AN APPLICATION FOR CREATING E-LEARNING CONTENT
STORYBOARD BASED ON INSTRUCTIONAL DESIGN PRINCIPLES

WAN ADLI RIDZWAN WAN HASSAN

FACULTY OF COMPUTER SCIENCE
AND INFORMATION TECHNOLOGY
UNIVERSITY MALAYA
KUALA LUMPUR

NOVEMBER 2007
AN APPLICATION FOR CREATING E-LEARNING CONTENT

STORYBOARD BASED ON INSTRUCTIONAL DESIGN PRINCIPLES

WAN ADLI RIDZWAN WAN HASSAN

THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF MASTERS IN COMPUTER SCIENCE

FACULTY OF COMPUTER SCIENCE
AND INFORMATION TECHNOLOGY
UNIVERSITY MALAYA
KUALA LUMPUR

NOVEMBER 2007
ABSTRACT

Developing content for e-learning is no different from traditional teaching content in the sense that it must be based on a solid foundation. Subject Matter Expert (SME) needs to be reminded and constantly guided throughout the content development process to ensure they do not go overboard with content design. The lack of pedagogical perspective during content design tends to make the SME handover the daunting tasks of designing content to Instructional Designer (ID). A typical scenario would be that the SME would simply pass a stack of unstructured training materials and expects the ID to go through it before engaging in a discussion with the SME on how to process the raw content. This paper discusses on the development of an application for assisting the SME to construct e-learning content storyboards based on an instructional design principles. Based on the targeted user group, the instructional design principles that has been identified for the study is Gagne’s Nine Learning Events (Gagne, 1992).

To accomplish the study, interviews with industrial practitioner was used to get the initial functional requirements of the application. The data gathered was then used to identify the data entities and hence the design of the application. The final version of the application was then tested by the interviewed practitioner to ensure the requirements were successfully translated into the application. After which, a quantitative measure via questionnaires was used to determine the effectiveness of the developed application. The application was given to a group of 18 industrial practitioners to be tried out in their working environment.
ACKNOWLEDGEMENTS

In the name of Allah, most Gracious, most Merciful.

Completing this thesis was certainly a daunting task for me as time was not on my side throughout the entire tenure of this research. However, I am grateful to Allah that I have made it this far and would also like to acknowledge those who have helped me throughout my study.

First of all, I would like to express my sincere gratitude to Puan Suraya Hamid for her guidance and tremendous patience throughout this long journey. Thank you for standing by me even when the end seemed very distant.

I would also like to convey my appreciation to the participants of this thesis, namely Dr. Azma Abd Hamid and En. Arif Rafhan. They have been very dedicated in helping me complete this study even though they live by a very hectic working schedule. Their insights in forming the application was a tremendous help and it could not have happened without the both of them. I wish to also extend my gratitude to the development team at Content Capital Sdn Bhd and In-Fusion Solutions Sdn Bhd for agreeing to participate in the study despite having a back-to-back dateline. I could never give back the time that they have lost while testing out the thesis’ application for me. For that, I am forever indebted to them.
I feel a deep sense of gratitude to my parents, Dr. Wan Hassan and Sarifah Yusof, who persuaded me to continue with my Masters. I can never thank them enough. I attribute all of my success to their moral support and prayers. I do not think there is anything I could ever do to repay the both of them. I am also grateful to my mother-in-law, Dr. Rahil Mahyuddin for her unconditional love and patience in caring for my family while I was occupied with this study.

My determination to strive further was inspired by my three children, Wan Nayl Ismat, Wan Nazyh Iman and Wan Naqyb Izzat. They have provided an additional and joyful dimension to my take on life. They are my inspiration and I hope to be theirs in the future.

Last but not least, I would like end my chain of gratitude by acknowledging my love and darling wife, Syireen Rose. Without her encouragement and understanding, it would have been impossible for me to complete this work. I wish to express my deepest gratefulness and indebtedness by dedicating this thesis to her.
# TABLE OF CONTENTS

1. Introduction .......................................................................................... 1
   1.1 Introduction .................................................................................... 1
   1.2 Statement of Problem ..................................................................... 5
   1.3 Research Objectives ....................................................................... 9
   1.4 Research Questions ....................................................................... 10
   1.5 Research Methodology .................................................................. 11
   1.6 Significance of Study .................................................................... 13
   1.7 Scope of Study .............................................................................. 14
   1.8 Thesis Organisation ....................................................................... 15

2. Literature Review ................................................................................... 17
   2.1 Introduction .................................................................................... 17
   2.2 What is Instructional Design? ....................................................... 18
   2.3 A Brief History of Instructional Design ........................................ 20
   2.4 Instructional Design Principles ...................................................... 23
     2.4.1 Traditional model ................................................................. 23
     2.4.2 Constructivist model ............................................................ 24
     2.4.3 The best model for e-learning content .................................. 25
   2.5 Gagné Nine Instructional Events .................................................... 26
     2.5.1 Use of various media to enhance retention .............................. 28
     2.5.2 E-learning implementation of the learning principle .............. 29
     2.5.3 Gagné’s theory for pilot implementation ............................... 32
2.6 Pedagogical Elements in E-Learning Content ................................................ 33
  2.6.1 Views from a professional in the industry.................................................. 33
  2.6.2 Reviews from academic research study ................................................... 35
2.7 Challenges of Instructional Designers.......................................................... 39
2.8 Managing E-Learning Content Development ................................................. 43
  2.8.1 Storyboarding ......................................................................................... 43
  2.8.2 Learning objects ....................................................................................... 44
2.9 Review on Existing Instructional Design Applications ..................................... 46
2.10 Summarisation of Facts from Literature Review ........................................... 49
2.11 Summary ....................................................................................................... 51

3. Research Methodology and Requirements Gathering ........................................ 52
  3.1 Introduction ................................................................................................. 52
  3.2 Research on Content Storyboarding Best Practice ....................................... 53
    3.2.1 Instrumentation ...................................................................................... 53
    3.2.2 Criteria for interviewee selection ............................................................ 53
    3.2.3 Background of the Interviewees .............................................................. 55
    3.2.4 Background of the interview ................................................................ 56
    3.2.5 Interview objectives .............................................................................. 56
    3.2.6 Interview questions organisation .......................................................... 57
    3.2.7 Interview findings on Section 1 (Instructional Designer’s background) ... 58
    3.2.8 Interview findings on Section 2 (Learning Principles) ............................ 60
    3.2.9 Interview findings on Section 3 (Content Storyboarding Process) ......... 62
    3.2.10 Interview findings on Section 4 (Collaboration Procedures) .............. 66
    3.2.11 Summarization of Interview Findings .................................................. 68
3.3 Research on the Application’s Effectiveness.................................................. 68
  3.3.1 Instrumentation .................................................................................. 68
  3.3.2 Background of sample group participants ............................................. 69
  3.3.3 Survey objectives ................................................................................. 70
  3.3.4 Survey questionnaires organisation ....................................................... 71
  3.3.5 Survey findings ..................................................................................... 72
3.4 System Framework ................................................................................... 73
3.5 Summary ................................................................................................. 76

4. System Design ............................................................................................. 77
  4.1 Introduction ............................................................................................. 77
  4.2 Development Methodology ..................................................................... 77
  4.3 System Requirements ............................................................................ 78
    4.3.1 General requirements ....................................................................... 79
    4.3.2 User management requirements ..................................................... 79
    4.3.3 Instructional design principle requirements ..................................... 80
    4.3.4 Storyboard templates requirements .............................................. 81
    4.3.5 Baseline requirements ..................................................................... 82
  4.4 System Design ....................................................................................... 83
    4.4.1 System Modules ................................................................................ 84
    4.4.2 Entity Relationship Diagrams (ERD) ............................................. 85
    4.4.3 Database Design ............................................................................. 88
  4.5 Summary ................................................................................................. 90
LIST OF FIGURES

Figure 2.1. Sample screen shots of IDXelerator™ ................................................................. 48
Figure 3.1. Template 1 - Storyboard template from organisation A................................. 63
Figure 3.2. Template 2 - Storyboard template from organisation B................................. 63
Figure 3.3. The Content Storyboard Application System Framework. .............................. 73
Figure 4.1. The waterfall model used in the application development. .............................. 77
Figure 4.2. Application ERD ......................................................................................... 86
Figure 4.3. Application Logical Data Model ...................................................................... 89
Figure 5.1. System Web Environment ............................................................................. 92
Figure 5.2. The Black Box Test Method ......................................................................... 99
Figure 5.3. Login page .................................................................................................. 103
Figure 5.3. Main page .................................................................................................. 104
Figure 5.4. User listing page ......................................................................................... 105
Figure 5.5. User details page ......................................................................................... 106
Figure 5.6. User’s group page ....................................................................................... 107
Figure 5.7. Assigning group to a particular user page ..................................................... 108
Figure 5.8. Learning Principle page .............................................................................. 109
Figure 5.9. Detail of Learning Principle page ................................................................ 110
Figure 5.10. Listing of Learning Principle items page .................................................... 111
Figure 5.11. Pop-up window to add to the listing of Learning Principle ........................... 112
Figure 5.12. Content team management page ................................................................. 113
Figure 5.13. Content team management details page ..................................................... 114
Figure 5.14. Adding users to content team page ............................................................. 116
Figure 5.15. Listing of content objects. .................................................................117
Figure 5.16. Content objects details........................................................................118
Figure 5.17. STEP 1 - Form template for creating storyboard.................................119
Figure 5.18, continued. STEP 1 - Form template for creating storyboard.................120
Figure 5.19. Discussion board..................................................................................121
Figure 5.20. STEP 2 - Form template for creating storyboard.................................122
Figure 5.21. STEP 3 - Form template for creating storyboard.................................123
Figure 5.22. STEP 4 - Form template for creating storyboard.................................124
Figure 5.23. STEP 5 - Form template for creating storyboard.................................125
Figure 5.24. STEP 6 - Form template for creating storyboard.................................126
Figure 5.25. STEP 7 - Form template for creating storyboard.................................127
Figure 5.26. STEP 8 - Form template for creating storyboard.................................128
Figure 5.27. STEP 9 - Form template for creating storyboard.................................129
Figure 5.28. Storyboard completion screen prompt..................................................130
Figure 5.29. Screen manager....................................................................................131
Figure 5.30. Listing of screens for a particular step..................................................132
Figure 5.31. Sample output in PDF format..............................................................133
Figure 5.32. Sample output in PDF format (2 of 2)..................................................134
Figure 6.1. Total questionnaire participants..............................................................137
LIST OF TABLES

Table 4.1. System application baseline requirements ....................................................... 83

Table 5.1. Server software installation ............................................................................. 92

Table 5.2. Server hardware specifications ....................................................................... 93

Table 5.3. Test results of User Access module functionality ............................................. 100

Table 5.4. Test results of User Management module functionality ................................... 100

Table 5.5. Test results of Instructional Design Principle Management module functionality. .............................................................................................................. 101

Table 5.6. Test results of Discussion Group Management module .................................. 102

Table 5.7. Test results of Storyboard Development module ........................................... 102

Table 6.1. Number of participants with pedagogical knowledge ..................................... 138

Table 6.2. Participants’ number of years using the computer ......................................... 139

Table 6.3. Participants’ number of years surfing the Internet ........................................... 139

Table 6.4. Participant’s feedback on composing content ................................................ 140

Table 6.5. Participant’s feedback on content template usage .......................................... 141

Table 6.6. Participant’s feedback on using the RTE ........................................................ 141

Table 6.7. Participant’s feedback on content template navigation .................................... 142

Table 6.8. Participant’s feedback on the Screen Manager .............................................. 142

Table 6.9. Participant’s feedback on removing screens .................................................... 143

Table 6.10. Participant’s feedback on application navigation .......................................... 143

Table 6.11. Participant’s feedback on the on-screen instructions ...................................... 144

Table 6.12. Participant’s feedback on learning principle awareness .................................. 145

Table 6.13. Participant’s feedback on application easy of use ........................................ 145
Table 6.14. Participant’s feedback on SME monitoring. ..................................................146
Table 6.15. Participant’s feedback on collaboration effort. ..............................................147
Table 6.16. Participant’s feedback on discussion board ease of use. ..............................147
Table 6.17. Participant’s feedback on discussion board. ..................................................148
Table 6.18. Participant’s feedback on discussion board usefulness ...............................148
Table 6.19. Participant’s feedback on production turn around time...............................149
Table 6.20. Participant’s feedback on production cost ....................................................150
Table 6.21. Participant’s feedback on using the application at work .............................150
Table 6.22. Participant’s feedback on recommending the application. ..........................151
Table 6.23. Participant’s overall rating of the application. ...............................................151
## ABRREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADL</td>
<td>Advance Distributed Learning</td>
</tr>
<tr>
<td>ASP</td>
<td>Active Server Page</td>
</tr>
<tr>
<td>COM</td>
<td>Component Object Model</td>
</tr>
<tr>
<td>ERD</td>
<td>Entity Relationships Diagram</td>
</tr>
<tr>
<td>GD</td>
<td>Graphic Designer</td>
</tr>
<tr>
<td>HTTP</td>
<td>Hyper Text Transfer Protocol</td>
</tr>
<tr>
<td>ID</td>
<td>Instructional designer</td>
</tr>
<tr>
<td>IMAP</td>
<td>Internet Message Access Protocol</td>
</tr>
<tr>
<td>LDAP</td>
<td>Lightweight Directory Access Protocol</td>
</tr>
<tr>
<td>LMS</td>
<td>Learning Management System</td>
</tr>
<tr>
<td>LO</td>
<td>Learning Object</td>
</tr>
<tr>
<td>MySQL</td>
<td>Multithreaded, multiuser SQL database management System</td>
</tr>
<tr>
<td>ODBC</td>
<td>Open Database Connectivity</td>
</tr>
<tr>
<td>PDF</td>
<td>Portable Document Format</td>
</tr>
<tr>
<td>PHP</td>
<td>Hypertext Pre-processor</td>
</tr>
<tr>
<td>POP3</td>
<td>Post Office Protocol version 3</td>
</tr>
<tr>
<td>RTE</td>
<td>Rich Text Editor</td>
</tr>
<tr>
<td>SCO</td>
<td>Sharable Content Object</td>
</tr>
<tr>
<td>SCORM</td>
<td>Shareable Content Object Reference Model</td>
</tr>
<tr>
<td>SME</td>
<td>Subject matter experts</td>
</tr>
<tr>
<td>SNMP</td>
<td>Simple Network Management Protocol</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for the Social Sciences</td>
</tr>
<tr>
<td>XML</td>
<td>Extensible Mark-up Language</td>
</tr>
</tbody>
</table>
1. Introduction

1.1 Introduction

E-learning can be defined as leveraging on the power of information and communications technology to drive learning on-line as part of the traditional instructor-led learning, distance education or professional training (Lewis, 2002). It provides learners with the opportunity to enhance their learning experience through greater interaction with course material and the ability to control their learning environment. With e-learning, learners are not bounded by the time constraints and they can learn at their desired pace.

Over the past few years, many corporations have been introducing e-learning or at least formed an e-learning strategy in trying to embed a continuous learning culture within their people to cope with the continual change and remain competitive in the business world. In fact, a vast majority of Fortune 500 companies has already implemented some form of e-learning to deliver continuous professional development and training to their employees. For example, IBM’s Chief Learning Officer, Ted Hoff, has been quoted for saying that IBM conducts 48% of its employee training via the electronic means as they find it as the most efficient way to train more than 320,000 employees scattered over 76 countries. On top that IBM was able to trim the training cost by USD400 million a year (Mullich, 2004).
The employees have to process more information in a shorter amount of time as new products and services are emerging with accelerating speed. This also makes the lifespan of the products short hence product information and training becomes obsolete quickly. Product knowledge and skills then has to be delivered more rapidly and efficiently whenever and wherever needed. A fast dissemination of knowledge is a critical element to organizational success.

E-learning provides the ease of deploying training on demand since course materials can be accessed via the Internet. It is because of this trend, Eid (2004) predicts the E-Learning industry will grow 16.7 percent annually worldwide from 2003 through 2008, and by that time, the industry will be generating an estimated USD$619.4 million in revenue. As the main hurdles to e-learning, such as lack of interactivity, content availability, technology standards, and bandwidth, are currently being addressed, the technological barriers that once hindered the successful deployment of e-learning are beginning to diminish. Especially with the continued adoption of broadband by the Government, it should facilitate higher use rates of media-rich e-learning products. This makes e-learning is one of the fastest growing and most promising markets in the education industry.

E-learning course materials are usually found in the form of a courseware. A courseware is computer-based educational multimedia software. It provides interactive learning sessions that may contain text, computer graphics, images, animation, sound and motion video. These media elements and interactivity coupled with a well structured content helps learner to gain better retention of the subject matter. The interactive course content of an e-learning courseware compensates for the absence of a trainer.
A courseware can provide a high level of simulation that can be adjusted according to the learners’ proficiency. Learners can access the courseware anytime, learn at their own pace and review the course material as often as needed. When a learner has more control over their learning process, they are able to better understand the material, leading to a 60% faster learning curve compared to the traditional instructor-led training (Bowsher, 1998).

Coursewares are commercially available in the open market as an off-the-shelf product. However, most corporations prefer to develop custom courseware for certain subject areas. For example, it is almost impossible to find third-party courseware that relates to the corporations’ unique culture, working methodology, or values. A courseware of these natures usually needs to be custom built.

