EFFECTS OF INTERACTIVE MULTIMEDIA AND TRADITIONAL MEDIA ON STUDENT ACHIEVEMENT:
AN EXPERIMENTAL STUDY

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Title

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AN EXPERIMENTAL STUDY

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The objectives of this study were to (1) compare the extent of student achievement within the cognitive and psychomotor domains upon use of an interactive digital game and printed media and (2) determine students’ attitudes toward use of an interactive digital game and printed media. Mixed methods research with pretest-posttest control group design was employed. Samples consisted of 60 Thai undergraduate students of Maejo University, Chiang Mai who were assigned to experimental and control groups by random sampling technique. The experimental group used Eternal Story digital game to learn selected lessons in Fundamental English while the control group used a print media to learn similar lessons. The instruments used in the study comprised of cognitive and psychomotor domain achievement tests and attitude questionnaires.

Statistically significant effects were found in the quantitative analysis of student achievement scores in the cognitive and psychomotor domains. Results of independent samples t-test showed that the interactive digital game was not as effective in increasing students’ cognitive and psychomotor domain achievement when compared with a print media. Print media users reported significant higher gain scores (p < .05) in the cognitive domain achievement test (\(\bar{X}=21.17\)) compared with the interactive digital game users (\(\bar{X}=12.17\)). Likewise, print media users reported significant higher gain scores (p < .05) in the psychomotor domain achievement test (\(\bar{X}=24.33\)) compared with the interactive digital game users (\(\bar{X}=18.17\)).

Descriptive analysis showed that the interactive digital game users attained a higher level of satisfaction compared with the print media users. The experimental group attained a total mean value of 4.07 while the control group attained a total mean value of 3.77.
Furthermore, thematic analysis on students’ attitudes indicated that almost all of the experimental group students responded positively to the benefits, features, and use of the interactive digital game. The students perceived the interactive digital game effective, engaging, and helpful in improving knowledge and skills. On the other hand, almost all of the control group students responded positively to the benefits, features, and use of the print media. The students perceived the content of the print media easy to understand because of the organization, lay-out, design, and availability of Thai translations. The control group students also perceived the print media effective, engaging, and helpful in improving knowledge and skills.
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CHAPTER 1

INTRODUCTION

Background of the Study

Effective communication involves effective information delivery and meaningful user interaction between audience and the channel in a communication environment. In traditional instructional settings, the delivery of information is carried out by an instructor using non-interactive, communication materials. With the integration of new information technologies and new communication media, new computer-supported learning environments and learning technologies have emerged. One such learning technology is the digital game.

Digital games are known for its potential in providing high levels of engagement and entertainment among its users. As an example, more than 11 million subscribers spend an average of 23 hours per week immersed in World of Warcraft (John & John, 2009). The digital game industry is also considered to be a multibillion-dollar entertainment industry that often exceeded the movie industry (Kirriemuir, 2002).

Aside from providing entertainment, digital games have been discussed to promote higher-order skills such as the ability to think, collaborate, solve complex problems, or communicate through media which many experts believed to be the skills needed in the twenty-first century. Moreover, digital games provide individualized instruction (Switzer, 2004: 225–233), a place for social interaction (Oliver & Carr, 2009: 444-457), and a tool for encouraging learning across a variety of domains (Barab & Squire, 2004; Barab, Thomas, Dodge, Carteaux and Tuzun, 2005: 86–107; Virvou, Katsionis and Manos, 2004).

