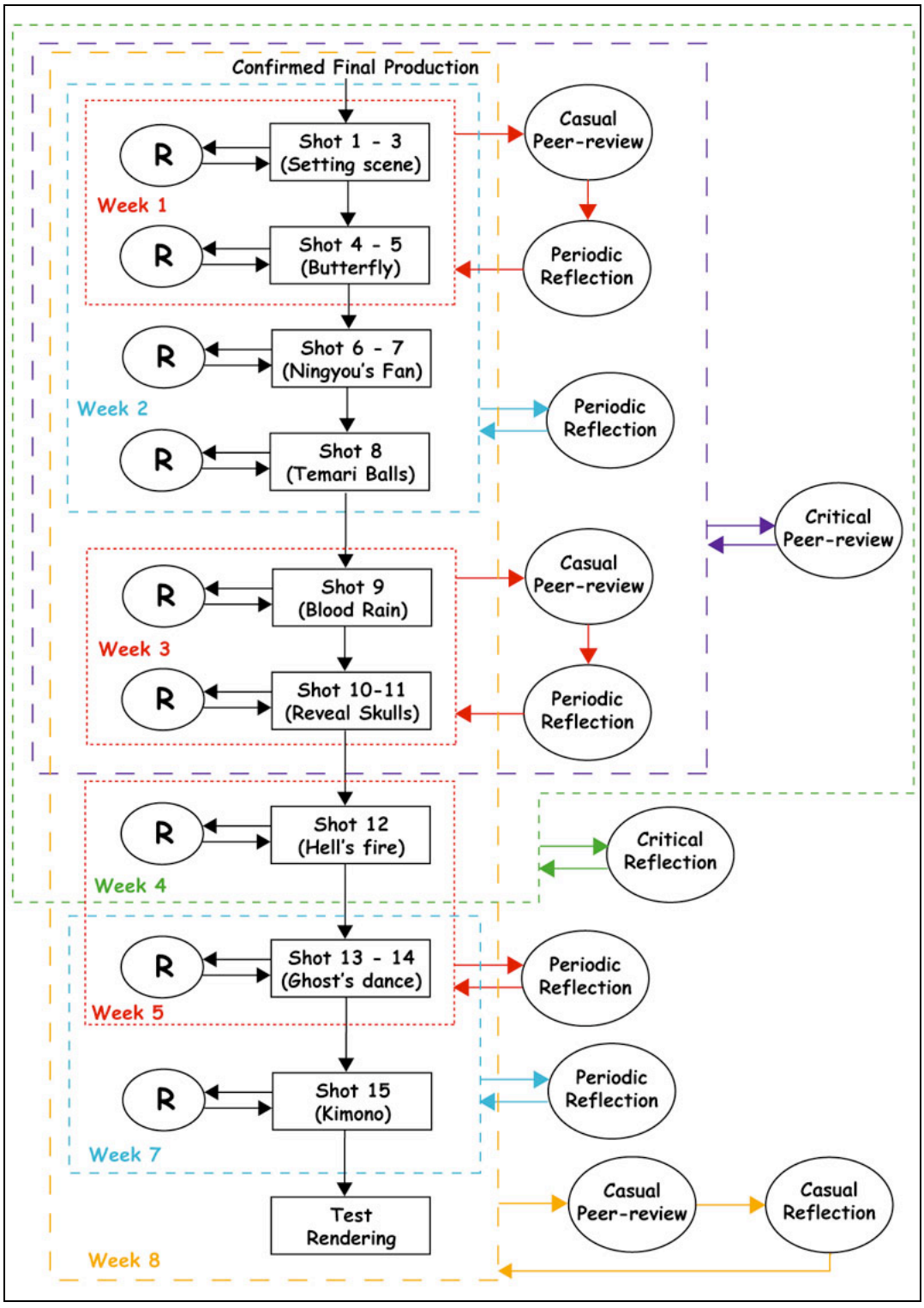
Here shows the stage scene rendered with basic test lights; used as a background for the Ningyou experiment. Two lanterns with paper elements inspired by the Japanese used of paper for furniture and items rather than it is a historical or practical design. Those lanterns are the only light sources on the stage which resemble 能 (Noh) setting. The wooden frame included elements of a traditional 鳥居 (Torii), found in most entrance of Japanese temples and inherited part of the design of an interior Kimono hanging rack. The hanging silk cloth concept came from Byōbu (屏風) - the mid-century Japanese 4-panel silk screen and here, it is used with meaning as a symbolic 'gateway'. A 'Temari' ball traditionally fashioned from silk threads, is a historical toy for children and nowadays being considered as a form of folk art. Here, it is used for drama with symbolic meaning of humanity (or corpse).