According to the International Data Corporation (IDC), in 2003, large corporations spending on e-learning rose by 22% as compared to the previous year. IDC also predicts that the e-learning spending trend will rise by an average of 27% until the year 2008. This shows demand for custom content is rising quickly than demand for off-the-shelf content products. In particular, large corporations place high value on customised high-quality content as they see it as a key differentiator against their competition.

The core ingredient to any courseware is the content. Content needs to be structured in a manner that can utilize the media elements to enhance learning experience. A well developed content design would guarantee the effectiveness of the learning outcome from the multimedia courseware. Therefore, it is essential that some form of pedagogical element exists in the content design to ensure that the content is relevant and able to achieve its teaching objective.
In developing content for custom courseware, the organisation’s Subject Matter Experts (SME) need to gather all materials related to the subject, decide which content is relevant and organise it in a coherent form. These contents would then need to be repurposed into an instructional form before it can be ready for courseware production. This would be the task of an Instructional Designer (ID) and storyboarding is the popular method for formatting contents into an instructional mode.

A storyboard is the documentation for interactive multimedia production. It contains instructions for programming, an audio script, and a detailed description of the visual elements such as text, video, graphics, and animation. The storyboard becomes the key design document that the entire production team uses as a base for developing the interactive program (Orr, Golas & Yao, 1993).

This thesis was conducted to explore the possibility of creating an application to assist the SME to construct e-learning content storyboards based on an instructional design principle and to determine whether such an application could be an effective means in assisting the SME to develop content storyboard that abides by such instructional design principles.
1.2 Statement of Problem

The following list of problem statements outlines the issues faced by IDs and SMEs involved in e-learning content development.

1. **Lack of learning theories by the SMEs.**

   The challenge here lies with the fact that most SME are groomed by the industry and were not exposed to any learning theories. Even though some SME do conduct in-house training, their approach is mainly based on training guidelines and standard materials that are provided to them by the corporation. Even if the SME have the experience of constructing training content, their content might not be based on a solid framework of instructional design principles. Thus the content will not be able to help the learning process hence, effective knowledge transfer and retention cannot take place. Content that is not based on sound principles are likely to fail to achieve its intended learning outcome (Kearsley, 1997). The deficient knowledge of learning theories makes it difficult for SME to construct viable instructional content.

2. **SMEs lack constant guidance throughout content development process.**

   Developing content for e-learning is no different from traditional teaching content in the sense that it must be based on a solid foundation. Furthermore, e-learning provide options for SME to include multimedia elements and interactivity that has never been possible with traditional ones. SME are spoilt with choices to enhance their content. However, these ability and appealing options often results in
haphazard content design that is not instructionally sound and did not match the learning objective (Gilbert & Moore, 1998; Kidney & Puckett, 2003). SME needs to be reminded and constantly guided throughout the content development process to ensure they do not go overboard with content design.

3. **Heavy burden on IDs during initial stage of content development.**

The lack of pedagogical perspective during content design tends to make the SME handover the daunting tasks of designing content to ID. A typical scenario would be that the SME would simply pass a stack of unstructured training materials and expects the ID to go through it before engaging in a discussion with the SME on how to process the raw content. The ID is left with a heavy burden as they have to grasp the essence the training materials before they could actually decide on how to repurpose it into an instructional form. After which, the ID would then have to convert the content design into a storyboard format. This would also mean the turnaround time for the content storyboarding would be prolonged as digesting training material of an unfamiliar subject could take up days or even weeks.

4. **Slow turnaround time due to time constraint.**

Since the ID and SME are two different groups of people being pulled together to work on a content project, it would be very difficult to set a common schedule for these two parties to congregate and collaborate on their content development effort. Should there be more than one SME required for a particular content project, scheduling would be an even greater effort especially if the two SME comes from a different department, or worst, a different organisation. This is another contributing factor to the slow cycle of generating content storyboard.
5. **High development cost due to engagement of external ID.**

Most organisations do not employ in-house ID. IDs are usually external consultants that are being paid premiums to render their services. The long duration of time spent by the ID would mean an escalating cost to the organisation. The heavy cost in turn would force the organisation to cut back on developing further e-learning content that could have benefited the employees and growth of the company. Even worst would be organisation trying to cut corners by disregarding the importance of proper content design by eliminating the role of an ID altogether. Therefore, reducing the task of the ID by removing certain job function could help cut consultation time and reduce the cost of developing an e-learning content.

The task of drafting the content storyboard should be the responsibility of the SME. If SME are able to construct the content storyboard independently in the proper and correct manner, it could help speed up the content development lifecycle. The dependency on the ID would then be reduced to merely editing and monitoring storyboards development instead of composing one. This could also be a cost cutting measure for the organisation to reduce cost by lowering the hours needed to engage external ID.
6. **Lack of suitable application that would expedite development process.**

   In order to make it easier for the SME to generate an e-learning content storyboard, there need to be an application to assist them in this conquest. However, there are no known applications available for creating e-learning content storyboard that caters for SME as their target user.

   The points stated above gives the motivation for creating such an application to overcome the problem of content development. This particular application should address the problems as stated above by:

   1. Providing a guideline of instructional design framework for SME to follow during content storyboarding development.

   2. Providing a platform to promote the collaboration between SME and ID. It should even support the scenario where multiple SME and ID from different department or organisation are involved in a particular content development effort.
1.3 Research Objectives

The objectives of this research are as follows:

1. To build an application to create an e-learning content storyboard based on a sound instructional design principle.

2. To determine if the application could help SME to easily generate content storyboard for their subject based on proven Instructional Design Principle.

3. To determine if the application could help IDs to easily monitor or supervise the SME throughout content storyboard creation process.

4. To determine if the application could help reduce the turnaround time to generate a content storyboard.

5. To verify that the storyboard generated by the sample group using the application abides by the Instructional Design Principle adopted by it.
If the research finds that the application proves to be helpful in helping SME to repurpose their content into a teaching and learning form, then the local e-learning industry would benefit as they are able to generate learning content at a greater pace and at a reduced cost.

A fast turnaround time would also mean an organisation could deploy their e-learning content on-line faster. As on-line training costs are far economical as compared to an instructor-led training, this would mean the organisation stand to save a huge amount of money in terms of training budget from a faster deployment of the training content.

1.4 Research Questions

The research aims to answer the following questions:

1. Would the SME be able to use the application to generate content storyboards?

2. Will content storyboard produced abides by the chosen learning principles?

3. Will the ID find it easy to invigilate the SME through this application?

4. Will it improve the process of creating e-learning content storyboard?
1.5 Research Methodology

The application must be built before it could be used by the sample group to test its usability and effectiveness. Due to the limitation of time and financial constraints, the requirements definition or application functional scope shall be derived from interviews with principle e-learning consultants from local companies whose core business is in the e-learning service industry. The application functional scope will be based on the content storyboarding process practiced in that company. The principal consultants shall conduct the user acceptance test on the application upon it being built before the application could be used by the sample test group.

The application to be developed will be a Web-Based Application as it provides end-users or SME greater access to the application without the geographical boundary. It will be an open-source application, based on the PHP-MySQL programming language to provide room application enhancements in the future.

The application will provided users with a step-by-step form-based template for content insertion. Content will be inserted based on a selected Instructional Design principle. Instructions will be added to guide users along the way. A feature to convert the storyboard into a PDF format will also be included. The application will automatically format the content to the appropriate storyboard layout ready for printing.
The sample test group will consist of SMEs, multimedia programmer, graphic designers, ID and others who are involved in content development. Each respondent will use the application according to their role in the content storyboard production, for example the SME shall be composing the content, while the ID will be monitoring and make necessary adjustments.

SME user group will be from the corporate sectors as they do not possess any formal training in pedagogical and learning theories. This is important as we are trying to determine if the absence of fundamental knowledge will have an adverse effect on the outcome of the content to be developed. Target number of SME shall be in the range of 10 to 15 people.

ID user group however must consist of qualified people with a strong knowledge on instructional design principle and processes. The ID will be responsible for monitoring the SME development progress therefore it is crucial for them to be equipped with the necessary skill-sets for the task. Target number of ID will be less than the SME as one ID could monitor multiple SME. Target number of ID shall be in the range of 5 people.

The study shall be of a quantitative nature where questionnaires shall be the instrument for data collection. Data collection will be done after the sample group have experienced using the application for a certain period of time. SPSS will be used to analyse the data collected.
1.6 Significance of Study

This study is deemed significant because if such an application could be built and prove to be effective, it would not only benefit the e-learning industry but the knowledge based industries as well. Companies or organisation would then be able to empower their SMEs repurpose their existing knowledge base into a teaching and learning form and disseminated that knowledge to other employees. By empowering the SMEs, development time and cost of content production could be reduced significantly. Reduction in development cost would spur organisation to repurpose more of their existing training materials or knowledge base into e-learning format thus giving employees greater access to the knowledge based content.

This would also encourage organisations that has not implement e-learning to embark on it as the savings in terms of training cost has already been enjoyed by most huge multinationals. Lower cost of content development would enable organisations to enjoy greater savings during pre and post e-learning deployment.

The ability to speed up learning content generation would definitely increase the organisation’s competitive advantage as their employees will always be equipped with the latest knowledge and hence drive the organisation forward at a greater pace.
1.7 Scope of Study

The scope of this study is restricted to the usage of an application to generate e-learning content storyboards. This thesis does not intent to address other issues pertaining to courseware development such as the issue of courseware production once the storyboard is ready.

Since the SME are from the corporate sector, the target audience for the content to be generated will be working adults in the same sector. The contents to be generated are thus catered for adult learners and thus will be based on an adult learning principle. Based on the targeted user group, the learning principle that has been identified for exercise will be Gagne’s Nine Learning Events (Gagne, 1992). No other learning principles shall be used or made to compare with Gagne’s learning principle.

The study will not consider demographics such as gender, race, domicile and socioeconomics status of the SME. These variables include status of SME in the organisation as their role and job scope within the corporation is not considered a factor that could affect the outcome of the content storyboard. Also, because the study is focused on a corporate environment, its findings cannot be generalised to all organisations in other sectors wishing to create e-learning content storyboards using the application.
In addition, the data to the study cuts across the boundary of subject matter. This study offers an overall indication of the effectiveness of using an application for generating content storyboard and no comparison shall be made between the outcomes of content storyboards of differing discipline. It also does not intend to prove or disprove any learning theory’s effectiveness.

1.8 Thesis Organisation

In order to present the fact of work conducted in an orderly fashion, this thesis’ chapters will be organised in the following manner:

1. Introduction

This chapter contains the overview of the study that has been conducted. It outlines the problem statement and the objectives of the research. It also gives a brief introduction on the research methods that was conducted.

2. Literature Review

This chapter examines previous literature or studies conducted that are relevant to the topic at hand. Pertinent findings from these studies was incorporated into the thesis’ study and made as part of the application requirement.
3. Research Methodology

This chapter details the research methodology and approach conducted used in this study.

4. System Design

This chapter uses the finding from Chapter 3 in order to draft the application’s requirement and design.

5. System Implementation and Testing

This chapter describes the implementation strategy used and the testing procedure that was conducted on the application before it was release for appraisal by the sample group.

6. Survey Findings of Application Reviews

This chapter presents the findings of the research study and summarises the findings.

7. Conclusion

This chapter analyses the summary of the research findings and discusses its implications towards the thesis’ objectives. It also gives recommendations for future studies that could be conducted based on this research.
2. Literature Review

2.1 Introduction

This chapter investigates existing work, research and publication that have been conducted with regards to instructional design. The sources for the literature are collected from academic research papers, published journals, product white papers and some online references.

While academic literature or journals on instructional design per se are in abundance, literature with regards to instructional design in the context of e-learning is very difficult to come by. However, the lack of academic materials has been compensated by other forms of literature that also provided great information to this thesis.

Literature reviews provide great insights into the topic being studied from the experts themselves. They act as a stepping stone to this thesis as they provide concrete evidence to findings and hypothesis of previous research that are similar or related to this one. Their finding can therefore be used and deemed as true.

The findings and recommendations presented by the authors could also act as a guide or give clues as to what is required in forming the application requirements for the thesis’s application.
2.2 What is Instructional Design?

There are many interpretations to the term ‘instructional design’. Sometimes an instructional designer are often called curriculum developer, learning specialist, or even instructional technologist. Now, especially with introduction of the World Wide Web, the term instructional design is sometimes being used to refer to computer-human interface design or visual interface design with regards to navigational instructions. Therefore, it is very important for this thesis to identify which definition to use in order to avoid confusion and misinterpretation of the term.

Smith & Ragan (1993) defined instructional design as

“the systematic process of translating principles of learning and instruction into plans for instructional materials and activities.”

According to West et al. (1991) instructional design is the procedure of planning the instruction in a manner that induces the learner to actively learn the materials using cognitive strategy. Gros et al. (1997) claims that instructional design is the process of providing a link between learning theories or how people learn, and the practice of building instructional systems as arrangement of resources and procedures to promote learning.

From the definitions pointed above, a list of what is not instructional design in the context of this thesis can be deduced as:
• Instructions of using visual elements such as buttons, text field, etc.

• The design of multimedia screens navigational flow.

• The design of multimedia navigation elements such as pull down menus, hyperlinks, etc.

In short, anything with regards to creative multimedia presentation and organisation is not considered as part of instructional design. Instructional design in this thesis shall only refer to following context:

• Design of instructional content to stimulate learning.

• Content repurposing to vet out unnecessary information.

• Logical arrangements of content in a manner that induces learning.
2.3 A Brief History of Instructional Design

The history is always a good place to start in trying to determine the future. In trying to understand the shape of instructional design to come, it is therefore important to look into the past and study how the subject was conceived.

In 2004, Leigh wrote an article on the brief history of instructional design for the Performance improvement global network; a chartered chapter of the international society for performance improvement. He indicated that the study of Instructional Design has been a long time in the making since the era of Aristotle, Plato and Socrates who observed the cognitive basis of learning and memory. The study was then expanded further as a formal discipline in the turn of the 20th century by the works of John Dewey who promoted the notion that learning happens best when it is done practically rather than through a routine or repetitious memorization process.

This notion opened the door to the behaviourist approach of educational psychology in the 1920’s where the original stimulus-response (S-R) model of behavioural psychology was introduced by Thorndike through his theory of connectionism. Twenty years later Hull expended the idea in his motivational model of behaviour which focuses on the learner’s wants, attention and activities.
By then the World War II was already in the becoming and need to train hundreds of thousand of military personnel arise. Military researchers resorted to a work by Ralph Tyler which indicated that learning objective should be written in terms of desired learner behaviours. They created standardised methods of delivering instructions via training films and other mediated materials. The method proved successful when victory was achieved by the allied forces. The victory sets the motion of heavy investment in the research and development of training methods by the United States government. The economic boom that followed suit saw further government allocation in the research of learning, cognition and instruction.

Benjamin Bloom was amongst those who has benefited from this government funding. In 1956 he came up with taxonomy of intellectual behaviours which provided a guideline for instructors to disseminate knowledge by writing instructional content in an effective manner. Bloom was a firm supporter of a mastery approach to learning. His instructional techniques varied both instruction and time according to learner’s requirement and offered instructional developers a way to match subject matter and instructional methods. However, Bloom’s taxonomy was unsuitable in large organisation because it does not address the performance of individuals in relation to resources and processes.

Research from Bloom’s studies sparked Robert Gagné to publish a book entitled "Military Training and Principles of Learning" in 1962 which complements Bloom’s six cognitive domains of learning. Gagné points out the different levels of learning that exists within an establishment. Gagné is well known as a behaviourist, and his focus is on the outcomes - or behaviours - that result from training.
Later in 1965 Gagné published another book entitled “The Conditions of Learning” which identified the mental conditions for learning. They were based on the information processing model of the mental events that occur when adults are presented with various stimuli. It included nine instructional events that detail the conditions necessary for learning to occur. Until today these nine events are still being used as a basis for most instructional designer in writing instructional content.

The late 1970’s and early 1980’s saw a surge in instructional design models. One of the attributes that contributed to the growth was the introduction of formal education and training department in both private and public organisations. By this time, market competition has become rapid and most organisations recognised the urgency to develop appropriate methods to train internal employees as business face stiff competition.

The dawn of new media such as the Internet and hypermedia has spawned a new approach to learning and instruction called the constructivist approach. It holds that learners construct their understanding of reality from interpretations of their experiences. Theorists such as Thomas Duffy and Seymour Papert suggest that constructivism provides a model whereby socio-cultural and cognitive issues regarding the design of learning environments can be supported by computer tools. This theory has been applied in many computer technologies such as the online help system as well as the LOGO programming language (Leigh, 2004).
Undoubtedly the study of education theories and principles will continue to grow and progress as the society embarks on new methods of learning or when the technology supporting the learning evolves. However, it is important to realise that there are no single best methods when it comes to education theories. The next section shall discuss the most commonly used learning principles and select the most appropriate one to be used in the pilot implementation of the application.

### 2.4 Instructional Design Principles

There are two commonly used instructional design model and principles; the objectivist or traditional instructional design model, and the constructivist or interpretive instructional model (Moallem, 2001).

#### 2.4.1 Traditional model

The traditional model or the objectivist approach is related to behaviourism and cognitive science. Behaviourism science provides the relationships between learning conditions and learning outcomes while cognitive science stresses on the learning schema as well as the knowledge organisation.
Objectivist believes that knowledge is objective. One can acquire that knowledge if it is presented to them in an appropriate manner as the knowledge already exist outside the learner’s mind and awaits to be replicated in the learners thinking. Therefore, according to the objectivist approach, an intended learning outcome can be achieved through a series of prescribed steps that are followed throughout the learning process.