For example, Immune Attack (www.fas.org/immuneattack), BBC!History Games (http://www.bbc.co.uk/history/interactive/games/), United Nations Cyberschool Bus Games (http://www.un.org/Pubs/CyberSchoolBus/), Quest Atlantis (http://atlantis.crlt.indiana.edu) and Food Force (www.food-force.com), are digital games developed for educational purposes. These games usually require the use of memory, problem solving, logic, critical thinking skills, and discovery (Annetta and Meng-Tzu, 2008: 1-11).
Much of the current state of knowledge concerning the advantage of digital games is that games tend to promote high levels of engagement, thus making the learning experience more motivating and appealing (Barab & Squire, 2004) and improving participation and achievement (Klave, 1999; Kambouri, Thomas and Mellar, 2006: 395–410; Hämäläinen, Manninen, Järvelä, and Häkkinen, 2006: 47–61). Furthermore, several studies in the field of cognitive science and educational psychology have provided additional dimensions to the study of digital games by focusing on instructional design, learners’ prior knowledge, or user interaction with virtual environments. The cognitive theory of multimedia learning, for example, posits that learning occurs when instructional messages in multimedia like digital games are presented using words and pictures than words alone (Mayer, 1999: 7-20). In this case, words can be printed text or spoken text while pictures can be illustrations, photos, charts, animation or video. Furthermore, the theory argues that multimedia messages that are designed in light of how people process information are more likely to lead to meaningful learning (Mayer, 1999: 7-20).

Statement of the Problem

Although most agree that digital games are effective in enhancing motivation and increasing student interest in a subject matter, the extent to which this translates into more effective learning is less clear (Annetta, 2008: 229-239). In connection with this, this study investigated whether an interactive digital game, designed to motivate students and present instructional messages using on-screen texts, improved learning achievement in the cognitive and psychomotor domains compared with a traditional print media which presented instructional messages using texts and pictures. Students’ attitudes toward the use of the interactive digital game and print media were also explored.

Significance of the Study

Identifying whether or not digital games are associated with increased scores on academic assessments when compared to traditional forms of learning media will contribute to the research literature about the effectiveness of digital games in relation to its learning outcomes.
Since digital games are now embraced by the education sector as a highly interactive media that can support and foster learning, it is but important to assess digital game’s effects not only on students’ ability to recall information but also on students’ ability to perform learned information. This study may tap teachers, learning technologists or instructional designers to develop multimedia presentations that are consistent with how the human mind works when learning with multimedia tools particularly with interactive digital games. Moreover, this study would be helpful to future researchers who wish to study the effects of interactive multimedia and traditional media on learning.

Objectives of the Study

This study aims to evaluate the effects of an interactive digital game and traditional media on students’ achievement and satisfaction. Specifically, this study aims to:

1. Compare the effects of an interactive digital game and traditional media on students’ achievement in the cognitive domain;

2. Compare the effects of an interactive digital game and traditional media on students’ achievement in the psychomotor domain;

3. Determine the attitudes of student participants toward the interactive digital game and booklet in terms of the affective domain and identify students’ level of satisfaction toward the use of the interactive digital game and traditional media in the following aspects:
   3.1 Usability
   3.2 Content
   3.3 Engagement
   3.4 Interface

Scope of the Study

This study attempted to evaluate the effects of an interactive digital game and traditional media on student achievement in the cognitive and psychomotor domains. A high quality 3D Massive Multiplayer Online Role Playing Game (MMORPG) was used in comparison
with a booklet. These two learning media contained similar lessons on Fundamental English. The lessons were References, Topic, and Main Idea. Student achievement was measured based on the acquired knowledge and skills on these lessons.

Scope of Content

1. Cognitive Domain: This study covered the assessment of the knowledge gained by the sample respondents concerning the learning contents included in the interactive digital game and booklet. These contents were (1) References (2) Topic, and (3) Main Idea. The first three levels of Bloom et. al.’s (1956) Taxonomy of the Cognitive Domain namely knowledge, comprehension, and application were the basis for evaluation.

2. Psychomotor Domain: This study covered the assessment of the skills acquired by the sample respondents concerning the learning contents included in the interactive digital game and booklet. These contents were (1) References (2) Topic, and (3) Main Idea. The first two levels of Dave’s (1970) Taxonomy of the Psychomotor Domain namely imitation and manipulation were the basis for evaluation.