Appendix 45 Narrative experiment working stages and Timeline

	Week	High level Tasks	Results
Oct	1		
	2	Draft storyboard	Narrative & Ideas
	3	Testing Ningyou design and Set Test simulation began	Rough image sequence & models
	4		
	5		
Nov	1	Reflection on simulation & Procedure	Confirmed Ningyou & Set
	2	De-compression; Writing up	Rendered Test Anim.
	3		
	4	Further testings & fixes	
Dec	1	Web update & Reflection (from Principal exp. - Ningyou - current Tests)	
	2	Writing up - reflection tools & quality Ningyou Animatic began	Confirmed storyboard; Outstanding issues/solutions from Tests
	3		
	4		
	5		
Jan	1		
	2	Reflection on principal exp. Animatic & the process	Rendered animatic sequence
	3	De-compression; Writing up – stages of reflection; quality of reviews	
	4	Web re-visit & update	
		Fixes	
Feb	1	Ningyou production began	Updated storyboard; Updated Model, Set
	2		
	3	Expert-Review	
	4	Reflection & Fixes	
Mar	1		
	2	Reflection on production	Additional ideas; Outstanding issues
	3	De-compression; casual review (using web update)	
	4	Fixes	Renderings
	5	Editing	Outstanding issues – lights, sfx & visual quality
		Reflection & Fixes	
Apr	1	Critical study - writing up	Production Renders
	2	Peer-Review	
	3		
	4	Critical Reflection & Conclusion	Alternative Renders

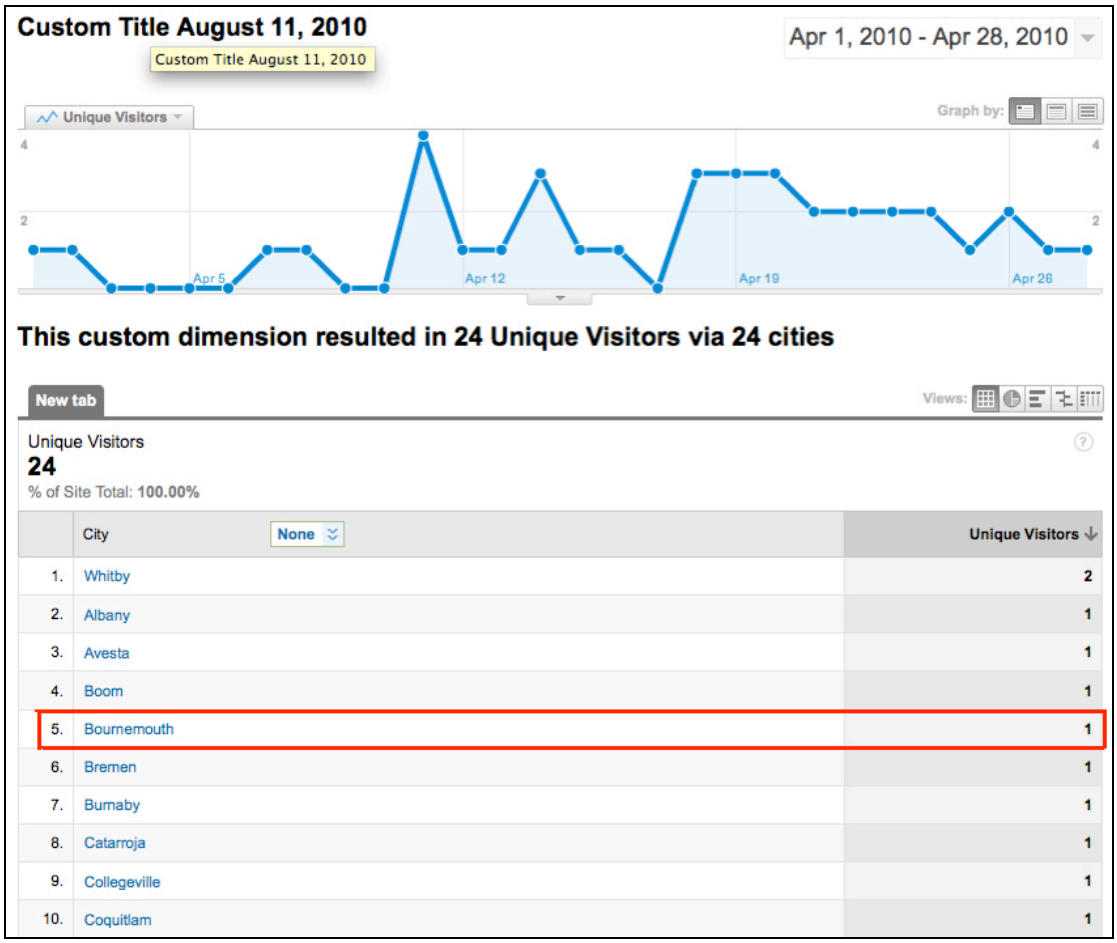
This chart captures the production stages, timeline and major activities in the Ningyou experiment. It created from the records on the production diary and the reflection notes in the logbook.