2.4.2 Constructivist model

The constructivist model is associated with cognitive science and constructivism. Constructivist believes that’s knowledge is constructed by the learner through active participation in the learning process. Therefore, the knowledge does not exist outside the learner’s mind but instead it is being created as the learner experience learning, hence, they puts greater value on collaborative, active, and engaging learning experience.

The constructivist models utilises these following concepts (Wilson & Cole, 1991):

1. Learning is embedded in a rich authentic problem-solving environment;

2. Authentic versus academic contexts for learning are provided;
3. Provisions for learner control are provided;

4. Errors are used as a mechanism to provide feedback on learner’s understanding; and

5. Learning is embedded in social experience.

Jonassen’s “Constructivist Learning Environment” (1998) is the most widely used constructivist model especially in constructing instructions for computer-based learning (Moallem, 2001).

2.4.3 The best model for e-learning content

There has been a lot of debate on which instructional models suites best for the Internet age but most experts agree that there is no one approach that is best suited for all learning conditions. This is because different instructional design model facilitates differing outcomes from the recipients of the instructions or learners. Different learners and learning context require differing approach in the design of the learning (Ertmer & Newby, 1993). Even in practical world a mix of both objectivist and constructivist approach is being used (Davidson, 1998).
In the future, instructional designers are likely to choose one of two paths: specialist or generalist. In the prior path, designers will focus on one aspect of learning or instruction and act as consultants or subject matter experts, whether internal or external to the organization. The other approach is one more aligned with managerial activities.

As the application to be built will not be able to accommodate all of the learning principles in its pilot implementation phase, it was important for this research to identify one that will suite the sample group of application test users. Since the sample group consists of users who deal with adult learners, this researcher has identified Gagné's nine instructional events as the potential principle to be used.

### 2.5 Gagné Nine Instructional Events

Robert Gagné has been regarded as a visionary in the study of instructional design over the past four and a half decades. His book Conditions of Learning published in 1965 turned him into a renowned behaviourist figure. Gagné believes that learning is cumulative and can be measured externally and has provided instructors with specific technique to convey various learning theories into effective learning. Gagné’s theory is composed of three major components: the nine events of instruction, taxonomy of learning outcomes, and specific learning conditions for the attainment of those outcomes (Driscoll, 1994, p. 333).
Although Gagné’s theories are fundamentally behaviourist in nature, he was taken under the influence by the cognitive theorists in the 1970s. He then began to incorporate the information-processing model into his theory.

“These [cognitive] theories propose that stimulation encountered by the learner is transformed, or processed, in a number of ways by internal structures during the period in which the changes identified as learning takes place.” (Gagné, 1977: 13).

When Gagné says "in a number of ways", he is indicating through commitment to short-term memory, conversion to long-term memory, and the retention and retrieval of that information. The external stimulations involved in instruction may be designed to support one or more of these processes (Gagné, 1977, p. 14). Gagné defined nine such external stimulations, or events, and created a nine-step process called the events of instruction, which correlate to and address the conditions of learning. Gagné claims that when the events of instruction occur, internal learning processes take place. The nine instructional events identified by Gagné and its cognitive process are as follows;

1. Gaining attention (reception)
2. Informing learners of the objective (expectancy)
3. Stimulating recall of prior learning (retrieval)
4. Presenting the stimulus (selective perception)
5. Providing learning guidance (semantic encoding)
6. Eliciting performance (responding)
7. Providing feedback (reinforcement)
8. Assessing performance (retrieval)
9. Enhancing retention and transfer (generalization).

2.5.1 Use of various media to enhance retention

Gagné also recommends using various media in instruction. This is to ensure that the information presented in a variety of different ways to achieve effective retention. On top of that, Gagné believes that various media are effective in reaching different outcomes. For example, models can explain difficult technical concepts visually as compared to textual description.

The cognitive load theory (Sweller, Van Merrienboer, & Pass, 1998) supports Gagne’s claim on multimedia usage in instruction. According to the theory, the presentation format of instructions could cause unnecessary memory load on the learners. These pointless memory loads are also referred to as extraneous load. However, by simply changing the presentation format, the extraneous load can be reduced and thus enhancing the retention rate of instructions amongst learners.

In another study done by Mayer (2001) shows how learners build mental representation of multimedia instructions. Mayer (2001) outlines one of the most important step in the process is the integration of both verbal and visual information in the learner’s working memory. Consider if the instruction consist of an image and an explanatory text. In this scenario, the learner has to alternately switch between the two media elements and integrate them mentally. This process is somewhat cognitively demanding and wasteful as the mental resource spent could otherwise the channelled to the learning process itself. If
the text were replaced with voice over and visual cues were added, the effectiveness of the instructions would increase in terms of better learning results as less mental effort is spent.

The two research concurred Gagné recommendation on applying various media treatment on instructions. Gagné visionary recognition of exploiting various media in instruction makes it perfect for use in e-learning as it propagates the use of digital multimedia content. Multimedia programs provide an almost unlimited variation of presenting instructional content to learners.

2.5.2 E-learning implementation of the learning principle


1. Gaining attention.

The first step is to capture the attention of the student before any learning begins. Use of animation accompanied by sound effects could startle the senses with auditory and visual stimuli. An alternative is to use thought-provoking question or interest fact to capture student’s attention. Curiosity is an excellent motivation for students to learn.
2. Informing learners of the objective.

A list of learning objectives should be presented to students. This is initiates the internal process of expectancy and helps encourage students to complete the lesson. These objectives should be used as the basis for lesson assessment. Usually, learning objectives are presented in the form of "Upon completing this lesson you will be able to. . . ."


Learning process could be made easier if learners are able to associate new information with prior knowledge and store information in long-term memory when there are links to personal experience and knowledge. The simplest way of accomplishing this task is to ask questions about previous experiences, an understanding of previous concepts, or a body of content.

4. Presenting the stimulus.

Present new content to learner. Content presentation should be organised and chunked meaningfully. A variety of media including text, graphics, audio narration, and video, could be used to enhance content appeal to learners.

5. Providing learning guidance.

Additional guidance should be provided along with the presentation of new content in order to help learner retain information for long-term storage. Implementation strategies include the use of examples, non-examples, case studies, graphical representations, and analogies.

The new skill acquired needs to be practiced. Eliciting performance allows learners to confirm their understanding of the subject and continuous repetition further increases the retention rate in learners.

7. Providing feedback.

As the new skill is being practiced, it is crucial to provide specific and immediate feedback to learners regarding their performance. Exercises and tutorials used in this stage should be for comprehension and encoding purposes and not for formal scoring. Additional guidance and answers provided at this stage are called formative feedback.


After completing a module, learners should be solicited to take a post-test or final assessment. Learners should sit for the final test without additional coaching, feedback or hints. Mastery of material, or certification, is granted if the learner achieves a certain score.

9. Enhancing retention and transfer to the job.

Repetition of learned concept is a proven means of aiding retention especially when it is being applied to the job.

Kruse (2006) suggestion is by no means the only way of applying the events of instructions to e-learning. Other experts could have different implementation strategy. However, no matter how it is implemented, the underlying principles still remains the same.
2.5.3 Gagné’s theory for pilot implementation

Gagné’s theoretical framework covers all aspects of learning and the focus of the theory is on intellectual skills. The theory has been applied to the design of instruction in all domains (Gagner & Driscoll, 1988).

“Gagné’s instructional theory is widely used in the design of instruction by instructional designers in many settings, and its continuing influence in the field of educational technology can be seen in the more than 130 times that Gagné has been cited in prominent journals in the field during the period from 1985 through 1990” (Driscoll, 1994: 357).

With arguments and substantiation presented above, the pilot implementation of the application to be developed shall be based on Gagné nine instructional events. Over the course of time, the application will be capable of accommodating multiple instructional design principles to cater all possible intended learning outcomes.

Consultation with practitioners from the local multimedia firms\(^1\) also confirms that it is one of the most popular principles adopted when creating learning content for adult learners due to its ease of use in instructional settings.

\(^1\) Dr. Azma Abd Hamid of In-Fusion Solutions Sdn Bhd
2.6 Pedagogical Elements in E-Learning Content

2.6.1 Views from a professional in the industry

In an article entitled “Successful Implementation of E-Learning Pedagogical Considerations” taken from the Internet and Higher Education in 2002, Govindasamy (2002) argues on the need to provide a pedagogical foundation as a prerequisite for successful e-learning implementation from a corporate practitioners point of view.

According to the author, a successful implementation of e-learning in the corporate scene could be measured via its return on investment (ROI). A justifiable ROI would be if the e-learning implementation would be the ability to train the people to gain the right skills or knowledge at the right time. Getting appropriate employees to obtain the right information at the right time could be achieved only if some pedagogical principles are imbedded to in the e-learning experience. However, he observed that in practice this is the most neglected aspects in any e-learning implementation.

In most corporations where management is not of an educational or training background, the ROI is simply gauge based on cost savings rather than the actual intention of the e-learning programme. The learning objective usually comes second to the corporation’s financial figures. The author’s argument was backed by Bixler and Spotts (2000) who also claims that pedagogical principles are not included in most e-learning implementations.
Govindasamy (2002) pointed out that not adhering to pedagogical principles will undermine the e-learning implementation process. It will result in educators or trainers resisting change, learners shying away from e-learning courses, learners not performing up to mark, and poor content quality. This observation is agreed to and reflects the thesis’ intention in trying to include pedagogical elements to the e-learning content creation process. A non-threatening method will be suggested and the methods shall be derived based on interviews and literature reviews made. Such a method shall be discussed in Chapter 3.

Govindasamy (2002) did made recommendations for developing e-learning content in his paper which could still hold to this day. He states that there an organisation should develop a systematic Instructional Development Methodology for content creation. Consistent use of the systematic approach to content development would ensure the quality of the learning material. However, his suggestion does not come with a practical implementation guide. It would be a great help if he had shared his experience in developing such Instructional Development Methodology.

Govindasamy (2002) also suggested that a minimum standard should be established and all e-learning content should meet the stipulated minimum standards. Again, the author failed to provide samples or how standards are maintained or should be managed.
2.6.2 Reviews from academic research study

While Govindasamy (2002) provided an insight based on his observation and experience, Moallem (2001) provided a more academic study on the importance of applying pedagogical elements to learning content.

Moallem (2001) conducted a study by which he redesigned a course for web delivery and applied the mixed instructional design approach to see how it compared to a normal instructor lead class. He used the constructivist approach as the general framework for the course while Gagné’s nine events of instruction were used as the framework for creating the units and lessons. The course has a total of six units and each unit had an average of 5 lessons. The lessons were designed such that each concepts or principles taught in the previous lesson become the prerequisite for the following lessons as accordance to the chosen instructional design principle.

The study group comprises of 5 males and 16 females student who was enrolled in the web based course. The following methods were used to gauge student’s satisfaction of the course and to determine if the objective of the course were achieved.

- A help forum was set up for students to post their concerns.

- Questionnaires which was given out to students twice per semester.

- Students’ performance results from proctored test.
• Interviews with students.

An analysis of the help forum revealed that a lot of posting were done as students were going through the first and second unit of the lesson. Most of the posting were mainly to find answers to their certainties about the course. The posting decreased remarkably during the fifth unit of instruction as students has already familiarised themselves with the learning environment.

The questionnaires handed out revealed that 77% of the students find that the lecturers elaborated notes to be the most useful components in helping them understand the course content. 63% ranked the individual course assignments as the most important characteristics of the course. 78% thought the instructors and students interaction in the course environment as an important factor.

The overall students’ performance in the proctored test showed that they performed at par with their counter parts who attend the normal face-to-face classes. The test comprises of objective tests, essays and case studies.

Interviews with students revealed that a majority of the students enjoyed the experience they had and liked working with their course mates via the web environment. Although most of them liked the course, they also suggested that the courses are more suited for students who are highly disciplined. Very few however were unable to suggest changes to the course as they taught the course was already well designed.
The research provided evidence that a course that has been given the correct instructional design treatment could ensure learners gain as much from the learning experience as they would in a typical classroom environment. The students’ performance and results showed that the goals and objectives of the course were achieved. The research also showed that although most students feel as though they need an instructor to lead the learning, they actually fared quite well on their own.

Even when most agree on the need of some form of pedagogical element to be present in learning content, Yusup (1999) from the Centre for Distance Education Studies, University Sains Malaysia, has found that most content writers tend to miss out this crucial element. His findings were published in the British Journal of Education Technology in 1999 entitled “Are instructional design elements being used in module writing?”. The objective of his research was to establish the instructional design and technical elements required in composing instructional modules, assess the use of instructional design principles in writing modules, and put forward recommendations to enhance module writing.

Yusup (1999) defined modules as a free standing, self-contained and self-instructional materials that are supported by multimedia elements. He stated that the module “has to get the learner’s attention, state instructional objectives, introduce the topic, recall previous learning, present new materials, provide examples and answers, provide practice and feedback, select appropriate media and learning strategies and give remedial and enrichment activities”. All of which are similar to Gagné’s Nine Learning Events (Gagné, 1992). His definition of a module and this thesis’ definition of an e-learning content are therefore comparable and this made his findings very relevant and important to
this research as it supports this thesis’ hypothesis on the lack of instructional design elements usage in writing e-learning content.

The evaluation instruments used in his research was meant to gauge the level of content quality was adapted from the instructional design components recommended by Dick and Carey (1990), Heinich et al. (1996) and Gagné’s instructional events (1992). The evaluation instrument was validated by in-house instructional designers.

The findings of his study revealed that most modules written by his sample group of writers had little or weak ID elements even though they had received proper training and have an experience range between 2 – 15 years. Yusup (1999) concluded that written modules needs to be checked and reviewed based on the principles of instructional design and a good instructional module needs to be evaluated periodically not only by the instructional designers but by the subject matter experts too.

The finding strengthens this thesis’ hypothesis that SME tend to overlook the instructional design elements when writing modules. Even when the writers themselves were trained and have years of experience in developing modules, they are still subjected to ignore certain principles. Trained writers themselves need constant reminder or guidance to keep them on track. Therefore, the outcome of a module written by a non-experienced and untrained writer could result in a worst condition.
One way of overcoming the problem would be to have modules writers trained on learning theories and instructional design. However, training SME from the industry might prove to be a daunting task as to most of them, writing modules is a secondary job specification.

As with the other researcher or observers, Yusup (1999) too agree that there should be clear and standardized guidelines in writing modules. This element shall therefore be a crucial functional requirement to the application to be built.

2.7 Challenges of Instructional Designers

Since the role of an instructional designer has outgrown traditional textbook definitions, the perspectives of practitioners in the field will provide the information needed to accurately assess the evolving responsibilities of an increasingly popular position. Also, given that the application to be built is intended to help instructional designers manage content development with the subject matter experts, it is important to see and understand their nature of work and what is required of them in the professional field.

In a study entitled “Challenges of Being an Instructional Designer for New Media Development: A View from the Practitioner”, Liu et al. (2002) outlines the many challenges that practicing instructional designers are confronted with. The purpose of the study was to learn the roles and responsibilities of a modern day instructional designer and how they handle the challenges that came with the responsibilities.
The subjects of the research are instructional designers working in various multimedia companies across Austin, Texas that has served clients such as AMD, Apple, Dell, IBM, Motorola, Samsung, Texas Instruments and several other smaller technology companies. Austin has a very strong multimedia community servicing large multinational companies as well as small start-ups and also a strong participation from the state government in supporting the multimedia industry. These are amongst the factors that drove the researchers to conduct their study in Austin.

Liu et al. (2002) have chosen to conduct interviews with instructional designers in trying to get their research data. By using the multimedia directory compiled by the Texas Governor’s Office of Music, Film, Television, and Multimedia Industries, the researchers were able to identify a list of potential multimedia companies which employed their potential interviewees. The list was streamlined further as they were only interested in companies that produce educational and training multimedia coursewares.

There were eleven subjects who met the researchers’ criteria and were available to participate in the research. These subjects were interviewed from the range of 45 minutes to two hours. Eight of the interview sessions were conducted face-to-face while two sessions were conducted online and one over the telephone line.

All of the interviewees were actively employed to do instructional design work during at that particular time. Of all the 11, one had a doctoral degree, 8 had masters and 2 had bachelor degree. They had multi-disciplined backgrounds from English literature, biology, theatrical arts, journalism and learning sciences. Their experiences in designing
and developing multimedia products ranges from as many as 20 years to as little as 1 year. While some instructional designers worked for large companies, some works for small multimedia setups. This was the intention of the researchers as they were trying to study the designers from a diverse working environment in order to gain the common challenges faced by them.

The interview questions were based on a survey conducted on graduate students enrolled in the Instructional Technology Program at the University of Texas. From the survey the researcher were able to identify the information and tips that future instructional designers would like to get from the practitioners. They also re-used and modified questions from their previous research which looked at multimedia design and development process from the practitioner’s perspective (Liu, Jones, Hemstreet, 1998). The final lists of interview questions were divided into 2 parts. In Part 1 the questions focused on the core role of instructional designers. In Part 2 the questions focused on the other role performed by instructional designers which is often the case in the field where employees are expected to perform tasks that is outside of their job scope.