3. Affective Domain: This study covered the assessment of emotional responses of the sample respondents toward the interactive digital game and booklet. The first three levels of Krathwohl’s (1964) Taxonomy of the Affective Domain namely receiving, responding, and valuing were the basis for evaluation. Moreover, this study covered the assessment of the level of satisfaction of sample respondents toward the use of the interactive digital game and booklet. The aspects of usability, content, engagement, and interface were the basis for evaluation.

Scope of Population and Research Sample

This study focused on undergraduate Thai students studying PS 103 under the School of Administrative Studies, Maejo University. Chiang Mai, Thailand during the Academic Year 2011-2012.
Scope of Location

This study was conducted at Maejo University, Chiang Mai, Thailand.

Scope of Duration

This study was conducted during the period of October 2011 to October 2012.

Expected Results of the Study

1. Instructional Designers, Learning Technologists, or Teachers
   1.1 Increased information regarding the effects of interactive multimedia, particularly of digital games, on students’ learning achievement in the cognitive and psychomotor domains.
   1.2 Increased information regarding students’ attitudes and satisfaction toward interactive digital games versus traditional media.
   1.3 Increased information regarding the effectiveness of interactive digital games on student learning. This could provide universities additional support in funding ICT-based education programs including digital game development and research.
   1.4 Increased information regarding effective use of instructional methods in multimedia presentations or lessons.
   1.5 Results of this study could provide practical implications toward enhanced teaching and learning with multimedia.

2. Students and Future Researchers
   2.1 Results of this study will be helpful to future researchers who wish to investigate the effects of interactive digital games on student achievement.
   2.2 The developed cognitive and psychomotor achievement test may be used for future assessment of knowledge and skills acquired.
   2.3 The developed attitude questionnaires may be used for future assessment of students’ attitudes toward interactive digital games or traditional media.
2.4 The developed satisfaction scale may be utilized for future assessment of students' level of satisfaction in terms of the usability, content, engagement, and interface of an interactive digital game or traditional media.

**Definition of Terms**

**Operational Definition of Terms**

Cognitive Domain Achievement involves knowledge and the development of intellectual skills. This includes the recall or recognition of specific facts, procedural patterns, and concepts that serve in the development of intellectual abilities and skills (Bloom, 1956). In this study, it refers to the knowledge gained by sample respondents concerning References, Topic, and Main Idea.

Knowledge level is defined as remembering of previously learned material. It represents the lowest level of learning outcomes in the cognitive domain.

Comprehension level is defined as the ability to grasp the meaning of a material. This level is one step beyond the simple remembering of material.

Application level refers to the ability to use learned material in new and concrete situations. This level requires a higher level of understanding than the comprehension level.

Psychomotor Domain Achievement refers to the application of previously learned knowledge and skills to new situations after the learning event. In this study, it refers to the skills gained by sample respondents concerning the use of References, Topic, and Main Idea.

Imitation refers to the ability to observe and pattern a certain action or behavior.

Manipulation refers to the ability to perform certain actions by following instructions.

Affective Domain includes the manner in which people deal with things emotionally, such as feelings, values, appreciation, enthusiasms, motivations, and attitudes. In
this study, it refers to the emotional responses of the sample respondents toward the use of the interactive digital game and booklet.

Receiving refers to the emotional responses of the learners relating to their selected attention, awareness, and willingness to hear.

Responding refers to the active participation on the part of the learners. It is the attention and reaction of learners to a particular phenomenon.

Valuing refers to the worth or value a student attaches to a particular object, phenomenon, or behavior.

Learning Achievement refers to the knowledge and skills that the students have attained as a result of their involvement in an instructional session.

**General Definition of Terms**

Interactive Multimedia refers to the Eternal Story digital game developed and owned by the Information and Technology Service Center, Chiang Mai University and Thai Cyber University, Commission on Higher Education. This game was used by the experimental group of this study.