Appendix 46 Reflection nesting process and reviews during Ningyou production

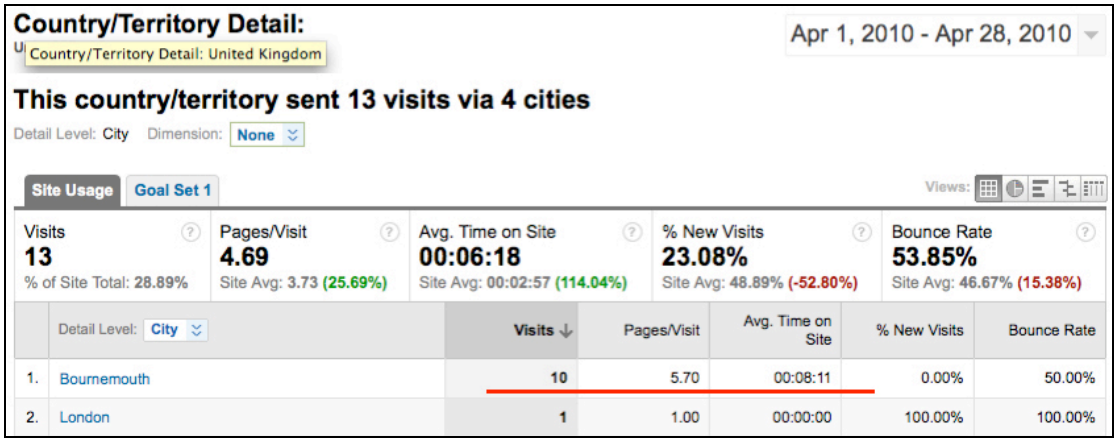


Here is a schematic to show the conducted reflection and review processes during the 8 weeks animation production. R represents the Involuntary reflection and 'Day-end' Periodic reflection. The dashed boxes (also colour coded) enclose the extent of a specific reflection and review processes. Note how in some weeks the project was assessed with multi-contextual* concept (weeks 3, 4 & 8, for example) and other time, production takes priority and reflection may not be need (week 6 for example).

Appendix 47 Monitoring for 4 weeks before the review



The above monitoring showed that there was one unique visitor from UK in the month period. It may be a disappointing result but it supports the argument that there was a general misapprehension about the need for preparation before a review of animation or other visual works.



The chart shows extensive visits with average 5-6 pages per viewing. Total time usage is over 80mins. The monitoring can also track down to individual page of the visit which can reflect individual's interest about the research.

Appendix 48 Example comments from review-on-completion for the Ningyou

From: [redacted]@pop07.odn.ne.jp)
Sent: 22 June 2010 14:34:02
To: Yasumiko Cindy Lo (yasumikolo@hotmail.com)

Hi, Cindy ^0^/

Now, I watched your animation. Umm...Totemo omoshiroi ne !!
I like that taste of the story and the atmosphere.
Classical Japonism + Gothic taste = emptiness of life....
I imagined something like that.

The texture of each images are excellent, I think.
The Japanese paper-like/nude tree-like texture of doll's outside,
a cocoon-like texture of balls before turning into skeletons,
blood on the floor and etc, etc....