The results of the interviews indicated that the 3 biggest challenges faced by instructional designers are 1) working with a client, 2) balancing multiple roles, and 3) adapting to technological changes. Of these 3 challenges faced, this thesis is able to address the first challenge. Although the other challenges also hold significance considerations for future instructional designers, it does not have an impact to the application that is being developed.
Going back to the results of the research, most practitioners identified that working with a client is the most challenging tasks they have to undertake. Some subjects in the research claims that most clients or SME are not aware of the process of creating an instructional module and lack the sense of time it takes to accomplish one. Instructional designers are expected to start developing material from scratch and produce the final result in a short period of time. In trying to cater to this lack understanding of development process, instructional designers must acquire the skill of getting feedback from the clients and SME. Most clients and SME tends to disregard this as critical to the development of instructional materials.

The other aspect that burdened the designer is the need to continuously educate clients on what it takes to accomplish the tasks. Even though the clients have walked through the process numerous times, they still require constant guidance as they rarely focus their attention on retaining knowledge about the development process. The clients do not understand the difference between an instructional training module and information presentation.

Some SME uses also mental notes and because of this, the materials were not readily presented to the designers during initial development process. Most often SME tends to realise of the missing content and designers are given the responsibility to adjust the content accordingly. A task that every designer dreads as it wastes a lot of development time.
In applying the findings as part of the application requirements of this thesis, the application should be able to elevate the daunting task of dealing with clients and pass the responsibilities back to the clients or SMEs. The role of the instructional designer should be reduced to just monitoring and overseeing the development process made by the SME. Even the task of educating the SME should be passed on the application as it is a very repetitious process.

In short the application should address the main challenges faced by most instructional designer by helping them pass back most of the tedious task of working with clients back to the clients themselves. By doing so, the risk of producing meagre content due to lack of understanding in jargons and terminology between ID and SME can be avoided.

### 2.8 Managing E-Learning Content Development

In getting the ID and SME, whom are obviously from two different backgrounds, to work together as a team, there need to be a common guideline or processes that both must adhere to.

#### 2.8.1 Storyboarding

A storyboard is the documentation for interactive multimedia production. It contains instructions for programming, an audio script, and a detailed description of the visual
elements such as text, video, graphics, and animation. The storyboard becomes the key design document that the entire production team uses as a base for developing the interactive program (Orr, Golas & Yao, 1993).

Using storyboard allows the author to depict what he or she had in mind for the content in a manner that is very systematic and easily understood by the multimedia developer. Storyboards are also the cheaper alternative to visualise the content prior to production.

In applying this concept, the application should create the content templates in storyboard forms where SMEs could write their initial content on. Their storyboards could then be refined and edited by the ID as they progress through the content development process. Once the storyboard is ready, it could be passed on directly to the development team.

2.8.2 Learning objects

Govindasamy (2002) suggested that content be designed and developed in small manageable chunks also known as Learning Objects (LO). The concept was not new even during the time his paper was written. It was first popularised by Wayne Hodgins in 1994 and it has became the industry standard for content creation in the computer-mediated learning field. The terms Learning Objects (LO) and Reusable Learning Objects (RLO) are used interchangeably in the field and the lack of conceptual clarity has spawned multiple definition of the term. In order for the storyboard application to adopt this approach to
content organisation, it must first define the term LO clearly, identify the principle foundation and articulate a set of guidelines for creating LO.

In a paper published in the Journal of Digital Information, Polsani (2003) provided answers the challenges outlined above. It states that various international bodies spearheading the LO efforts, including the IEEE Learning Technology Standards Committee (LTSC), Learning Object Metadata Working Group, the IMS Global Learning Consortium Inc, and the Dublin Core Metadata Initiative, has come up with a consensus of what an LO should be. They group conclude LO should fit the following functional requirement:

1. **Accessibility**

   LO stored in the database should be tagged so that it can be easily referred to.

2. **Reusability**

   The LO should be reusable in different context of learning requirement.

3. **Interoperability**

   The LO should be independent from the entire course package and the learning management system.

Polsani (2003) reviewed several definitions of LO in his paper. Out of the four definitions that he reviewed, he found that L’Allier’s was the clearest and most carefully articulated. L’Allier (1997) states that
“A Learning Object is defined as the smallest independent structural experience that contains an objective, a learning activity and an assessment.”

By using this definition of LO, each LO would then be able to stand on its own as it is by itself a complete teaching content. In trying to emulate the concept of LO into the application, it would then be logical to make each storyboard produced to represent a single LO.

However, SMEs might not be able to distinguish when a content is able to stand on its own or otherwise. As for the ID it should not be a problem. IDs are trained to reorganised or restructure existing content into a learning format. Therefore, the application should have a mechanism that allows the ID to create the LO prior to the SME writing the storyboard.

2.9 Review on Existing Instructional Design Applications

Instructional Design applications are not widely available in the general market. This is not surprising since there are hardly any demands for such software. However, by searching through the Internet, one product stands out almost in every search made under the ‘Instructional Design Applications’ keywords. The application or software is called IDXelerator™.

IDXelerator™ is learning-oriented instructional development application that includes built-in instructional strategies based on instructional principles. This sound very
similar to the application that this thesis is trying to build but a closer review proves otherwise.

The IDXelerator™ is a client-based application that was designed to run within Multimedia ToolBook™ and requires the ToolBook runtime system to in order to deliver instructions to the student. In essential, IDXelerator™ does not create content storyboards. Instead it aims to create the instructional object itself. The instructional objects in turn are in the form of a ToolBook screens complete with text, audio, visuals, and the necessary interaction.

Figure 2.1 below shows a sample screen shot taken from the IDXelerator™ application.
The strong points of IDXelerator™ are:

- Provides users with guided templates for organising and structuring content according to some instructional design principle.

- Multimedia content are created on the fly without having to wait for multimedia developers.

- Comes with built in templates for users to create content with a variety of formats.

The weak points of IDXelerator™ are as follows:

- Even though contents are created on the fly, the multimedia elements within the content needs to be created by developers before hand. The application merely acts as an assembly plant for the multimedia component.

- Not web based. Using the application requires users to do a manual installation on the PC.

- Not stand alone. It requires additional software in order for it to be able to run.
• Fixed output. The final product is a ToolBook™ object or screens. Content cannot be exported into a different format such as HTML pages.

• Content developers are expected to work independently. The application does not provide nor propagate any group collaboration effort.

Therefore, one should view IDXelerator™ more as a courseware authoring application rather than instructional design application.

According to the IDXelerator™ whitepaper (Merrill & Thompson, 1999), it is made commercial available by Mindware Creative, Inc, (www.mindwaresystems.com) a U.S. based company and was previously known as Electronic Trainer™. However, browsing to the URL seems to redirect viewers to an investment company with a different name. It is assumed that the company has ceased to exist. On top of that, no evidence has been found to prove that IDXelerator™ is still commercially available to the public. Perhaps it is safe to deduce that the product was a failure as it failed to gain any market interests.

2.10 Summarisation of Facts from Literature Review

From the reviewed literature the following conclusions were derived as to the important issues that the intended application should address:
1. The application should use Gagné’s Nine Instructional Events as the default instructional design principle.

2. However, no single instructional model could cater for all learning needs. Therefore, the application should be able to address this issue by allowing flexibility in the type of learning principles provided.

3. The storyboard development should be organised into learning objects or content objects. One storyboard should represent one sharable content object.

4. The definition on learning objects in this thesis refers to the smallest independent structural experience that contains an objective, a learning activity and an assessment (L’Allier, 1997)).

5. The application should provide a clear guideline on writing storyboards or content module. Even a veteran module writer needs a reminder on how to write a good content.

6. Being an instructional designer of this new age is a very daunting task and working closely with clients or SME being one of the major responsibilities of an instructional designer. ID should monitor while SME do content. In short the application should address the main challenges faced by most instructional designer by helping them pass back most of the tedious task of working with clients back to the clients themselves.
7. Need platform for collaboration effort; place to store comments and notes from other group members

8. The application should be web based and users should be able to use the application by using a typical web browser only. Users should not be subjected to having to install additional plug-ins in order to use the application system.

2.11 Summary

This chapter has looked into the definition of Instructional Design and also a brief history of Instructional Design. Several key points have been extracted from the reviewed literature and these key points have been translated into application requirements as will be shown in Chapter 4.
3. Research Methodology and Requirements Gathering

3.1 Introduction

This chapter describes the research methodology used in detail. The research for this thesis is divided into two parts; one involves the gathering of application requirement and the other in evaluating the final application’s usefulness and effectiveness.

As the main objective of the research is to determine whether an application could be used to expedite content storyboarding process, the application needs to be built in the first place for the sample groups to use. Owing to the limitation of time and financial resources, the application requirements definition was based on best practices implemented in a local multimedia company specialising in e-learning content development as well findings from literature reviews.

After the application has been built, the sample group then tested the application for the purpose of creating e-learning content storyboard. Data collection from the sample group was done after they had used the application to create at least one complete and sound content storyboard. SPSS was used to analyse the collected data. The effectiveness of the application was then recorded.
3.2 Research on Content Storyboarding Best Practice

3.2.1 Instrumentation

As mentioned above, apart from literature reviews, interviews were used as the main instrument in researching the best practice for creating content storyboard. The findings of the best practice were then used as part of the application requirements definition.

Interview was chosen because it is a direct way of getting the required information and interviewees could be probe further into giving out details. Interview is also an excellent method to obtain tacit information, sincere opinions and point of views in an impulsive and immediate manner.

Other methods such as questionnaires would require the researcher to define possible answers or opinions to the respondents. This approach might be suitable for certain cases but in the event where the possible answers are unknown, interview was deemed as the best tool.

3.2.2 Criteria for interviewee selection

Interviewees for this research have to be selected carefully to ensure data collected from the interview session are viable to for use in this research. Therefore, the following criteria were used in the process of interviewee selection:
1. Company background

Looking at the background of the company where the potential interviewee works provides an indication of his/her credibility in providing sound data. Companies with good track records in deploying e-learning solution shows that their clients had accepted their solution and are satisfied with the outcome. This would mean the candidate would have the right industrial knowledge, exposure and the know how in executing e-learning project and will able to assist in providing reliable data.

2. Educational background

The formal education background of the interviewee is also important. Since this research intends to study the pedagogical aspect of content creation, the candidate should have good knowledge in pedagogical theories and its implementation as well as its application. Amongst the pedagogical theories the candidate should be familiar with are Gagne’s Nine Learning Events and John Keller’s ARCS Model for Learner Motivation.

3. Years of professional experience

With experience comes wisdom. Wisdom is something that cannot be taught or gained via formal tertiary education. Wisdom that has been garnered by potential candidates will provide insights into minute details that might be overlooked by this research.
3.2.3 Background of the Interviewees

The first step taken was to approach the right company and getting their support to contribute their ID to participate in this research. Two companies had been identified and they had been chosen based on their good track record in delivering e-learning solutions to client from various industrial background.

The interview was then conducted with two experienced Instructional Designers (IDs) from those two local multimedia firms. The list of criteria from 3.2.2 was used in choosing these interviewees. Both of the selected interviewees are attached to different organisations as to provide this research with variations on e-learning approach by differing companies.

These IDs have a combined 17 years professional experience in the field. Their client portfolio includes government agencies, corporate organisation and institutions of higher learning. The curriculum vitae of these IDs and the company profile can be seen at Appendix A.
3.2.4 Background of the interview

The interviews were conducted at ID’s work premise. That venue was chosen at the request of the IDs as most of their materials and documentations are kept at their office. On top of that the researcher was also able to take advantage to conduct minor first hand observation into the working process of conducting storyboards.

3.2.5 Interview objectives

The objectives of the interview were as follows:

• To validate the chosen learning principle.

• To get insight on developing the application’s content storyboarding template.

• To validate the findings from the literature review based on the ID’s professional experience.
3.2.6 Interview questions organisation

The interview questions were divided into four sections; Instructional Designer’s background, learning principles, content storyboarding process and collaboration procedures. Apart from the first section, some of the questions for all of the other sections were based on literature review findings. It was placed there to validate the findings against the opinion of the professional IDs.

The first section (Instructional Designer’s background) looked into the background of the interviewees and was meant to establish the interviewees’ credibility as an ID. The research dwelled into the background such as academic qualifications, professional resume, and client testimony.

The second section (learning principles) tried to get the ID’s opinion on which learning principle to be used for the pilot implementation of the application.

The section on content storyboarding process tried to get an in depth understanding of the organisations’ working processes in creating the final content storyboard.

The final section is on collaboration procedures. The questions here were designed to get an understanding on how the organisation manages the collaboration effort between all parties that are involved in content production.

The interview questions can be seen at Appendix C.
3.2.7 Interview findings on Section 1 (Instructional Designer’s background)

**Question 1: How many years of experience do you have as an Instructional Designer?**

From the interview conducted, it was found that the IDs have 10 and 7 years of professional experience in the field of instructional design. With experience come wisdom and the amount of years that has been put in by the interviewees show that these two are very well versed in the subject of instructional design.

**Question 2: What qualifications do you possess to quantify you as a credible Instructional Designer?**

One of the interviewees holds a Doctorate in Education (Ed.D) while the other has a Masters degree in educational psychology. Both IDs are more than qualified in terms of paper qualification. This also meant they have the necessary theoretical foundation on education learning theories.
Question 3: How many instructional design project have you successfully commissioned?

Both interviewees have successfully commissioned more than 10 instructional design projects for various industries such as corporate banking, government departments, and institutions of higher learning. The exposure to various subjects has given them a wider perspective of implementing various instructional design principles according to the subjects undertaken. This proves that the selected interviewees have both the theoretical and the practical knowledge on applying the instructional design knowledge.

Question 4: Have you conducted any training on Instructional Design?

One interviewee also often conducts instructional design workshops and has been doing it for almost 4 years. The other has no experience in conducting professional workshop but has been giving on the job training to her subordinates within the company. Being able to conduct training means that the IDs are able to transfer their knowledge onto others and this capability is particularly useful as it shows that the interviewee will be able to pass on their knowledge onto this research.

Based on the finding, both interviewees have shown that they are very capable and experienced instructional designers with both academic and professional credential. Therefore their views and opinions on the subject being studied carries weight and can be deemed as relevant and true.
3.2.8 Interview findings on Section 2 (Learning Principles)

**Question 1: Which learning principle do you normally use for adult learners?**

For adult learners, amongst the favourite learning principles that both interviewees adopts most in their work are Gagne’s Nine Learning Events and John Keller’s ARCS Model for Learner Motivation.

**Question 2: Why do you normally use that particular principle?**

Gagne’s principles are based on behavioural learning while Keller focuses on the motivational aspects. Depending on the learning objective, these two are used interchangeably by the interviewees.

**Question 3: Would you recommend the intended application to use that principle for the pilot implementation?**

Since the target content to be created are meant for adult learners, both interviewees answered ‘yes’ to this question.
Question 4: (If the recommended principle is not Gagne’s Nine Learning Events)

In your opinion, could Gagne’s Nine Learning Events be used instead of your recommended principle?

None of the interviewees raised any objections or reservations on using Gagne’s Nine Learning Events for the pilot implementation of the application. Gagne’s principle is very structured and they see it as very fitting to be implemented in the pilot stage as the storyboard to be produced can be easily gauge against the learning principle itself.

Question 5: Do you agree that one learning principle does not fit all learning requirements?

Both of the interviewees agreed that no one learning principle fits all the learning requirements. Different principles focuses on different aspects of learning therefore it is very important to study the objective or the intended outcome of the learning. Learning principles are usually chosen after the instructional designers have identified the learning objective and then finds the best learning principle to achieve the objective. They also agreed that it would be better if the application is able to cater for different learning styles.
3.2.9 Interview findings on Section 3 (Content Storyboarding Process)

**Question 1: Do your organisation have a clear guideline on content writing?**

Like most established firms dealing with e-learning content development, both interviewees belonged to an organisation that has proper development process in place. Therefore guidelines in content creation have also been established within their organisation. The guidelines were put in place to ensure speedy development process and minimise faulty output.

**Question 2: How does your storyboard template look like?**

Both organisations have differing styles when it comes to storyboard templates. *Template 1* in figure 3.1 shows the storyboard template from the first organisation while *Template 2* in figure 3.2 shows the template from the other organisation.
Figure 3.1. Template 1 - Storyboard template from organisation A.

Figure 3.2. Template 2 - Storyboard template from organisation B.
A closer look at the differing templates will show that both have similar attributes. They only differ in the way these attributes are organised.

**Question 3: What is the organisation of your storyboard like? Do you adopt the LO/SCO approach?**

The ADL SCORM\(^2\) is the most widely accepted e-learning specification in the world. Even the two interviewees are not spared from using it in their content design. Each storyboard produced usually represents one Sharable Content Object (SCO). This way they are ensured that their content will work on most Learning Management Systems (LMS) available out there.

**Question 4: Are your implementation team able to understand the storyboard in order to develop the multimedia content?**

Most of the in-house development team have undergone orientation or hands-on training in the organisation content development process. This training includes exposing the developer to the storyboard format so that they become familiar with the content structure.

\(^2\) Advanced Distributed Learning (ADL) is an initiative formed by the United States’ Department of Defense to develop e-learning standards.
The answer to this question would then be a straightforward ‘yes’ but it does not show if the template is truly readable without any assistants from the IDs themselves.

**Question 5: What tools do you normally use to create content storyboard? Do you find these tools to be practical?**

Word processing software is the tool commonly used by both IDs and their team to write storyboards. Both of them also agree while using that particular software is comfortable and relatively practical, they are drawbacks to it. Inserting new screens or content in-between existing ones would require them to re-number or re-aligned the content arrangements. This exercise proves to be a very tedious process using the current word processing software.

**Question 6: Could you recommend the storyboard template design for the application?**

Both the interviewees would recommend using their template design for the application. No modifications or improvements were suggested to be added onto the templates.
Question 7: Even after you have been doing ID for years, do you agree that once in a while instructional designer do need to be reminded on how to write content?