Traditional Media refers to the Let’s Learn English! booklet developed by the researcher that was used by the control group of this study.

PS 103 refers to the elective course on International Relations taken by undergraduate students of Maejo University, Chiang Mai, Thailand.

Interactive Digital Game refers to an electronic medium in which players engage in an artificial conflict, defined by rules that have intended educational outcomes targeted at specific groups of learners.

Cognitive Theory of Multimedia Learning an explanation of how people learn based on the idea of dual channels (information is processed in visual and auditory channels), limited capacity (only a small amount of information can be processed in each channel at one time), and active learning (meaningful learning occurs when learners pay attention to relevant information, organize it into a coherent structure, and integrate it with what they already know).
Active Processing refers to a psychological principle stating that learning occurs when people engage in appropriate mental processing during learning, such as attending to relevant materials, responding to practice exercises, reflecting on examples.

Working Memory refers to a part of the cognitive system in which the learner actively (consciously) processes incoming information from the environment and retrieves information from long-term memory. Working memory has two channels (visual and auditory) and is limited in capacity.
CHAPTER 2

LITERATURE REVIEW

This chapter provides a review of major issues associated with interactive multimedia, digital games, and learning. Theoretical and empirical aspects of the cognitive theory of multimedia learning are addressed. Moreover, this chapter presents similar conducted studies related to interactive digital games and learning. This chapter is divided into the following:

1. Cognitive Theory of Multimedia Learning
2. Effects of Multimedia on Learning
3. Interactive Multimedia
4. Digital Games
5. Digital Games and Learning
6. Learning Taxonomies
7. Related Studies
8. Conceptual Framework

Cognitive Theory of Multimedia Learning

Multimedia instructional environments are widely recognized to hold great potential for improving the way people learn (Mayer, 1999: 7-20). In multimedia instructional environments, learners are exposed to materials in verbal (such as on-screen text or narration) as well as pictorial form (including static materials such as photos or illustrations, and dynamic materials such as video or animation).

Cognitive researchers see learning as an internal process, and contend that the amount learned depends on the processing capacity of the learner, the amount of effort expended during the learning process, the depth of processing (Craik & Lockhart, 1972: 671-684; Craik & Tulving, 1975: 268-294), and the learner’s existing knowledge structure (Ausubel, 1974: 47-55). The term cognitive refers to perceiving and knowing, and cognitive scientists seek to understand mental processes such as perceiving, thinking, remembering, understanding language, and learning (Stillings, Weisler, Chase, Feinstein, Garfield & Rissland, 1995).
The cognitive theory of multimedia learning posits that learners attempt to build meaningful connections between words and pictures and that they learn more deeply than they could have with words or pictures alone (Mayer, 2003: 297-313). Based on this premise, Mayer (2003: 297-313) developed a model of how people learn from multimedia lessons that have served as the basis for most multimedia learning studies. Mayer calls for instruction with multimedia methods that are based on empirical evidence.

Based from figure 1, multimedia presentations usually contain graphics and words (in printed or spoken form). In the second column, the graphics and printed words enter the learner’s cognitive processing system through the eyes, and spoken words enter through the ears. Some of the material is selected for further processing in the learner’s working memory if the learner pays attention. Mayer (2003: 297-313) asserts that working memory is severely limited in both capacity and duration when handling new information. While the senses holds an exact sensory copy of what was presented for less than .25 of a second, working memory holds a processed version of what was presented for generally less than thirty seconds and can process only a few pieces of material at any one time. Finally, the learner can connect the incoming material with existing knowledge from long-term memory, which is the learner’s storehouse of knowledge.