I'd like to watch the final completed version, too ^_- and I hope
your success at the festival q^0^p

RE: Hi Miko

From: [redacted]@hotmail.com)
Sent: 04 July 2010 17:03:04
To: miko cindy lo (yasumikolo@hotmail.com)

Hi Miko,

I've seen your trailer with a lot of expectations. The animation is very touching and I think you captured the emotion of the poem quite good. I particularly like how expressive the animation is, the feeling of despair comes across just right. Another thing I like is the look of the spirit version. If you've time for it, it might be worthwhile to spend some time on the lighting. Making the lighting a little bit more dramatic could help to make the emotion even stronger. Maybe even a whole new light setup after certain key moments in the movie. Unless you want to keep the lighting as unobtrusive as possible, so it doesn't distract from the animation. If you'd want to change the lighting, I could lend you hand. Just let me know.

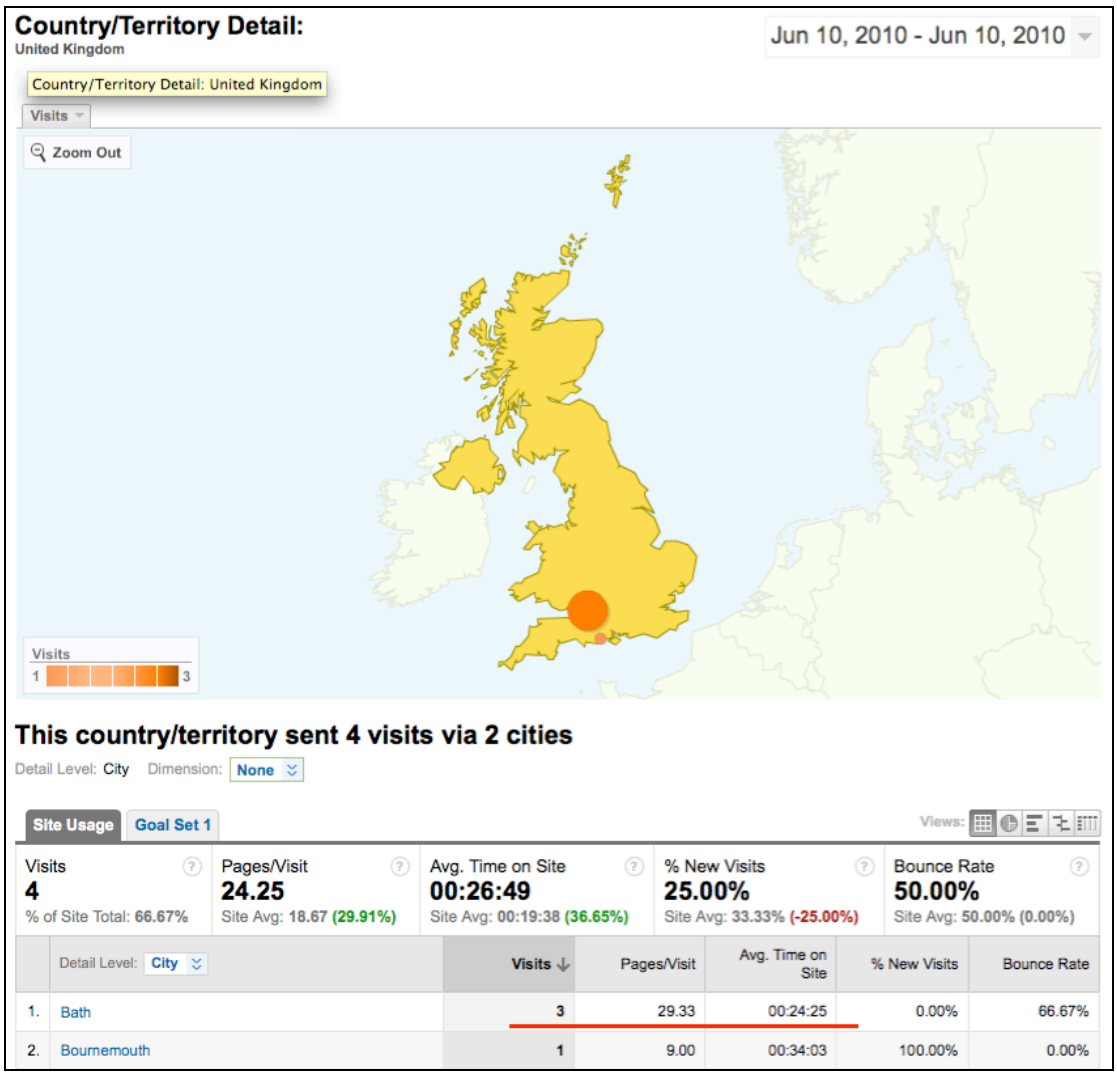
About the sound, I'm not sure I'm the right person to ask. I like the 'reflection' version more, because it's more dynamic, and stronger with the drums and such, less flat. I'm not sure what you mean by "not hybrid enough".