After having to endure writing educational content for years, both of them feels that they already had adequate practice in writing content to the extent that the process has become a natural process as they work. They do not think they need reminders on how to write unless they are taken out of the job scope for a long period of time.

3.2.10 Interview findings on Section 4 (Collaboration Procedures)

Question 1: How people are usually involved in the storyboarding process?

In a typical content development setting, only ID and SME are actively involved in content storyboarding. The other team members such as graphic designers, animators and programmers are usually called for opinions and consultation only when they feel the need arise. Otherwise the rest of the team member only gets hold the storyboard when it is deemed ready for production.
Question 2: How do you manage the collaboration effort between all the parties?

Collaborating between all parties involved in the development of storyboards is not easy. Meetings and ad-hoc discussions are the most popular methods of getting all the team members to get together and discuss certain raising issues. However, most of the meetings do not enjoy a 100% attendance by all team members as there is always a clash of timing between the team members.

Matters are worse should external parties are involved in the content project. Projects are often delayed or stretched because of the inability to conduct meetings due to differences in work schedule.

Question 3: How would you recommend the collaboration platform be designed?

A suggestion was made for the platform to be similar to the online forum concept. This way team members express their views and have their comments documented on the platform without having to wait to the others to be present at the same time.

The other suggestion was to make the platform available without any time restriction. This could easily be solved by implementing the first suggestion mentioned earlier.
Q4: Do you agree that dealing with clients or SME is one of the most challenging tasks of an ID?

A resounding ‘yes’ was the response given by the interviewees. Both of the IDs attest to this statement and thus validate the findings from the literature review.

3.2.11 Summarization of Interview Findings

Data collected from the interviews showed a correlation with the findings from the literature review. Therefore the data that were used to construct the systems requirements can be assumed as correct and fits the end user requirements.

3.3 Research on the Application’s Effectiveness

3.3.1 Instrumentation

To gauge the application’s effectiveness in creating content storyboards, a sample test group consisting of SME, ID, multimedia programmer and graphic designer were asked to use the application in a full content storyboarding development cycle. They shall be using the application according to their professional roles in content development.
To document their views, a quantitative approach was used. Questionnaire was the chosen instrument for data collection and SPSS was used to analyse the collected data.

3.3.2 Background of sample group participants

The SME, multimedia programmers and graphics designers who participated in the research were of a professional background and do not have any academic knowledge on pedagogy nor learning theories. The group were selected to as such as the research was trying to prove that even with the lack of fundamental educational knowledge, it was possible for these group of people to create a pedagogically sound content storyboard.

The ID that participated in the study had strong knowledge on instructional design theories. This is crucial as they were responsible to guide the other group throughout the content development process. The number of ID chosen to participate was less than that of the other group as the research was also trying to determine if the application could help IDs manage multiple clients at one time.
3.3.3 Survey objectives

The objectives of the survey were as follows:

- To determine if the application was user friendly to typical computer users.

- To determine if the tool could help SME to easily generate content storyboard for their subject based on proven Instructional Design Principle.

- To determine if the application was useful in helping IDs to monitor the storyboard development process.

- To determine if the tool could help reduce the turnaround time to generate a content storyboard.

- To get opinion on how to enhance the application for better customer experience.
3.3.4 Survey questionnaires organisation

The survey questionnaires were divided into two sections; Participant’s background and Application usage.

The first section (Participant’s background) was intended to get an idea of the participant’s background with regards to their IT proficiency level and their basic knowledge in e-learning. Part of the research was also meant to see if content storyboards of the similar quality can be produced by users of differing IT literacy level and e-learning experience.

The second section (Application usage) aims to get the users’ opinion on the application itself. The questions were categorized into 4 sub-sections:

- **Application functionality**
  Answers were based on a five point rating scale where 1 denotes a strong and definite ‘No’ and 5 denotes a strong and definite ‘Yes’. Questions were designed to capture the users’ level of comfort or the users’ experience with the application.
• **Collaboration**

  Answers were based on a five point rating scale where 1 denotes a strong and definite ‘No’ and 5 denotes a strong and definite ‘Yes’. Questions were designed to gauge the usefulness of the collaboration platform provided by the application.

• **Opinion**

  Answers were based on a five point rating scale where 1 denotes a strong and definite ‘No’ and 5 denotes a strong and definite ‘Yes’. Questions were designed to capture users’ opinion on the usage of the application in professional work.

• **Open Ended Question**

  The question aims to get feedback and comments from users’ regarding the application and how to improve the application’s functionality and usability.

  The interview questions can be seen at Appendix D.

**3.3.5 Survey findings**

Survey findings or application evaluation shall be discussed in Chapter 6.
3.4 System Framework

The diagram below (figure 3.3) shows the overview of the system application framework. This framework has been called the ‘Content Storyboard Application System Framework’.

![Diagram of System Framework](image)

Figure 3.3. The Content Storyboard Application System Framework.

The framework depicts two main components in the application; the Learning Principle module and the Storyboard module.
The *Learning Principle* module holds the rules for content generation with accordance with an actual instructional design principle. Design principles rules are kept in a data store and can be manipulated to cater for multiple design principle.

The *Storyboard* module sits on top of the *Learning Principle* module in a way that it uses the instructional design rules in order to create the content templates or *content screens*. A typical storyboard will consists of multiple content screens that has been organised in proper sequence as determined by the instructional design rules from the *Learning Principle* module.

The framework in figure 3.3 also shows three groups of user. These are the key groups that will be using the application in order to create the content storyboard. They are:

1. **Subject Matter Experts**

   The Subject Matter Experts or SME are the main authors of the content storyboard. All the relevant knowledge resides within them and therefore it is hoped that by using this application, the SME are able to transcribe their tacit knowledge into an explicit form.
2. **Instructional Designers**

The Instructional Designer or ID serves to moderate work that has been written by the SME. They should play minimal part in writing the actual content. Their roles are restricted to editing and invigilating only.

3. **Team Members**

The team members comprises of all the parties involved in the multimedia content development such as graphic designers, programmers, project managers and etc.

The *collaboration platform* attached on the *Storyboard* modules to allow all parties involved in content development to view the work in progress and post comments and have a group discussion during content development. An instance of a collaboration platform exists for each individual screens and team members are meant to discuss their ideas on a screen per screen basis.

The content storyboard data is kept in a database and if users wish to extract the data out, they could publish the final storyboard in PDF format. That particular format was chosen because documents render with PDF format ensures that the document will retain its formatting and style. Even if the document is opened using differing platforms or operating system, the document will still retain its original looks.
3.5 Summary

The method for gathering application requirements as well as the method for evaluating the application’s effectiveness was discussed in this chapter. Based on the application requirements research findings a system framework was drawn out and was used as the basis for designing the actual application system as will be discussed in the next chapter.
4. System Design

4.1 Introduction

This chapter details out the design of the application system. It will discuss the development methodology used, the derived application requirements as well as the application design.

4.2 Development Methodology

The development of the system was based on the classic waterfall model. The size and complexity of the application was deemed as appropriate and it was decided that using the basic waterfall model was sufficient to accomplish the task of creating the system.

Figure 4.1. The waterfall model used in the application development.
The waterfall model has its share of critics. The model was based on the assumption that each process must be completed before it can be moved down linearly. However, in real life application development practice, this rarely happens as most of the times, the process does take a step back in form of feedback loops (Ghezzi, Jazayeri & Mandrioli, 1991).

Despite the criticism this model, it was suitable for this particular application since the development only involves one person. It was a basic model fitting for a basic development process. Also the feedback loop was unlikely to take place since there are no real user requirements as the requirements were derived (will be explained in the next section.)

4.3 System Requirements

The requirements for the system were based on the findings of literature review as well as from the interview sessions with potential users. After a careful analysis of the findings, the following application requirements were derived:
4.3.1 General requirements

The general requirement refers to the generic features of the application. This feature shall span across the application regardless of functionality and modularity. The derived general requirements were as follows:

- The application must be a web based thin client system. This is to allow users with greater access to the application.
- The application must develop on open source platform to allow future easier future upgrade and enhancements.
- Application navigation should be easy to use and self explanatory.

4.3.2 User management requirements

There should be 4 main groups of user; the system administrator, the Instructional Designer (ID), the Subject Matter Experts (SME), and the project team members. Each member shall have different access level or privilege to the application as their role within the project team also differs. The following describes each user role:

- The system administrator has access to the entire system and could assume any role.
• The ID could initiate the content storyboard project, create content storyboard and participate in the discussion forum.

• The SME could create content storyboard and participate in the discussion forum.

• The team members are only able to participate in the discussion forum.

4.3.3 Instructional design principle requirements

This requirement reflects how the instructional design principles should be managed within the application. The following describes the derived requirements:

• Application should come with Gagné’s Nine Instruction Event as default ID principle.

• Instructional designers should be able to create or insert new ID models to the system.

• Each step within the model should come with a description to educate users about its intended objective.
4.3.4 Storyboard templates requirements

The storyboard template requirement refers to how the users interact with the system to create the actual content storyboard. After careful analysis of literature reviews and results from the interview sessions, the following requirements were derived:

- Each content storyboard should represent one complete unit of learning or one Sharable Content Object (SCO).

- The content storyboard templates shall be created in the sequence determined by the ID model.

- Each step or sequence is made of screen templates with the necessary content attributes.

- SME or ID should be able to re-arrange the order of the content screen on their discretion or to remove unwanted screen.

- A collaboration platform should be available for all users to discuss the content. Discussion or the platform should be on per screen basis to allow micro level discussion to take place.
• The storyboard template should come with a Rich-Text Editor\(^3\) to allow users to the freedom to format the text on the content template.

• The final storyboard should be created in PDF format and the arrangement of the content attribute shall follow one of the two samples taken from Chapter 3.

### 4.3.5 Baseline requirements

The baseline requirement defines the minimum requirement needed in order for end users to have a comfortable and enjoyable experience with the application. The baseline was self defined based on statistics taken from http://www.w3schools.com/. Though the statistic taken from the site may not be an actual representative of the actual fact, it was adequate as a guideline to developing the baseline requirement. Refer Appendix B.

The baseline requirements could be summarised in a table as shown below.

\(^3\) Rich-Text Editor is a web based JavaScript and HTML text editor which allows users to create multiple formats for the text.
Table 4.1. System application baseline requirements.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Baseline Requirement</th>
<th>Targeted and Optimised for</th>
</tr>
</thead>
<tbody>
<tr>
<td>Browser</td>
<td>Netscape 6.0 / MSIE 5.5</td>
<td>MSIE 6.x</td>
</tr>
<tr>
<td>Screen Resolution</td>
<td>800 x 600 pixels</td>
<td>1024 x 768 pixels</td>
</tr>
<tr>
<td>Colour Depth</td>
<td>65,536 colours (16-bit)</td>
<td>32-bit</td>
</tr>
<tr>
<td>Connectivity</td>
<td>56K Modem and faster</td>
<td>128k Broadband</td>
</tr>
<tr>
<td>Plug-In</td>
<td>Acrobat Reader</td>
<td>Acrobat Reader</td>
</tr>
<tr>
<td>Javascript</td>
<td>JavaScript 1.2</td>
<td>JavaScript 1.2</td>
</tr>
<tr>
<td>HTML</td>
<td>HTML 1.0</td>
<td>XHTML 1.0</td>
</tr>
</tbody>
</table>

Note: For the purpose of clarity, the following words are defined:

- Optimized for - best viewed, best experienced

4.4 System Design

After careful analysis of the requirements has been done, the system required functionality was then designed in modules and a descriptive specification of the application, in the form of Entity Relationship Diagrams, was used to describe the system’s model.
4.4.1 System Modules

The system was designed to consist of five main modules. They are:

1. **User Access**
   This module is responsible for controlling the user access into the application. It collaborates with the User Management module to gain the user access privilege upon login. With that, users are only able to gain access or view application feature that was assigned to them. It is also responsible for user session creation and termination.

2. **User Management**
   As the name suggest, this module manages the creation of application users. It is also responsible for the management of user groups and the application user access level.

3. **Instructional Design Principle Management**
   This module is responsible for the creation and management of learning principles to be used in the application. By default, the Gagne’s Nine Learning Events will be included in the application. However, the application is designed to be able to cater for more learning principles.
4. Discussion group Management

Each content storyboard development project could only be done by one content team. This only makes sense as two or more teams would only create havoc and disharmony during content development. This module manages the creation of content team or discussion group and also the selection of team members from the pool of application users.

5. Storyboard Development

This module is responsible for the management of storyboard creation. Each storyboard development will be known as *Storyboard Project* and each storyboard project shall represent the creation of one Sharable Content Object.

4.4.2 Entity Relationship Diagrams (ERD)

The scale of the pilot application can be considered small as it attempts to prove a concept rather than showcase the application’s complexity. The minimal complexity of the application allows the use of Entity-Relationship Diagrams (ERD) to design the application based on the derived requirements.

ERD provides a high-level conceptual description of the data structure using graphical notations (Ghezzi, Jazayeri & Mandrioli, 1991). This makes it easier for system developers to get the overall design of the application and relate how the data flows from one entity to the other. It also shows how entities are related to one another as well as gives the system developer a guideline on how to develop the database structure.
Figure 4.2 below depicts the ERD of the intended application system.

![Application ERD Diagram](image)

Figure 4.2. Application ERD.

From the figure above, it can be seen that the application consists of 8 main entities. They are:

- **Users**

  The actual application users. This entity holds all the personal information needed for the user to use the application.
• **Application Group**
  Grouping of users within the application. Each user group has its own defined roles and application permissioning. Users who are a member of a group will inherit all the privileges granted to the group.

• **Application Permission**
  This entity holds all the permissioning objects available to the application. Groups which have been assigned to the objects shall be granted the functionality that comes with the permissioning object.

• **Instruction Design Principles**
  The instructional design principles are held by this entity. This entity will hold all the steps and rules of the ID principle.

• **Content Group**
  Content group can also be seen as a project group or project team that has been assigned to create a particular storyboard.

• **Content Object**
  This entity represents the content storyboard that is to be developed. It acts as a place holder or container for the Content Screen objects.
• **Content Screens**

  Storyboards were designed to show what is to be presented on each courseware screens. This entity thus represents each content screen that must be developed by the content team.

• **Comments**

  Each screen has a collaborative platform for team members to post their views and comments. This entity was created to handle that requirement.

### 4.4.3 Database Design

After the conceptual system design has been finalised, the logical database design was drawn up based on the ERD. The database design includes details such as data type and size, the key constraints, as well as the relationship type between entities. From this logical design, the actual physical database structure could be generated.

Figure 4.3 below depicts the logical design of the application. The diagram shows the usage of the Crow’s Feet notation to define the relationship between entities. This form of notation provides clarity in identifying the child side of an entity which is marked by the claw-like shaped edges. Figure 4.3 below depicts the logical design of the application.
Figure 4.3. Application Logical Data Model.
4.5 Summary

This chapter has described the development methodology used for the application as well as showed the application design. The next chapter will explain in detail the application implementation process.
5. System Implementation and Testing

5.1 Introduction

This chapter details out the implementation strategy of the application system as well as explain the application’s testing procedure. The initial test was conducted by the interviewed IDs to ensure that their requirements had been capture by the application. After that the application was release for testing by the sample group.

By the end of this chapter, test results and screen shots of the ready application will be presented according to is functionality and purpose.

5.2 System Implementation

5.2.1 System environment

The final system shall run on a typical web environment setup which consists of the following components; relational database system, web server, web application, and the user interface or browser. Since the application is web-based, it is possible for users to access the application via a web-enabled Personal Digital Assistant (PDA) or mobile phone. Figure 5.1 illustrates the system environment setup that was used for the storyboard application.
The system was developed and tested on a single machine or server with the following software installations as listed in Table 5.1:

Table 5.1. Server software installation.

<table>
<thead>
<tr>
<th>Item</th>
<th>Software Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating System</td>
<td>Microsoft Windows XP Professional</td>
</tr>
<tr>
<td>Web Server</td>
<td>Microsoft Internet Information Server (IIS) 5.0</td>
</tr>
<tr>
<td>Web Application</td>
<td>PHP 4.3.10</td>
</tr>
<tr>
<td>Database</td>
<td>MySQL 5.0 Database Server – Community Edition</td>
</tr>
</tbody>
</table>
The server had the following hardware specifications as listed in Table 5.2 which also represents the recommended minimum hardware requirements:

<table>
<thead>
<tr>
<th>Item</th>
<th>Hardware Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>Intel Pentium 4 (1.8MHz)</td>
</tr>
<tr>
<td>Memory</td>
<td>1GB DDR2 RAM at 553 Mhz</td>
</tr>
<tr>
<td>Hard Disk</td>
<td>40GB SATA</td>
</tr>
<tr>
<td>Network Interface</td>
<td>10/100 Ethernet</td>
</tr>
</tbody>
</table>

### 5.3 Programming Language and Development Tools

This section will examine the chosen scripting language and database as well as look at the development tools that were used in the construction of the application.

#### 5.3.1 PHP Programming Language

PHP is a recursive acronym for *PHP: Hypertext Pre-processor*. It is an open-source server-side scripting language that was first introduced in 1994. Since then it had become the most popular open-source web based programming language used by over 6 million domains with a monthly growth rate of 15% (according to Netcraft, http://www.netcraft.com/survey/).
Amongst the benefits of using PHP are:

1. The scripting language is very easy to learn and there are an abundance of PHP resources available on the Internet. This makes it easier to maintain and upgrade PHP applications as compared to other scripting languages such as Perl or ASP.