Generally, the sensory memory serves as the cognitive structure that allows us to attend or perceive new information, working memory as the cognitive structure in which we consciously process information, and long-term memory as the cognitive structure that stores our knowledge base. Therefore, the cognitive theory of multimedia learning argues that meaningful learning occurs when words and pictures in a lesson are transformed and processed through the working memory so that they are incorporated into the existing knowledge in long-term memory (Clark & Mayer, 2008: 37). These events rely on the following processes:

1. Selection of the important information in the lesson,

2. Management of the limited capacity in the working memory to allow the rehearsal needed for learning,

3. Integration of auditory and visual sensory information in working memory with existing knowledge in long term memory by way of rehearsal in working memory, and
4. Retrieval of new knowledge and skills from long term memory into working memory when needed later.

**Figure 1** Cognitive Theory of Multimedia Learning (Mayer, 2003: 129)

**Assumptions of Cognitive Theory of Multimedia Learning**

In explaining the model of the cognitive theory of multimedia learning, it is essential to understand its four guiding principles or assumptions. These assumptions are based from research in cognitive science:

1. Dual-channels – the idea that people have separate channels for processing visual/pictorial materials and auditory/verbal materials (Paivio, 1969: 241-263). Information that is represented in both channels is more likely to be recalled than information that is stored in either format alone.

2. Limited capacity – the idea that people can actively process only a few pieces of information in each channel at one time (Sweller, J, van Merrienboer, J.J. & Paas, 1998: 251–296)

3. Active processing – the idea that meaningful learning occurs when people engage in appropriate cognitive processes during learning such as attending to relevant material, organizing it into a coherent structure, and integrating it with existing knowledge (Mayer, 1999: 7-20; Wittrock, 1989: 345–376)
4. Transfer — the idea that new knowledge and skills must be retrieved from long-term memory during performance (Clark & Mayer, 2008: 36).

**Limited Cognitive Resources during Multimedia Learning**

It is essential to note that during multimedia learning, learners have a working memory with very limited capacity and duration when handling new information (Sweller, van Merriënboer, J.J. & Paas, 1998: 251–296). The consequence of this is when a person reaches the limits of attention and working memory capacity, performance declines exponentially. In other words, people can actively process only a few pieces of information in each channel one at a time (Mayer, 1999: 7-20). Therefore, the challenge for the learner is to carry out these processes within the constraints of severe limits on how much processing can occur in each channel at one time. According to Clark & Mayer (2008: 36), there are three kinds of demands on cognitive processing capacity:

1. Extraneous processing — is cognitive processing that does not support the instructional objective and is created by poor instructional layout;

2. Essential processing — is cognitive processing aimed at mentally representing the core material (consisting mainly of selecting the relevant material) and is created by the inherent complexity of the material; and

3. Generative processing — is cognitive processing aimed at deeper understanding of the core material (consisting mainly of organizing and integrating) and is created by motivation of the learner to make sense of the material.

Mayer (2003: 57) made this model the organizing framework for the cognitive theory of multimedia learning and stated that a major goal of multimedia learning and instruction is to manage essential processing, reduce extraneous processing and foster generative processing. The model is heavily based on Sweller’s cognitive load theory (Chandler & Sweller, 1991: 293–332).
Transfer of Learning

Transfer is undoubtedly a key concept in multimedia learning because the major desired outcome of instruction through multimedia presentations is the ability of the user to transfer what is learned from one interaction to a new situation. Transfer of learning or "transfer" broadly means the ability of learners to apply knowledge or procedures learned in one context to new contexts. Cormier and Hagman (1987: xi) suggest that transfer of learning is one of the most general phenomena of learning and, by means of its influence, almost all learned behavior is interrelated in complex ways.

Many of the differences lead to distinctions in how transfer is classified depending on the level of complexity of the transfer. Specifically for multimedia lessons, Clark & Mayer (2008: 217) distinguished two types of transfer when multimedia lessons are designed primarily to build awareness or provide information. These are near transfer and far transfer. Near transfer occurs when learners transfer previous knowledge to new situations closely similar to, yet not identical to, initial situations. For example, lessons designed to teach students step-by-step tasks which are performed more or less the same way each time. Far transfer entails the application of learning to situations entirely dissimilar to the initial learning. This level of transfer of learning reflects analogical reasoning. For example, learning about logarithms in algebra and applying this knowledge in assessing the growth of bacteria in microbiology.