Your hypothesis reminds me a bit of the animations of the cinematic team of Blizzard. They also tend to use a lot of special effects and cloth simulation, but using it to make the animation and posing stronger. Especially in the period cloth animations were the new big thing, lots of animators made that error. Here's the clip of blizzard which reminded me:
http://www.youtube.com/watch?v=srkeqFc2P14&feature=related

I think the short is very well suited for a festival, it certainly has the right subject for it.

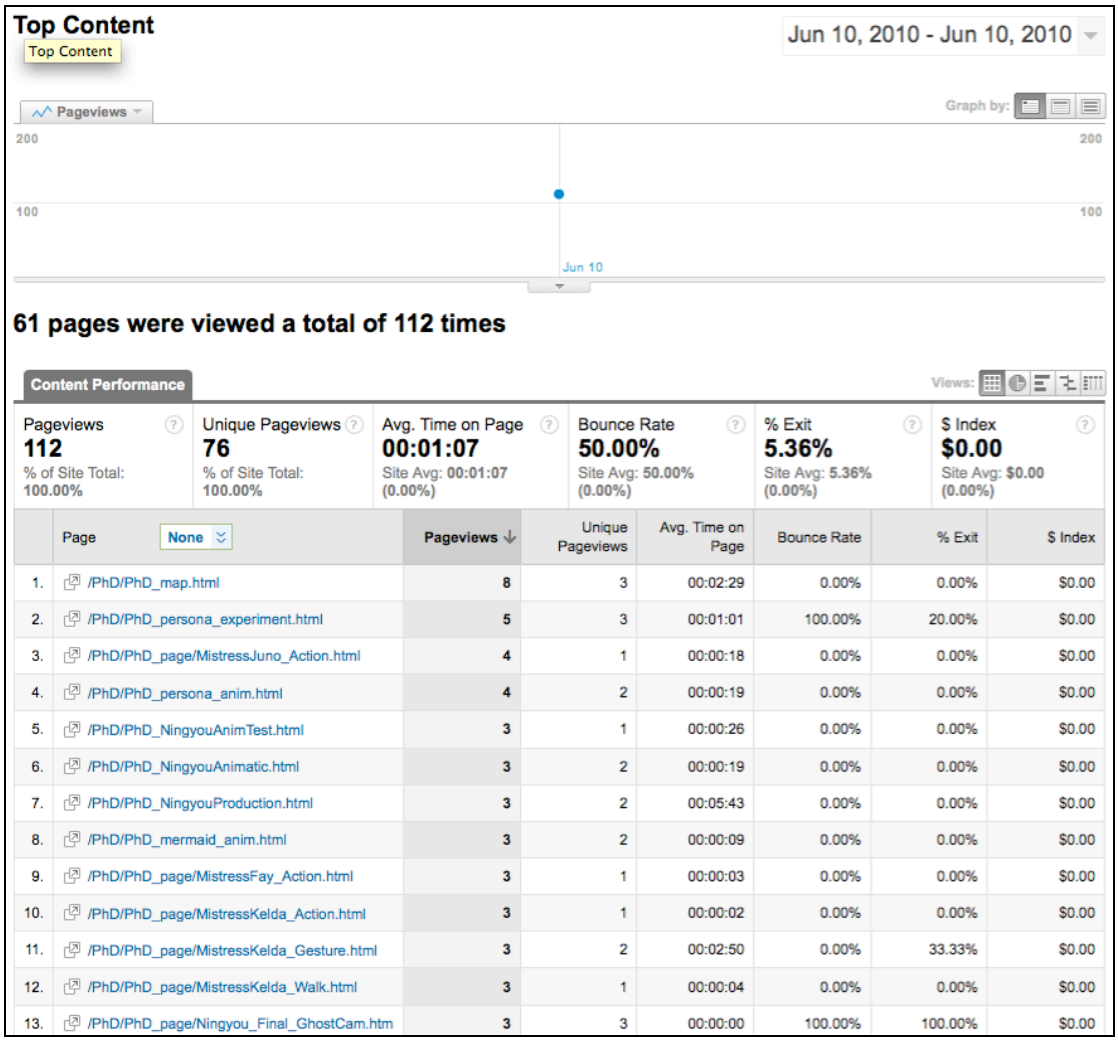
Here are two examples of communication between the additional reviews with a lead artist in the animation industry and a novice reviewer who understood Japanese theatre.