2. PHP works on almost any operating system. This cross-platform compatibility feature makes it easier to deploy and install completed applications on existing Internet servers such as Apache, Microsoft and Netscape service solutions. This makes it very suitable for today’s heterogeneous network environments.

3. PHP also has built-in supports for a wide variety of commercial as well as non-commercial databases such as MySQL, Informix, mSQL, Microsoft SQL Server, PostgreSQL, Oracle, Sybase and also ODBC type database connection.

4. Supports protocols such as POP3, LDAP, SNMP, HTTP, COM, and IMAP and also offers integration with various external libraries. This allows PHP developers to do almost anything from generating PDF documents, creating graphic images to parsing XML documents. It is also able to work with other server-side language such as JAVA and COM.
5. Being an open source scripting language with wide distribution and a large community of users, PHP is very well supported. PHP bugs are found and fixed quite regularly and the language enjoys continuous improvements to enhance its capabilities due to its huge pool of open-source developers. Most importantly, all these benefits are made available to its users without any hidden cost.

5.3.2 MySQL Database System

MySQL is a powerful, secure and scalable multithreaded, multi-user relational database management system owned by the Swedish firm MySQL AB. Although small in size as compared to other commercial relational databases, MySQL is extremely fast. Perhaps the most convincing reference of MySQL implementation is the Google search engine, which is built entirely on MySQL technology.

The main reason of using MySQL as the application database is due to PHP’s extensive built-in support for MySQL database. PHP has numerous functions available to allow developers to control and manipulate the MySQL database without having to code new procedures. This will expedite the application development as less coding needs to be done.

__________________________

Google (http://www.google.com) is a popular Internet search engine owned by Google Inc.
5.3.3 Development Tools

The following tools were used during the development of the Content Storyboard Application system:

- **PHP Designer 2007 Personal**
  This tool is available as a freeware and can be downloaded from the Internet. It is developed by MPSoftware and is an Integrated Development Environment (IDE) for PHP designed to help ease and enhance the process of editing, debugging, and analysing PHP scripts.

- **DBDesigner 4**
  DBDesigner is database tool created by fabForce.net. It is a visualisation tool for database design which includes the ability to create and maintain database in a single, seamless environment.

- **MySQL Query Browser**
  MySQL Query Browser is a tool for creating, executing, optimising and testing SQL queries for the MySQL Database server. It is available and can be downloaded for free at http://www.mysql.com.
MySQL Administrator

MySQL Administrator is a free tool that is available from the MySQL website for administering and managing MySQL databases. It provides database administrators with an easy to use but powerful visual interface that gives better visibility on how the databases are operating.

5.4 System Test

Human beings are susceptible to making mistakes. Even with the use of the most meticulous and sophisticated application design approach, erroneous results can never be avoided (Ghezzi, Jazayeri & Mandrioli, 1991). Therefore, the final product must always be verified against the intended requirement to ensure its usability and functions acts accordingly.

An application that has undergone a system test will garner greater user confidence in the system’s quality and reliability. It also gives the assurance that the system has met it expectation and able to produce its desired outcome. Therefore, the content storyboard application was tested on its system’s functionality. Functional tests are conducted to ensure the functional feature provided by the application works in a manner that it is suppose to.
Due to the lack of software and hardware infrastructure, further tests such as the systems performance test could not be carried out. Performance tests are usually carried out to ensure the application is able to serve the user within the required timeframe without triggering any system timeout failure. Indirectly, it also serves to validate other quality attributes of the systems such as scalability and reliability.

5.4.1 Functional Test Design

The goal of the functional test is to evaluate the systems’ functionality against its specified requirements. In order to accomplish the test objectives, the black box method was used.

By using this method, the function or object to be tested is regarded as a black box in the sense that the internal structure (code and logic) of the object is not known. This approach takes the external perspective of the object where a valid or invalid input to the object should produce the correct output. In other words, this approach looks at what the program is intended to do rather than on its structure.

The black box methods allow test case to be derived from the requirements specifications. Each module’s functionality was tested with regards to its specifications (requirements) and its context (events) as depicted in Figure 5.2. The output was then checked for its correctness.
In theory, there are many possible permutations of input and output combination that could be generated for the test cases. In reality, however, a thorough black box testing is close to impossible or unreasonable. The normal procedure undertaken for this test is to design a small, manageable set of test cases so as to maximise the chances of detecting a fault whilst minimising the redundancy amongst the other cases.

5.4.2 Test Procedures

The test was conducted by the two IDs who were also the interviewees during the application requirement data gathering. They were given the test case script as shown in Table 5.3 to 5.7. Each system’s functionalities were tested and considered as successful only if both of the assessors are satisfied with the outcome.

Test case provides evidence that the functions behaves as desired. Only after the IDs had accepted the application for use shall it then be deployed to the sample test group.
5.4.3 Test Results

The final result of the application functional test results are shown in Table 5.3 below. It was based on the aggregated results taken from both assessors.

Table 5.3. Test results of *User Access* module functionality.

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Pass</th>
<th>Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>To ensure access to authorised user.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>To deny access to unauthorised user.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>To terminate user session upon logout.</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

Table 5.4. Test results of *User Management* module functionality.

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Pass</th>
<th>Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create new user.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Edit existing users.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Delete existing users.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Display list of existing application users.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Search for existing users based on search criteria.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Assign users to group.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Create new user group.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Edit existing user groups.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Delete existing groups.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Display list of existing application groups.</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
Search for existing groups based on search criteria. ✓
Assign groups to users. ✓
Assign application permission objects to user groups. ✓
Un-assign permission objects from user groups. ✓

Table 5.5. Test results of *Instructional Design Principle Management* module functionality.

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Pass</th>
<th>Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gagne’s Nine Learning Events instructional design principle object already exists in the application.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Sub-item in Gagne’s Nine Learning Events object is available and complete.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Insert new instructional design principle object into the application.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Edit existing instructional design principle object.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Delete existing instructional design principle object.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Display list of existing instructional design principle object.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Search for existing instructional design principle object based on search criteria.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Insert new sub-item in existing instructional design principle object.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Edit existing sub-item within an instructional design principle object.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Delete existing sub-item within an instructional design principle object.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Re-arrange the sort order of the sub-item within an instructional design principle object.</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
Table 5.6. Test results of Discussion Group Management module

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Pass</th>
<th>Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create new discussion group.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Edit existing discussion group.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Delete existing discussion group.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Display list of existing discussion group object.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Search for existing discussion group based on search criteria.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Assign application users as member of discussion group.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Un-assign application users as member of discussion group.</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

Table 5.7. Test results of Storyboard Development module.

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Pass</th>
<th>Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create new Content Storyboard project.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Select any existing instructional design principle as the project instructional design template.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Assign storyboard project to an already existing discussion group. Only members of the discussion group are allowed to contribute to the project.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Storyboard content templates are organised according to project instructional design principle.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Create/add screens on each instructional design items.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Delete screens from each instructional design items.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>View discussion board for each instructional design items’ screen.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Enter text messages onto discussion board.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Re-organise screen order for each instructional design items.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Generate PDF output on content storyboard project.</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
The tables above had shown that all of the system functionalities has passed the test. Therefore, the system was deemed as ready to be deployed to the sample group for further evaluation.

5.5 Screen Capture

5.5.1 Login Screen

All users are required to login in order to use the application.

![Login page](image)

Figure 5.3. Login page.

The username and password are created by the system administrator and users will be able to change their password once they have logged in.
Upon successful login, the user will be taken to the main screen (Figure 5.3) which will display the application menu on the left hand side. The visibility of the function that is available on the application menu will depend on the user’s application permissioning that has been set by the system administrator.
5.5.2 User Management

User of the applications are created via The User Management module. By default, this functionality is only available to the system administrator.

Figure 5.4 above shows a listing of available users in the system. The system administrator could add or delete users as required. By clicking on the username, the system will display the user’s details.
User’s detail could also be modified after its initial creation. User’s detail includes two parts: the login information and the group information.
Figure 5.6. User’s group page.

The figure above shows the listing of groups that has been assigned the selected user. Assigning users to a particular could easily be accomplished by using the management module. The administrator could also easily de-register a user from a particular group if deemed necessary.
Assigning users to a group could be done by clicking on the ‘Add Membership’ link. A pop-up window will appear with the list of group names that the current user is not a member of. By selecting the group name from the list, users will be added to the group membership instantaneously.
5.5.3 Instructional Design Principle Management

This module manages the Learning Design Principles by outlining the steps or rules of a particular learning principle. By default, the Robert Gagne’s Nine Learning Events has been included into the system. However, the system is designed to be able to incorporate more learning principles to cater for different learning requirements.

Figure 5.8. Learning Principle page.

Figure 5.8 show the listing of available learning principle in the system. Administrators could add, delete or edit the available list of principles.
By clicking on the principle’s name (as shown in Figure 5.9), the system will display the details of the learning principle.
Figure 5.10. Listing of Learning Principle items page.

By clicking on the ‘Item’ link at the sub-menu, system will display the steps or rules of the selected principles. From this listing page, administrators could re-organise the order of the rules by clicking on the sorting arrow on the right. Administrators could also delete any steps deemed as unnecessary by clicking on the checkbox and by pressing on the ‘Delete’ button.
To add a new step or rules could also be done by clicking on the ‘Add Entry’ link. A pop-up window will appear and the administrator needs to fill in necessary attributes in an easy to use form. Upon clicking on the ‘Submit’ button, the new item will be included in the item listing.
5.5.4 Discussion Group Management

Before a storyboard could be created, the team that will be responsible for the storyboard must be first be available.

Figure 5.12. Content team management page.

Figure 5.12 above shows the listing of available team or discussion group that is available in the system. Teams could be added, deleted or have its membership details modified according to the team leaders’ discretion.

By clicking on the team name from the figure above, the system will display the details of the selected team, as shown in the figure below.
To select or de-select content team members, administrators or team leader could click on the ‘Members’ link in the sub-menu to get a listing of all users who are member of this particular group.
Figure 5.14. Adding users to content team page.

Adding users to this group could be done by clicking on the ‘Add Members’ link. A pop-up window will appear with the names of users who are not a member of this particular group yet. To include any particular user, simply tick the corresponding checkbox and click on the ‘Add’ button.

5.5.5 Storyboard Development

Application users will only get to see the content storyboard project in which he/she is a team member of. This is to prevent non-member from making changes or editing the content storyboard in which they have no prerogative in.
A content object could only be initiated by a content team leader. Figure 5.16 below shows the template for initiating a content object. Team leader could also choose the learning principle to be used.
After the content has been initiated, the system will provide the content template (as in figure 5.16) for content team members to fill. The organisation of the content template will depend on the learning principle that the content subscribes to. By using the storyboard template, team members could edit each other’s work, add screens, preview the screen design, and also enter a screen discussion board.
Figure 5.16 and 5.17 below shows the first step for content template of Gagne’s Nine Learning Events learning principle which is the Attention Getter.

Figure 5.17. STEP 1 - Form template for creating storyboard.
Figure 5.18, continued. STEP 1 - Form template for creating storyboard.

Each template represents a content screen or will contain the raw content that should appear on the final courseware screen.
Each screen has its own discussion board as shown in Figure 5.19. Team members could engage in discussion and share their ideas related to that particular screen by using this platform.
Figure 5.20. STEP 2 - Form template for creating storyboard.

Figure 5.20 above shows the template for the second step of Gagne’s Nine Learning Events learning principle. The attributes and feature of the template is similar to that of Step 1.

At the very top of the template frame, there is also an indicator highlighting the current steps.
Figure 5.21. STEP 3 - Form template for creating storyboard.

Figure 5.21 shows the template for the third step of Gagne’s Nine Learning Events learning principle. Each step in the learning principle contains a descriptive guide on how the content should be written for that particular learning event.
In Gagne’s Nine Learning Events, Step 4 (content presentation) would probably be the step that would contain the most number of screens. This is where the actual content or knowledge is being presented to the learner. Figure 5.22 depicts the screenshot for Step 4.

As each content template represents one screen, the application provides a feature for users to add multiple screens to each step.
Figures 5.23 to 5.27 show the content template for the remaining steps of the Gagne’s Nine Learning Events.

Figure 5.23. STEP 5 - Form template for creating storyboard.
Figure 5.24. STEP 6 - Form template for creating storyboard.
Figure 5.25. STEP 7 - Form template for creating storyboard.
Figure 5.26. STEP 8 - Form template for creating storyboard.
The users are allowed to backtrack or jump to any of the learning events or steps at any time. This is to allow flexibility for the users to slot in any missing content throughout the content storyboard development process.
After the final step in the content template has been completed, the system will prompt users that the content storyboard is complete, as in Figure 5.28, in terms of proper content structure. The final content however, has to be verified by the Instructional Designer in charge of the storyboard before the storyboard is released to the development team.

Figure 5.28. Storyboard completion screen prompt.
The screen manager functionality, as shown in Figure 5.29, provides application users with the number of screens that are available for each learning principle steps.
Team members could re-organise the order of the team according to their discretion. As shown in Figure 5.30, users could use the sorting arrow to ascend or descend the screens sorting position. They could also remove any unwanted screens from the content storyboard.
The ‘PDF Preview’ option in the sub-menu will generate the PDF version of the content storyboard. Team members could preview the PDF output by using this option. A sample of the output is shown in Figure 5.31 and 5.32.
They could also opt to save the PDF document should the storyboard is already complete and ready to be passed on to the multimedia development team.
5.6 Summary

This chapter has described the implementation details of the application. It also shows the test procedure and the test results. Based on the results that was gathered, it can be concluded that the application has met its intended requirements and therefore can be released to the sample group for its effectiveness test.
6. Survey Findings of Application Reviews

6.1 Introduction

This chapter aims to present the results of the survey findings on the application review by the sample group of users. The result of the survey will answer the research question posted in Chapter 1 and help determine if the research objectives has been met.

6.2 Tools and Participants

The detail on the tools used and the background of participants involved in the survey has already been mentioned in detail in Chapter 3 (section 3.3).
Figure 6.1 above show the total number of participants from the sample group of application reviewers. In total, there are 18 respondents that made up the sample group which reviewed the application. From that figure, only 3 are professional IDs. The rest are made up of 11 SMEs, 2 graphic designers and 2 multimedia programmers.

The participants were given to test and use the application for duration of 1 month. They were asked to produce a simple content storyboard by using the application to get a hands-on experience and a feel of the application. After which, they were given questionnaires to fill and their response recorded.
6.3 Findings and Result

6.3.1 Participant’s Background

From this sample group, only the ID had prior knowledge of learning principles (see Table 6.1). This also meant that the sample group was suitable in testing the application as one of this thesis’s objectives was to prove that any ordinary SME could create a pedagogically sound content storyboard by using it.

Table 6.1. Number of participants with pedagogical knowledge.

<table>
<thead>
<tr>
<th>Job Role</th>
<th>Participants with pedagogical knowledge (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction Designer</td>
<td>100</td>
</tr>
<tr>
<td>Subject Matter Expert</td>
<td>0</td>
</tr>
<tr>
<td>Multimedia Programmer</td>
<td>0</td>
</tr>
<tr>
<td>Graphic Designer</td>
<td>0</td>
</tr>
</tbody>
</table>

In terms of computer literacy, almost all of the users have been using the computer for than 5 years and has been surfing the World Wide Web for about the same duration of time (see Table 6.2 and 6.3).
Table 6.2. Participants’ number of years using the computer.

<table>
<thead>
<tr>
<th>How many years have you been using the computer?</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid 5 - 10 years</td>
<td>5</td>
<td>27.8</td>
<td>27.8</td>
<td>27.8</td>
</tr>
<tr>
<td>&gt; 10 years</td>
<td>13</td>
<td>72.2</td>
<td>72.2</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Out of the 18 respondents, only 27.8% has been using the computer for 5 to 10 years. The rest of them had more than 10 years of experience operating the computer. This means that this group of participants were computer literate and should have no problems operating the computer.

Table 6.3. Participants’ number of years surfing the Internet.

<table>
<thead>
<tr>
<th>How many years have you been surfing the World Wide Web?</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid 5 - 10 years</td>
<td>9</td>
<td>50.0</td>
<td>50.0</td>
<td>50.0</td>
</tr>
<tr>
<td>&gt; 10 years</td>
<td>9</td>
<td>50.0</td>
<td>50.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Fifty percent of the respondents had more than 10 years experience surfing the World Wide Web while the other had 5 to 10 years worth. With that kind of exposure on to the Web, all of the participants were assumed to be comfortable with navigating through the Internet by using a typical web browser.
This set of data proves that the sample group have the necessary experience using the computer to the level that they were able to give credible reviews on the application usability and functionality.

6.3.2 Application Functionality

Below are results of what the sample group thinks of the application’s functionality. The result from this section shows the user’s level of comfort using the application and identifies any weak areas that the application could enhance upon.

Based on the statistic in Table 6.4, a huge majority of the respondents felt that the application does help them compose content in an easier fashion. One of the respondents felt unsure of the application’s usability but none of them thought that the application makes composing content more difficult than it already is.

Table 6.4. Participant’s feedback on composing content.

| The application makes it easier to compose content according to learning principles. |
|---------------------------------|---------|------|----------|---------|
| Valid | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Maybe | 1 | 5.6 | 5.6 | 5.6 |
| Valid | Yes | 10 | 55.6 | 55.6 | 61.1 |
| Valid | Definite Yes | 7 | 38.9 | 38.9 | 100.0 |
| Valid | Total | 18 | 100.0 | 100.0 |
The result in Table 6.5 shows that almost none of the participant found using the content template to be challenging or difficult. This proves that the template layout and organization was acceptable by all of the respondents.