Transfer is especially important to learning theory and educational practice because very often the kinds of transfer hoped for do not occur. As a result, researchers identified major factors that influence a learner's ability to understand or apply new knowledge:

1. The nature of the initial learning experience,
2. The contexts for both the initial learning and the new situation to which it may apply,
3. The ability of learners to see similarities and differences across situations, and
4. Learners' metacognitive abilities to reflect on and monitor their own learning.

To summarize, for transfer to occur, learning must involve more than simple memorization or applying a fixed set of procedures. Learners must understand a concept or have command of a skill in order to be able to use it themselves. They must know how to apply what
they have learned to new situations or problems, and they must know when it applies. (Bransford, Brown, & Cocking, 2000: 55).

**Effects of Multimedia on Learning**

It is emphasized that, in applying cognitive theory of multimedia learning, one should carefully consider or examine the conditions under which multimedia promotes learner understanding. The theory considers twelve principles of using multimedia as a tool that improves learning: multimedia principle, coherence principle, redundancy principle, spatial contiguity principle, temporal contiguity principle, modality principle, signaling principle, segmenting principle, pre-training principle, personalization principle, voice principle, and image principle. Based on these principles, researchers have built multimedia learning hypotheses and tested them. In this section, each principle will be explicated along with a summary of evidence-based researches.

**Multimedia Principle**

Multimedia principle is arguably the foundation of the cognitive theory of multimedia learning. This principle states that people learn more deeply from words and graphics than from words alone (Mayer, 2003: 297-313). In this case, words can be in the form of on-screen text or audio and pictures in the form of static images or motion images such as videos or animations. The basic assumption for the multimedia principle is that people are more likely to understand material when they can engage in active learning – that is, when they engage in relevant cognitive processing such as attending to the relevant material in the lesson, mentally organizing the material into a coherent cognitive representation, and mentally integrating the material with their existing knowledge.

To test the multimedia principle, researchers compared the test performance of students who learned using animation and narration versus narration alone or from text and illustrations versus text alone (Mayer, 1989: 43–64; Mayer & Anderson, 1991: 312–320, 1992; Mayer, Bove, Bryman, Mars, & Tapangco, 1996: 64–73; Mayer & Gallini, 1990: 64–73; Moreno
& Mayer, 1999a: 358–368). For example, in one study students read an accurate verbal description of how a bicycle pump works while others read the same verbal description and viewed a diagram depicting the same steps. In all eleven comparisons, students who received a multimedia lesson consisting of words and pictures performed better on a subsequent transfer test than students who received the same information in words alone (Clark & Mayer, 2008: 66). In a related study involving interactive multimedia, Moreno and Mayer (1999b: 215–248) developed a mathematics computer game intended to teach students how to add and subtract signed numbers (such as $2 - 3 = \underline{\hspace{2cm}}$). Some students learned from drill-and-practice problems, whereas others worked on the same problems, but as feedback also saw a bunny hop along a number line to represent each problem (such as starting at 2, turning to face the left, hopping backward three steps, and landing on 5). Students learned better with symbols and graphics than from symbols alone (Clark & Mayer, 2008: 66).

Providing relevant graphics with text is a proven method of fostering deeper cognitive processing in learners. In short, learning is facilitated when the graphics and text work together to communicate the instructional message. Moreover, Clark (2007), indicated in Clark & Mayer (2008: 60-64), presented the use of graphics with an instructional rather than decorative role:

1. Graphics to teach content types - Table 1 summarizes each content type and lists graphic types commonly used to teach specific types of lessons.