Appendix 49 Hypertext monitoring shows extensive viewing data



The system records the number of visits within a day (3 visits), pages and time per visit (~75 mins in total) and the below shows the number of unique visitors (2 only).

The chart shows a few records of the number of pages visited by the two individuals in one day and the time spent on those pages. From there, I can see which part of the Hypertext interested them.



Top Content

Top Content

Jun 10, 2010 - Jun 10, 2010

Pageviews

Graph by:

200

100

Jun 10

61 pages were viewed a total of 112 times

Content Performance

Views:

Pageviews	Unique Pageviews	Avg. Time on Page	Bounce Rate	% Exit	$ Index
112	**76**	**00:01:07**	**50.00%**	**5.36%**	**$0.00**
% of Site Total: 100.00%	% of Site Total: 100.00%	Site Avg: 00:01:07 (0.00%)	Site Avg: 50.00% (0.00%)	Site Avg: 5.36% (0.00%)	Site Avg: $0.00 (0.00%)

	Page (None)	Pageviews ↓	Unique Pageviews	Avg. Time on Page	Bounce Rate	% Exit	$ Index
1.	/PhD/PhD_map.html	8	3	00:02:29	0.00%	0.00%	$0.00
2.	/PhD/PhD_persona_experiment.html	5	3	00:01:01	100.00%	20.00%	$0.00
3.	/PhD/PhD_page/MistressJuno_Action.html	4	1	00:00:18	0.00%	0.00%	$0.00
4.	/PhD/PhD_persona_anim.html	4	2	00:00:19	0.00%	0.00%	$0.00
5.	/PhD/PhD_NingyouAnimTest.html	3	1	00:00:26	0.00%	0.00%	$0.00
6.	/PhD/PhD_NingyouAnimatic.html	3	2	00:00:19	0.00%	0.00%	$0.00
7.	/PhD/PhD_NingyouProduction.html	3	2	00:05:43	0.00%	0.00%	$0.00
8.	/PhD/PhD_mermaid_anim.html	3	2	00:00:09	0.00%	0.00%	$0.00
9.	/PhD/PhD_page/MistressFay_Action.html	3	1	00:00:03	0.00%	0.00%	$0.00
10.	/PhD/PhD_page/MistressKelda_Action.html	3	1	00:00:02	0.00%	0.00%	$0.00
11.	/PhD/PhD_page/MistressKelda_Gesture.html	3	2	00:02:50	0.00%	33.33%	$0.00
12.	/PhD/PhD_page/MistressKelda_Walk.html	3	1	00:00:04	0.00%	0.00%	$0.00
13.	/PhD/PhD_page/Ningyou_Final_GhostCam.htm	3	3	00:00:00	100.00%	100.00%	$0.00

Glossary

Anima	from the Latin means "to breathe"; from which 'animal' and 'animation' arise. The word is used to refer to a representation of a living soul or spirit. It helps us to capture the wider concept of animation.
Animation	My definition of Animation (with a capital) embraces the concept of anima - from the Latin "to breathe"; from which 'animal' and 'animation' arise. Anima is used to refer to a representation of a living soul or spirit, therefore Animation includes folk arts to show nature, mimicking beings and the world, puppetry, mime performance through to more recent hand-drawn animation, stop motion and computer animation.
Artifact	An object made by man, typically an item of cultural or historical or something observed in a scientific investigation or experiment that is not naturally present.
Artificial intelligence AI	The theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.
CAQDAS	Computer assisted qualitative data analysis software
Classical animation	hand-drawn 2D animation in particular Disney style, specific technique in traditional animation.
Coding	Coding in this research refer to sorting data into themes or categories; often used in qualitative methods and also CAQDAS software
Common knowledge	Knowledge being applied in various fields and its strength or weakness are known. Note: common sense is not common knowledge.
Dynamic animation	Animation generated by mathematical modeling or physics simulation. Users are also allowed to write their own mathematical equations (expressions) to create variety of simulation.
Epistemological	The theory of knowledge, esp. with regard to its methods, validity, and scope. It is philosophical and skeptical approach to analyze nature of knowledge and how it is acquired.
Explicit knowledge	Explicit knowledge is knowledge that has been or can be articulated, codified, and stored in certain media. It opposes Implicit or Tacit knowledge.
Falsifiable	It must be possible to create a test that would show a given theory to be false.
Forward kinematics FK	The term describes given the angles of all the joints, the orientation of the arms and the location of the end effector in space can be calculated.
Hermeneutic	Using methods of interruption