The RTE that comes with the content template gave the author tremendous freedom to style and format their text compared to the normal text field. From the responses that were gathers, 66.7% truly liked the feature while 11.1% seems unsure on its usage and advantages. The remaining 22.2% of the respondent agreed that the RTE was a useful feature to be included.

Table 6.5. Participant’s feedback on content template usage.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>7</td>
<td>38.9</td>
<td>38.9</td>
<td>38.9</td>
</tr>
<tr>
<td>Definite Yes</td>
<td>11</td>
<td>61.1</td>
<td>61.1</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Table 6.6. Participant’s feedback on using the RTE.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maybe</td>
<td>2</td>
<td>11.1</td>
<td>11.1</td>
<td>11.1</td>
</tr>
<tr>
<td>Yes</td>
<td>4</td>
<td>22.2</td>
<td>22.2</td>
<td>33.3</td>
</tr>
<tr>
<td>Definite Yes</td>
<td>12</td>
<td>66.7</td>
<td>66.7</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
From the content template, users are able to add screens and navigate between the screens as well as the discussion board. At first it was thought that users might be slightly confused with the numerous and buttons available on the template page. However, as shown in Table 6.7, 55.6% of the respondents agreed that navigating through the content template was easy while the other 44.4% strongly agreed to it.

Table 6.7. Participant’s feedback on content template navigation.

<table>
<thead>
<tr>
<th>Navigating through content template was easy.</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Yes</td>
<td>10</td>
<td>55.6</td>
<td>55.6</td>
<td>55.6</td>
</tr>
<tr>
<td>Definite Yes</td>
<td>8</td>
<td>44.4</td>
<td>44.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

The Screen Manager is a function that allows users to reorganize or rearrange their content screen packing order. The data shown in Table 6.8 reveals that only 11.1% strongly agreed that this feature was very useful while 33.3% was unsure of its usefulness.

Table 6.8. Participant’s feedback on the Screen Manager

<table>
<thead>
<tr>
<th>The Screen Manager was useful in rearranging content screens.</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Maybe</td>
<td>6</td>
<td>33.3</td>
<td>33.3</td>
<td>33.3</td>
</tr>
<tr>
<td>Yes</td>
<td>10</td>
<td>55.6</td>
<td>55.6</td>
<td>88.9</td>
</tr>
<tr>
<td>Definite Yes</td>
<td>2</td>
<td>11.1</td>
<td>11.1</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
Table 6.9 shows that 44.4% of the respondents found removing unwanted content screen as extremely easy. Another 50.0% found it relatively easy while 5.6% was unsure.

Table 6.9. Participant’s feedback on removing screens.

<table>
<thead>
<tr>
<th>Removing unwanted screens was relatively easy.</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>1</td>
<td>5.6</td>
<td>5.6</td>
<td>5.6</td>
</tr>
<tr>
<td>Maybe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>9</td>
<td>50.0</td>
<td>50.0</td>
<td>55.6</td>
</tr>
<tr>
<td>Definite Yes</td>
<td>8</td>
<td>44.4</td>
<td>44.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Although it was thought that the application had the familiar feel of a typical web based application, 5.6% of the respondents did not thought it was easy to navigate thru and another 5.6% was unsure of the navigation as well (see Table 6.10). The percentage of respondents who agreed and strongly agreed that the navigation was easy stood at 44.4%.

Table 6.10. Participant’s feedback on application navigation.

<table>
<thead>
<tr>
<th>Navigating through the entire application was relatively easy.</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>1</td>
<td>5.6</td>
<td>5.6</td>
<td>5.6</td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>5.6</td>
<td>5.6</td>
<td>11.1</td>
</tr>
<tr>
<td>Maybe</td>
<td>1</td>
<td>5.6</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>8</td>
<td>44.4</td>
<td>44.4</td>
<td>55.6</td>
</tr>
<tr>
<td>Definite Yes</td>
<td>8</td>
<td>44.4</td>
<td>44.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
For every learning principle step, an instruction on the kind of content that should be placed there was given in the application. However, a majority of the respondents were either unsure or did not find the instructions to be adequate. From table 6.11 it can be seen that 11.1% of the respondents did not agree while 55.5% of them were unsure of the given instructions’ adequacy.

Table 6.11. Participant’s feedback on the on-screen instructions.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>No</td>
<td>2</td>
<td>11.1</td>
<td>11.1</td>
</tr>
<tr>
<td></td>
<td>Maybe</td>
<td>10</td>
<td>55.6</td>
<td>66.7</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>6</td>
<td>33.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>18</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Except for the IDs, the rest of the respondents do not possess any pedagogical knowledge or any learning principles knowledge. By using the application, it was hoped that they were able to be made aware of the learning principle that was implemented in their content project. Table 6.12 shows that only 11.1% were unsure if the application had made them aware of the intended learning principles. A majority of the respondents found that the application does help alert them on the learning principle with 55.6% respondent agreeing to this fact while another 33.3% strongly agreeing to it.
Table 6.12. Participant’s feedback on learning principle awareness.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>2</td>
<td>11.1</td>
<td>11.1</td>
<td>11.1</td>
</tr>
<tr>
<td>Maybe</td>
<td>10</td>
<td>55.6</td>
<td>55.6</td>
<td>66.7</td>
</tr>
<tr>
<td>Yes</td>
<td>6</td>
<td>33.3</td>
<td>33.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Definite Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Based on Table 6.13, half or 50.0% of the respondent strongly agreed that the application was easy to use versus 5.6% who were unsure. Another 44.4% simply agreed the application was user friendly.

Table 6.13. Participant’s feedback on application easy of use.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>1</td>
<td>5.6</td>
<td>5.6</td>
<td>5.6</td>
</tr>
<tr>
<td>Maybe</td>
<td>8</td>
<td>44.4</td>
<td>44.4</td>
<td>50.0</td>
</tr>
<tr>
<td>Yes</td>
<td>9</td>
<td>50.0</td>
<td>50.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Definite Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
6.3.3 Collaboration Platform

This section looks at the impact the collaboration platform had on the respondents. The result from this section shows the usefulness and the effectiveness of the collaboration platform.

One of the main purposes of the application is to assist SMEs to develop content storyboard independently while being monitored remotely by the IDs. After using the application for a period of time, 44.4% of the respondents strongly felt that the application does help the ID monitor the content progress (see table 6.14). Only 11.1% were unsure that it makes the monitoring process easier.


<table>
<thead>
<tr>
<th>The application makes it easier for Instructional Designers to monitor the work of Subject Matter Experts.</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>2</td>
<td>11.1</td>
<td>11.1</td>
<td>11.1</td>
</tr>
<tr>
<td>Maybe</td>
<td>8</td>
<td>44.4</td>
<td>44.4</td>
<td>55.6</td>
</tr>
<tr>
<td>Yes</td>
<td>8</td>
<td>44.4</td>
<td>44.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Definite Yes</td>
<td>8</td>
<td>44.4</td>
<td>44.4</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

All of the participants were expected to play a role during content production. The collaboration platform was created to allow team members to freely discuss or post their comments on the content during development phase. In Table 6.15, the result of the questionnaires shows that only 11.1% of the respondents were unsure if the application had
help the collaboration effort between all parties involved. Half or 50% of the respondents agreed while another 38.9% strongly agreed on the fact.

Table 6.15. Participant’s feedback on collaboration effort.

The application helps the collaboration between various parties (e.g. programmers, graphic designer) involved in content production.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>2</td>
<td>11.1</td>
<td>11.1</td>
</tr>
<tr>
<td>Yes</td>
<td>9</td>
<td>50.0</td>
<td>61.1</td>
</tr>
<tr>
<td>Definite Yes</td>
<td>7</td>
<td>38.9</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Table 6.16 shows all of the respondents agreed that the discussion board was easy to use with 77.8% strongly agreeing to it.

Table 6.16. Participant’s feedback on discussion board ease of use.

The discussion board was easy to use.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>4</td>
<td>22.2</td>
<td>22.2</td>
</tr>
<tr>
<td>Yes</td>
<td>14</td>
<td>77.8</td>
<td>100.0</td>
</tr>
<tr>
<td>Definite Yes</td>
<td>18</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
It was thought that by using the discussion board, team members would be more participative in production process as they were able to throw in their ideas at any given time without having to wait for a formal meeting or discussion to take place. It would also encourage the shy team members to contribute ideas as they would not have to speak in public. From Table 6.17, results shows that majority of the respondents felt that the discussion board does encourage team members to participate more actively in content production with 61.1% saying ‘yes’ to the statement.

Table 6.17. Participant’s feedback on discussion board.

The discussion board promotes all parties to contribute ideas better compared to normal face-to-face meetings/discussions.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>2</td>
<td>11.1</td>
<td>11.1</td>
<td>11.1</td>
</tr>
<tr>
<td>Maybe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>11</td>
<td>61.1</td>
<td>61.1</td>
<td>72.2</td>
</tr>
<tr>
<td>Definite Yes</td>
<td>5</td>
<td>27.8</td>
<td>27.8</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

In terms of the overall usefulness of the discussion board, 38.9% agreed that it was very useful and another 38.9% strongly agreeing to this fact as well.

Table 6.18. Participant’s feedback on discussion board usefulness

The screen discussion board was very useful during content production.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>4</td>
<td>22.2</td>
<td>22.2</td>
<td>22.2</td>
</tr>
<tr>
<td>Maybe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>7</td>
<td>38.9</td>
<td>38.9</td>
<td>61.1</td>
</tr>
<tr>
<td>Definite Yes</td>
<td>7</td>
<td>38.9</td>
<td>38.9</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
6.3.4 Opinion

The respondents were made to test the application for only a short duration of time. After which their opinion and thoughts on the application were sought with regards to actually using it in their daily profession. This section will present the findings on the matter.

When asked if they taught the application would speed up the content storyboarding lifecycle, a resounding 55.6% of the participant strongly agreed to it. The figure can be seen on Table 6.19. Only a mere 11.1% were unsure it would actually reduce development time.

Table 6.19. Participant’s feedback on production turn around time.

<table>
<thead>
<tr>
<th>Do you think using the application could reduce the amount of time it usually takes to produce content storyboards.</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Maybe</td>
<td>2</td>
<td>11.1</td>
<td>11.1</td>
<td>11.1</td>
</tr>
<tr>
<td>Yes</td>
<td>6</td>
<td>33.3</td>
<td>33.3</td>
<td>44.4</td>
</tr>
<tr>
<td>Definite Yes</td>
<td>10</td>
<td>55.6</td>
<td>55.6</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Table 6.20 below shows that a huge majority (61.1%) of the respondents strongly feels that the application will be able to cut content development cost especially during the storyboarding phase. Only 16.7% were unsure while the remaining 22.2% also agreeing to it.
Table 6.20. Participant’s feedback on production cost.

| Do you think such an application will be able to lower the cost of content production? |
|---------------------------------|----------------|----------------|----------------|
|                                 | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                           | 3         | 16.7    | 16.7           | 16.7               |
| Yes                             | 4         | 22.2    | 22.2           | 38.9               |
| Definite Yes                    | 11        | 61.1    | 61.1           | 100.0              |
| Total                           | 18        | 100.0   | 100.0          |                    |

When the participants were asked if they would consider using the application professionally, an overwhelming 61.1% gave a definite yes as shown in Table 6.21. Only a mere 16.7% of the participants were unsure but there was no objections recorded.

Table 6.21. Participant’s feedback on using the application at work.

| Would you consider using this application in your professional work? |
|----------------------------------------------------------|----------------|----------------|----------------|
|                                                         | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                                                   | 3         | 16.7    | 16.7           | 16.7               |
| Yes                                                    | 4         | 22.2    | 22.2           | 38.9               |
| Definite Yes                                           | 11        | 61.1    | 61.1           | 100.0              |
| Total                                                  | 18        | 100.0   | 100.0          |                    |

Table 6.22 shows that 50.0% of the respondents would actually recommend the use of the application to other organisation. This is a strong indication of their level of comfort and confidence in the application.
Table 6.22. Participant’s feedback on recommending the application.

<table>
<thead>
<tr>
<th>Would you recommend this application to other organisation?</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>4</td>
<td>22.2</td>
<td>22.2</td>
<td>22.2</td>
</tr>
<tr>
<td>Maybe</td>
<td>2</td>
<td>11.1</td>
<td>11.1</td>
<td>11.1</td>
</tr>
<tr>
<td>Yes</td>
<td>5</td>
<td>27.8</td>
<td>27.8</td>
<td>50.0</td>
</tr>
<tr>
<td>Definite Yes</td>
<td>9</td>
<td>50.0</td>
<td>50.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Table 6.23 shows how the respondents rate the application. From the result, it showed that the application received a very good rating from the majority with a 55.6% vote. This is another strong indication of the applications’ usefulness and effectiveness in helping users to create content storyboard.

Table 6.23. Participant’s overall rating of the application.

<table>
<thead>
<tr>
<th>Overall, how would you rate this application?</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>2</td>
<td>11.1</td>
<td>11.1</td>
<td>11.1</td>
</tr>
<tr>
<td>Moderate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>6</td>
<td>33.3</td>
<td>33.3</td>
<td>44.4</td>
</tr>
<tr>
<td>Very Good</td>
<td>10</td>
<td>55.6</td>
<td>55.6</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

6.3.5 Open Ended Questions

Open ended questions allow respondents to give feedback without being constrained or guided by a fixed set of options. This approach is particularly useful in getting opinions and comments from the respondents.
After analysing the questionnaires, the following recommendations given by the respondent were thought to be insightful and could possibly help enhance the application functionality and usability further.

1. Most the respondents liked the use of RTE in the content template. So much that they even suggested the RTE be included in the discussion board so they are able to use the RTE formatting feature in it.

2. One recommendation given was for the application to provide the option to include a blank screen or an unformatted screen for them to paste huge graphics or reference table.

3. The discussion board should include a feature for users to share documents amongst each other.

The respondents were also asked to comment on the application. Comments are placed in the questionnaire to get a general feedback and reaction of the respondents towards the application. Comments are helpful in enhancing the application’s value and boost users perception on the application. Amongst the notable comments that were gathered from the questionnaires include:
1. Option for users to increase the text size as the current default font was rather small.

2. More graphic should be included in the interface to enhance the beauty hence increases the mood for using the application.

6.4 Summary of Findings

The results of the finding could be summarised as follows:

1. The application does help users to create content storyboard

2. The application was very user friendly

3. The on-screen instructions was not as helpful.

4. The ID was able to monitor the SME very effectively.

5. The discussion board was found to be useful as the team member were able to contribute ideas during content production.

6. Content production time could be reduced by using this application hence reducing the production cost.
7. The application could be used professionally and many would recommend it to others.

8. Application was well received by the majority of test users.

9. Application needs to upgrade its discussion board and content template for it to be more effective.

This chapter had presented the results of the survey study conducted on the sample group of application users. The results would be further discussed in the Chapter 7.
7. Conclusion

7.1 Introduction

This study aimed at creating an effective application that would help users to create e-learning content storyboard based on some instructional design principle. This chapter will discuss and conclude if the application built had been thought to be useful after it was tested by a sample group of test users. The discussions will be based on the finding results from Chapter 6.

7.2 Discussion

The traditional or current method of creating storyboard is by using word processing software. The storyboard authors would need to create or use the proper template in their text document to ensure proper formatting of storyboards. In an organisation that does not provide proper templates, differing author would come up with various looking storyboard that would eventually confused their development team. Through this application however, users need not worry about formatting the storyboard document to ensure readability to their developers. Writing storyboard became as easy as filling in forms as they would be automatically formatted into one standard version.
Furthermore, a traditional storyboard that is written on text document would normally go through multiple cycles of editing and approval process before it is considered as complete. Throughout this process, the documents are usually passed from one approval stage to the other via emails. The process often results in several versions of the same documents to exist within the organisation. Confusion and chaos would then come should the latest version of the documents is not properly identified. The application solves this problem by giving authors only one copy to work on. Changes made can be viewed instantaneously by the content approver without having to create duplicating text. Although the application does help rid of confusion over the latest version of the content, it does not however keep track of the changes made throughout the development process. They are instances when authors need to revert to previous version of the content. At this point in time, the application does not support this feature but many felt that it would a great asset to the application if it were included in future application versions.

Many felt the application does help speed up content production and improves their current working process. By providing and easy to use content template and a collaboration platform, users were able to conduct their work more efficiently as a lot of layers in the current working process have been removed. The IDs were able to monitor the work of the SMEs without having to schedule appointments or waiting for the content to be emailed. This has directly sped up the approval process.

Feedback from team members has also improved as they do not need to schedule weekly meetings as often. Team members were able to post their ideas anytime by using the collaboration platform. However, it was important to note that the sample group of test users were dynamic and driven individuals. The collaboration platform works well for
them as each of them had the initiatives to participate even without being told to. The same might not be true for passive team members. The platform might not be useful as passive team members usually never contribute ideas without being asked to.

Improvement in working process usually results in shorter development period. A shorter development period then translates to lower production cost and higher yields. Ironically, most of the test users would recommend the application to other organisations even though it meant giving away their competitive advantage. A noble gesture but then again, the test users are made up of IDs, SMEs and developers. Neither one was a shrewd businessmen.