**Table 1: Graphics to Teach Content Types**

<table>
<thead>
<tr>
<th>Content Type</th>
<th>Description</th>
<th>Useful Graphic Types</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facts</td>
<td>Unique and isolated information such as specific application screens, forms, or product data</td>
<td>Representational, Organizational</td>
<td>Screen captures; A table of parts’ names and specifications</td>
</tr>
<tr>
<td>Concepts</td>
<td>Groups of objects, events, or symbols designated by a single name</td>
<td>Representational, Organizational, Interpretive</td>
<td>Diagrams; A tree diagram of biological species</td>
</tr>
</tbody>
</table>
Table 1 (Continued)

<table>
<thead>
<tr>
<th>Content Type</th>
<th>Description</th>
<th>Useful Graphic Types</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>A description of how something works</td>
<td>Transformational, Interpretive, Relational</td>
<td>Animations of how the blood pumps blood; Still diagrams to illustrate how a bicycle pump works</td>
</tr>
<tr>
<td>Procedure</td>
<td>A series of steps resulting in completion of task</td>
<td>Transformational</td>
<td>An animated illustration of how to use a spreadsheet; A diagram with arrows showing how to install a printer cable</td>
</tr>
<tr>
<td>Principle</td>
<td>Guidelines that result in completion of a task; cause-and-effect relationships</td>
<td>Transformational, Interpretive</td>
<td>A video showing two effective sales approaches; an animation showing genes passing from parents to offspring</td>
</tr>
</tbody>
</table>

**Remark:** Adapted from E-learning and the Science of Instruction (Clark & Mayer, 2008: 61; Clark, 2007)

2. Graphics as topic organizers — in addition to illustrating specific content types, graphics such as topic maps can serve an organizational function by showing relationships among topics in a lesson.

3. Graphics to show relationships — graphics in the form of dynamic and static graphs can make invisible phenomena visible and show relationships. For example, a geographic map can illustrate population density by adding a small red dot to represent five thousand individuals. If made interactive, the map could include a slider bar that accessed different time periods, allowing the viewer to see population shifts over time.

4. Graphics as lesson interfaces — courses designed using a guided discovery approach often use a graphical interface as a backdrop to present case studies.
Clark & Mayer (2008: 57) argued that not all kinds of graphics are equally important. They presented several possible functions of graphics (Clark & Mayer, 2008: 58):

1. Decorative graphics – serve to decorate the page without enhancing the message of the lesson, such as a photo or a video of a person riding a bicycle in a lesson on how bicycle tire pumps work;

2. Representational graphics – portray a single element, such as a photo of the bicycle tire pump along with a caption, “bicycle tire pump”;

3. Relational graphics – portray a quantitative relation among two or more variables, such as a line graph showing the relation between years of age on the x-axis and probability of being in a bicycle accident on the y-axis;

4. Organizational graphics – depict the relations among elements, such as a diagram of a bicycle tire pump with each part labeled or a matrix giving a definition and example of each of three different kinds of pumps;

5. Transformational graphics – depict changes in an object over time, such as a video showing how to fix a flat tire, or a series of annotated frames showing steps in how a bicycle tire pump works; and

6. Interpretive graphics – illustrate invisible relationships such as an animation of the bicycle pump that includes small dots to show the flow of air into and out of the pump.

Based on this analysis, Clark & Mayer (2008: 58) suggested that graphics that decorate the page should be minimized (decorative graphics) or simply represent a single object (representational graphics), and graphics that help the learner understand the material should be incorporated (organizational graphics). Providing relevant graphics with text is a proven method of fostering deeper cognitive processing in learners. In short, learning is facilitated when the graphics and text work together to communicate the instructional message.

According to Clark & Mayer (2008), there is increasing evidence that the multimedia principle is specifically important for learners who have low knowledge of the subject matter or “novices”, rather than learners who have high knowledge of subject matter or “experts”. In a series of experiments involving lessons on brakes, pumps, and generators, Mayer and Gallini (1990) reported novices learned better from text and illustrations than from words alone, but experts learned equally well from either condition. Their results showed that experts or advanced
learners were able to create their own mental images as they read the text about how the pump works, whereas the less experienced learners need help in relating the text to a useful pictorial representation.