Heuristic	It stands for strategies using readily accessible, though loosely applicable, information to control problem solving in human beings and machines
Holistic thinking	All ideas or elements are given equal importance. It is good for exploration of an idea since priority or focus is taken away in the thinking process.
Hypertext	a software system that links topics on the screen to related information and graphics, which are typically accessed by a point-and-click method.
Lateral thinking	De Bono's model of thinking sideway, in oppose to linear way of thinking.
Linear thinking	One idea after another which has an imposed procedure. For example, logical reasoning dealing with one fact after another; cause and consequence.
Inductive Observation	The concept comes from inductive reasoning which is a kind of logic that allows for the possibility that the conclusion is false even where all of the premises are true.
Internal dialogue	Mentally talking to oneself, usually occurs in reflection or when the one is trying to work out a thought with oneself.
Implicit knowledge	Same as Tacit knowledge. Knowledge that cannot explicitly communicate to another person; sometime even unclear to the person; it is the integration of different personal experiences, explicit intellectual knowledge and generations of evaluation.
Interdisciplinary	It defines a field of study that crosses traditional boundaries between academic disciplines or different schools of thought. Sometimes, used as multi-disciplinary.
Introspection	The examination or observation of one's own mental and emotional processes
Inverse kinematics IK	The term is usually seen in robotics, considering a given desired position, and reversed calculate all the angles of the joints to achieve the end effector reaching that location. This is in contrast to the forward kinematics problem.
Keyframe technique	A term in animation technique using individual keyframe to build up an animation. The simplest way is to create two keys for the start and end positions and build up inbetween frames between the two keys.
Laban movement	Laban is a way and language for interpreting, describing, visualising and notating all ways of movement. A tool created by Rudolf Laban for actors or dancers mainly to study human movement
Mental rehearsal	Techniques that actor may use to rehear an action, mean mentally going through a scenario in their head and create possibilities.

Meta-	Denoting something of a higher or second-order kind
Meta-cognitive process	A conscious mental process that assesses/reflects the unconscious thoughts to conjure different and unrelated ideas. It is a systematic and self-disciplined approach to attempt to understand thinking.
Mindful	Conscious or aware of something. When used to describe thinking and practice in this research, it also includes the meaning of the Buddhism term - mindfulness - the critical factor in the path to liberation and subsequent enlightenment.
Motion capture (Mocap)	A physical system that can capture an action from an actor, sample the data and copy the action onto an animated character.
Multi-contextual	A state of or involving several contexts.
Multi-tasking	A process that simultaneously executes a few tasks, usually used in computer term meaning one single processor can handle multiple programs.
Ontological	It is s philosophical study; a branch of metaphysics dealing with the nature of being.
Procedural animation	It is a type of computer animation, automatically generate animation in real-time to allow for a more diverse series of actions. Most of the time, it requires dynamic systems such as particles or cloth, etc. (see also dynamic animation)
Photorealistic	It describes detailed and unidealized representation in art and detailed visual representation, like that obtained in a photograph and in a nonphotographic medium such as animation or computer graphics.
Recall process	Acts to remind and identify what has happened in the past.
Semiotic	Interpretative – original from the study of signs and symbols and their use or interpretation.
State Flow diagrams	A representation of a finite state machine and include the display of data flow or control flow to demonstrate some functionality. Usually used in software or electronic design.
Stop motion animation	Stop motion animation refers to traditional animation produced by a technique making a manipulated physical object or puppets appear to move on its own.
Tacit knowledge	Tacit knowledge (as opposed to Formal or Explicit knowledge) is knowledge that is difficult to transfer to another person by means of writing it down or verbalising it. It can also be described as Implicit knowledge.
Theme	In this research, it refers particularly to interview theme – topics of interest, thoughts and ideas