Although many find the application to be user friendly, they also thought the on-screen instructions was not sufficient as they still had to spend some extra time playing around the application to get the feel of it. This fact reveals a severe deficiency that could hinder future users from even trying use the application, especially users that do not have the luxury of time to spend on experimenting with new tools.

Another aspect of the application that did not receive such a high rating was the screen removal feature. Further probe revealed that users to seemed to be confused in identifying the target screen to be removed. To resolve this issue, each screen should probably carry a name or title for easier distinction.
Since the application feature was derived based on the interview of 2 IDs, it was not possible to capture a requirement that would fit all potential users. It does however provide a stepping stone for others to give their recommendations to enhance the application. One notable recommendation was for the application to include the option to insert a blank screen in between the normal content screens. The blank screen would be useful should the SME or ID need to paste huge graphics or include a table of reference to the storyboard.

Most of the test users enjoyed using the RTE very much. So much that most of them would like to see the same feature be applied in the discussion board. They argued there are times when the team members needs to have discussion regarding specific tables or images. The current platform forces them to describe their problems rather than showing it directly.

Another recommendation received was for the application to support file uploads in the collaboration platform. Apparently during typical content development process, it was quite common for team member to share documents or files. This feature would definitely add value to the application and strengthen the collaboration efforts amongst team members.

The non-technical feature of the application also received its share of criticism. One of the test users commented that the text size used in the application was rather small. She said it would have been great if the application could allow the users to customise the text size for easy readability.
Another comment worth mentioning was that the application lack graphic elements as an eye candy. The pilot implementation did not intend to incorporate cosmetics as it focused on the functionality of the application. However, it was later found that cosmetics do play a part in getting the users excited about using the application. It could enhance the mood of the users who is working on the content development. Short term enhancement could be to apply soothing graphics to entice users.

The results from the study conducted reveal that the majority of test users thought highly of the application as they had given it a very good rating. This finding was very reassuring as it gives good ground for future researchers to continue this work and improve the delivery of creating content storyboard even further.
7.3 Suggested Future Application Enhancements

Based on the feedback from the sample group, the following application enhancement suggestions were derived:

1. Provide a clearer on-screen instructions for users of the application.

2. Incorporate RTE in the collaboration platform.

3. Provide feature to allow users to share documents in the collaboration platform.

4. Provide feature to allow users to insert blank screens in between all the content screens.

5. Provide feature to keep track of content versioning.

6. Give each screen a title for easy screen identification.

7. Enhance the application’s cosmetics to induce the users’ mood.

8. Allow users to customise the look and feel of the application to fit their fancy.
7.4 Suggested Future Studies

1. **Creating an intelligent module to match the best learning principle to fit a particular learning objective.**

   In the current application, the choosing of learning principle for the content is determined by the group leader or ID. The ID has the expertise to match various learning principles to fit the learning conditions or objectives. However, this approach still incurs an additional task on the ID especially during project initiation. Therefore, as a continuation of this thesis, a research could be conducted on how to create an intelligent system that could correctly identify learning principles to match the learning objectives or requirements.

2. **Observe if the lack of human contact will have a long term adverse effect on the team camaraderie hence the quality of storyboard produced?**

   In all its beauty, technology does have a darker side. One of it is the removal of human contact in performing tasks. In a working environment where team camaraderie is essential, this application could have a negative impact as it promotes team members to work virtually rather than face-to-face. A research study could be made to find if the hypothesis is true.
7.5 Conclusion

At the end of this thesis, the following were achieved:

1. An application to create an e-learning content storyboard based on a sound instructional design principle was built.

2. It was determined that the application could help SME to easily generate content storyboard for their subject based on proven Instructional Design Principle.

3. It was also determined that the application could help IDs to easily monitor or supervise the SME throughout content storyboard creation process.

4. Most of the test users agreed that the application was able to help reduce the turnaround time to generate a content storyboard.

5. The IDs were able to verify that the storyboard as it was being generated by the SMEs to ensure it abides by the Instructional Design Principle.

Based on the results of finding conducted, it could be concluded that this study was successful in meeting its intended objectives. The current application can be seen as the first version of many that could be spawned from this initial implementation. Future versions of the application could prove to be more effective as it will incorporate more features to enhance its usability and effectiveness.
APPENDIX A: PROFILE OF INTERVIEWEES
Profile of Dr. Azma Abdul Hamid from In-Fusion Solutions Sdn Bhd

With more than 18 years experience in education, Dr Azma is an advocate of e-Learning. Her teaching experience included stints in the USA, Mexico and Malaysia. Focusing on developing teaching skills among teachers as her focus, she continually searches for effective and efficient modes of teaching, which led her to focus on e-learning initiatives for the last three years.

Her involvement in e-learning requires her not only to implement solutions but also to plan with client especially on the area of e-content deployment.

She was an Adjunct Lecturer for two community colleges namely LaGuardia Community College, Queens New York, NY USA and Jersey City State College, New Jersey USA, and Centro De Idiomas, Merida Mexico. In addition, she served as a language instructor with the New York Public Library Refugee Program for 3 years. She was also the Deputy Dean and Lecturer of School of Languages and Scientific Thinking, Universiti Utara Malaysia.

Ever since her first involvement in e-learning in year 1998, she has done numerous workshops for public and private organizations. Universities such as UIA, UPM, UMS, KUITTHO, KUKUM, SUNWAY, TAYLORS have engaged her to do workshops on e-content creation. Currently, she is an adjunct lecturer with the Multimedia Faculty of Universiti Teknologi Petronas.

She was engaged by Islam Council Kedah to do content analysis and to plan and develop content creation blueprints for eleven (11) secondary school subjects. With Citibank Malaysia, she was responsible for developing blueprints to repurpose traditional content for the sales training program. Sapura Advanced Systems engaged her to develop the storyboards for 11 modules for the Royal Malaysian Air Force web based training programs. She has also been engaged by CPF Singapore to plan and develop blue print for repurposing their online customer service training manuals.

Profile of In-Fusion Solutions Sdn Bhd

In-Fusion Solutions Sdn Bhd (IFSSB) was set up in the year 2002 offering a total e-learning solution to its clients. Amongst the clients of IFSSB includes Maybank, Bank Negara and the Ministry of Education. Apart from e-learning business, the company also has a private college under its wing, namely the Cyberjaya University College of Medicinal Sciences (CUCMS).
Profile of Arif Rafhan Othman from Content Capital Sdn Bhd

Arif Rafhan is an Instructional Designer with a bachelor's degree from UiTM, Shah Alam with more than 8 years experience in the of multimedia content development. He co-founded the company Content Capital Sdn Bhd in 2003. He is in charge of the company’s content development operations.

Prior to establishing the company, he worked for a Singapore based public listed firm. There he served as a senior multimedia development consultant for almost 3 years. He was also tasked to manage courseware development for numerous multinational corporations based in Singapore.

Profile of Content Capital Sdn Bhd

Content Capital Sdn Bhd (CCSB) was formed in year 2003. The company’s core business is in the field on e-learning content development. Other than that, CCSB also provides e-learning consultancy service to its clients. CCSB had served clients from various backgrounds ranging from government agencies to multinational corporations. Amongst the notable MNCs that had engaged the services of CCSB includes Standard Chartered, Citibank, Motorola, Shell and Petronas. CCSB had also been engaged by the Brunei’s Ministry of Education to provide consultancy service in drafting the country’s drive towards replicating Malaysia’s own Smart School project.
APPENDIX B: WEB STATISTICS
Statistics taken from [http://www.w3schools.com/browsers/browsers_stats.asp](http://www.w3schools.com/browsers/browsers_stats.asp)

Most popular browser for the year 2006 (in percentages %).

<table>
<thead>
<tr>
<th>Month</th>
<th>Browser</th>
<th>IE7</th>
<th>IE6</th>
<th>IE5</th>
<th>Fx</th>
<th>Moz</th>
<th>N7/8</th>
<th>O7/8/9</th>
</tr>
</thead>
<tbody>
<tr>
<td>November</td>
<td></td>
<td>7.1</td>
<td>49.9</td>
<td>2.9</td>
<td>29.9</td>
<td>2.5</td>
<td>0.2</td>
<td>1.5</td>
</tr>
<tr>
<td>October</td>
<td></td>
<td>3.1</td>
<td>54.5</td>
<td>3.2</td>
<td>28.8</td>
<td>2.4</td>
<td>0.3</td>
<td>1.4</td>
</tr>
<tr>
<td>September</td>
<td></td>
<td>2.5</td>
<td>55.6</td>
<td>4.0</td>
<td>27.3</td>
<td>2.3</td>
<td>0.4</td>
<td>1.6</td>
</tr>
<tr>
<td>August</td>
<td></td>
<td>2.0</td>
<td>56.2</td>
<td>4.1</td>
<td>27.1</td>
<td>2.3</td>
<td>0.3</td>
<td>1.6</td>
</tr>
<tr>
<td>July</td>
<td></td>
<td>1.9</td>
<td>56.3</td>
<td>4.2</td>
<td>25.5</td>
<td>2.3</td>
<td>0.4</td>
<td>1.4</td>
</tr>
<tr>
<td>June</td>
<td></td>
<td>1.6</td>
<td>58.2</td>
<td>4.3</td>
<td>24.9</td>
<td>2.2</td>
<td>0.3</td>
<td>1.4</td>
</tr>
<tr>
<td>May</td>
<td></td>
<td>1.1</td>
<td>57.4</td>
<td>4.5</td>
<td>25.7</td>
<td>2.3</td>
<td>0.3</td>
<td>1.5</td>
</tr>
<tr>
<td>April</td>
<td></td>
<td>0.7</td>
<td>58.0</td>
<td>5.0</td>
<td>25.2</td>
<td>2.5</td>
<td>0.4</td>
<td>1.5</td>
</tr>
<tr>
<td>March</td>
<td></td>
<td>0.6</td>
<td>58.8</td>
<td>5.3</td>
<td>24.5</td>
<td>2.4</td>
<td>0.5</td>
<td>1.5</td>
</tr>
<tr>
<td>February</td>
<td></td>
<td>0.5</td>
<td>59.5</td>
<td>5.7</td>
<td>25.1</td>
<td>2.9</td>
<td>0.4</td>
<td>1.5</td>
</tr>
<tr>
<td>January</td>
<td></td>
<td>0.2</td>
<td>60.3</td>
<td>5.5</td>
<td>25.0</td>
<td>3.1</td>
<td>0.5</td>
<td>1.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IE</th>
<th>Internet Explorer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fx</td>
<td>Firefox (identified as Mozilla before 2005)</td>
</tr>
<tr>
<td>Moz</td>
<td>The Mozilla Suite (including Safari, Konquerer, Gecko)</td>
</tr>
<tr>
<td>O</td>
<td>Opera</td>
</tr>
<tr>
<td>N</td>
<td>Netscape</td>
</tr>
</tbody>
</table>
### Most popular display resolution for the year 2006 (in percentages %).

<table>
<thead>
<tr>
<th>Month \ Res.</th>
<th>Higher</th>
<th>1024x768</th>
<th>800x600</th>
<th>640x480</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>19</td>
<td>58</td>
<td>17</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>January</td>
<td>17</td>
<td>57</td>
<td>20</td>
<td>0</td>
<td>6</td>
</tr>
</tbody>
</table>

### Most popular colour depth for the year 2006 (in percentages %).

<table>
<thead>
<tr>
<th>Month \ Colour</th>
<th>16,777,216 (32 bit)</th>
<th>65,536 (16 bit)</th>
<th>256</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>81</td>
<td>16</td>
<td>3</td>
</tr>
</tbody>
</table>

### Javascript statistics for the year 2006 (in percentages %).

<table>
<thead>
<tr>
<th>Month</th>
<th>Javascript On</th>
<th>Javascript Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>90</td>
<td>10</td>
</tr>
</tbody>
</table>
APPENDIX C: RESEARCH INSTRUMENTS - INTERVIEW QUESTIONS
SECTION 1: INSTRUCTIONAL DESIGNER’S BACKGROUND

1. How many years of experience do you have as an Instructional Designer?

2. What qualifications do you possess to quantify you as a credible Instructional Designer?

3. How many instructional design project have you successfully commissioned?

4. Have you conducted any training on Instructional Design?

SECTION 2: LEARNING PRINCIPLES

1. Which learning principle do you normally use for adult learners?

2. Why do you normally use that particular principle?

3. Would you recommend the intended tool to use that principle for the pilot implementation?

4. (If the recommended principle is not Gagne’s Nine Learning Events) In your opinion, could Gagne’s Nine Learning Events be used instead of your recommended principle?

5. Do you agree that one learning principle does not fit all learning requirements?
SECTION 3: CONTENT STORYBOARDING PROCESS

1. Does your organisation have a clear guideline on content writing?

2. How does your storyboard template look like?

3. What is the organisation of your storyboard like? Do you adopt the LO/SCO approach?

4. Are your implementation team able to understand the storyboard in order to develop the multimedia content?

5. What tools do you normally use to create content storyboard? Do find these tools to be practical?

6. Could you recommend the storyboard template design for the application?

7. Even after you have been doing ID for years, do you agree that once in a while instructional designer do need to be reminded on how to write content?

SECTION 4: COLLABORATION PROCEDURES

1. How people are usually involved in the storyboarding process?

2. How do you manage the collaboration effort between all the parties?

3. How would you recommend the collaboration platform be designed?

4. Do you agree that dealing with clients or SME is one of the most challenging tasks of an ID?
APPENDIX D: RESEARCH INSTRUMENTS -

QUESTIONNAIRES
Dear Respondents,

This study attempts to discover the effectiveness and the practicality of using the Content Storyboard Application as a supporting tool in your professional work.

We seek you kind cooperation to complete this Questionnaire by providing your honest and most accurate response regarding your experience after using the Content Storyboard Application. Your response is of great importance to us and we truly appreciate your time and effort in participating in this research.

Thank you.

Yours sincerely,

Wan Adli Ridzwan Wan Hassan
Masters of Computer Science
Faculty of Computer Science & Information Technology
University Malaya
Kuala Lumpur

Supervised by:
Pn. Suraya Hamid
Faculty of Computer Science & Information Technology
University Malaya
Kuala Lumpur
SECTION A: PARTICIPANT’S BACKGROUND
Please tick (✓) on the appropriate boxes.

1. What is your primary job scope in relation to e-learning content development?

- Instructional Designer
- Subject Matter Expert
- Multimedia Programmer
- Graphic Designer
- Others

2. How many years of experience do you have in relation to the job scope stated above?

- < 1 year
- 1 – 2 years
- 2 – 5 years
- 5 – 10 years
- More than 10 years

3. What is your highest tertiary education level?

- None
- Diploma
- Degree
- Masters
- Doctorate (PhD) or equivalent

Pedagogical Exposure

4. How many years of training experience do you have?

- None
- < 1 year
- 1 – 5 years
- 5 – 10 years
- More than 10 years

5. Do you have any knowledge on pedagogy or learning principles?

- Yes
- No
## IT Proficiency

6. How many years have you been using the computer?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1 year</td>
<td></td>
</tr>
<tr>
<td>1 - 2 years</td>
<td></td>
</tr>
<tr>
<td>2 – 5 years</td>
<td></td>
</tr>
<tr>
<td>5 – 10 years</td>
<td></td>
</tr>
<tr>
<td>More than 10 years</td>
<td></td>
</tr>
</tbody>
</table>

7. How many years have you been surfing the World Wide Web?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1 year</td>
<td></td>
</tr>
<tr>
<td>1 - 2 years</td>
<td></td>
</tr>
<tr>
<td>2 – 5 years</td>
<td></td>
</tr>
<tr>
<td>5 – 10 years</td>
<td></td>
</tr>
<tr>
<td>More than 10 years</td>
<td></td>
</tr>
</tbody>
</table>
## Application Functionality

Application Functionality

Use the following five point rating scale that is located below:

|----------------|------|----------|-------|----------------|

1. The application makes it easier to compose content according to learning principles.

2. Filling in the content templates was easy.

3. Using the Rich Text Editor was very useful compared to normal text field.

4. Navigating through content template was easy.

5. The Screen Manager was useful in rearranging content screens.

6. Removing unwanted screens was relatively easy.

7. Navigating through the entire application was relatively easy.

8. The on-screen instructions given were adequate in order to help one use the application without any human guidance.

9. The format used in the PDF output is easily understandable by the multimedia development team.

10. Does the application make you aware of the various components of the intended learning principles?

11. Overall, do you think the application was easy to use?
Collaboration

Use the following five point rating scale that is located below:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The application makes it easier for Instructional Designers to monitor the work of Subject Matter Experts.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. The application helps the collaboration between various parties (e.g. programmers, graphic designer) involved in content production.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. The discussion board was easy to use.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. The discussion board promotes all parties to contribute ideas better compared to normal face-to-face meetings/discussions.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. The screen discussion board was very useful during content production.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Opinion

Use the following five point rating scale that is located below:

|----------------|------|----------|-------|---------------|

1. Do you think using the application could reduce the amount of time it usually takes to produce content storyboards?

2. Do you think such an application will be able to lower the cost of content production?

3. Would you consider using this application in your professional work?

4. Would you recommend this application to other organisation?

5. Overall, how would you rate this application?

<table>
<thead>
<tr>
<th>Very Bad</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mediocre</td>
</tr>
<tr>
<td>Moderate</td>
</tr>
<tr>
<td>Good</td>
</tr>
<tr>
<td>Very Good</td>
</tr>
</tbody>
</table>
Open Ended Questions

1. What other recommendations would you like to make to the system?

2. Do you have any other comments regarding the system?
~ Thank you for your time and cooperation. ~
BIBLIOGRAPHY