**Spatial Contiguity Principle**

Spatial contiguity principle states that learners are better able to build mental connections when on-screen words are placed near the parts of the on-screen graphics to which they refer. The psychological advantage of integrating text and graphics results from a reduced need to search for which parts of a graphic correspond to which words, which allows the user to devote limited cognitive resources to understanding the materials (Clark & Mayer, 2008: 80). This principle is not only based on cognitive theory, but it is also based on several relevant research studies (Mayer, 1989b: 240–246; Mayer, Steinmoff, Bower, & Mars, 1995: 31–43; Moreno & Mayer, 1999b: 215–248). In five different tests involving lessons on lightning formation and how cars’ braking systems work, learners received printed text and illustrations containing several frames (or on-screen text with animation). For one group of learners (integrated group), text was placed near the part of the illustration that it described. For another group (separated group), the same text was placed under the illustration as a caption. In five studies, the integrated group performed better on problem-solving transfer tests than the separated group. Overall, the integrated group produced between 43 and 89 percent more solutions than the separated group. The median gain across all the studies was 68 percent for an effect size of 1.12, which was a large effect (Clark & Mayer, 2008: 92). In summary, Clark and Mayer (2008: 92) argued that texts could be broken into chunks and placed near the part of the graphic that it describes.

**Temporal Contiguity Principle**

Temporal contiguity principle states that people learn more deeply when corresponding graphics and words are presented at the same time. Research by Baggett (1984: 408–417) and Baggett and Ehrenfeucht (1983: 23–32) shows that learners experience difficulty in
learning from a narrated video, even when corresponding words and graphics are separated by a few seconds. When you have a narrated animation, narrated video, or even a narrated series of still frames, there is consistent evidence that people learn best when the words describing an element or event are spoken at the same time that the animation (or video or illustration) depicts the element or event on the screen. Moreover, in one experiment, some students (integrated group) viewed a 30-second narrated animation that explained how a bicycle tire pump works, in which the spoken words described the actions taking place on the screen. The animation on the screen showed the inlet valve moving from the closed to the open position. Other students (separated group) listened to the entire narration and then watched the entire animation (or vice versa). On a subsequent transfer test, the integrated group generated 60 percent more solutions than did the separated group, yielding an effect size greater than 1, which is considered large (Mayer & Anderson, 1991: 312–320; Mayer & Sims, 1994: 389–401; Mayer, Moreno, Boire, & Vagge, 1999: 638–643). There is consistent evidence that people learn best when the words describing an element or event are spoken at the same time that the animation (or video or illustration) depicts the element or event on the screen.

In explaining the principle of spatial and temporal contiguity, people must use their scarce cognitive resources to match them up when words and pictures are separated from one another on the screen or in time. This is turn creates extraneous processing, a cognitive processing that is unrelated to the instructional goal. When learners use their limited cognitive capacity for extraneous processing, they have less capacity to use to mentally organize and integrate material. In contrast, when words and pictures are integrated, people can hold them together in their working memories and therefore make meaningful connections between them. This act of mentally connecting corresponding words and pictures is an important part of the sense-making process that leads to meaningful learning (Clark & Mayer, 2008: 90).

Modality Principle

Modality principle states that people learn better from animation and audible narration than from animation and on-screen or printed text. This principle is similar to Clark and Paivio’s dual coding theory which demonstrated that learners do better when both the visual and
auditory perceptions are activated instead of having text and graphics both competing for attention by the learner’s visual channel alone. Multimedia lessons that present words as on-screen text can conflict with the way the human mind works. According to the cognitive theory of learning, people have separate information processing channels for visual/pictorial processing and for auditory/verbal processing. When learners are given concurrent graphics and on-screen text, both must be initially processed in the visual/pictorial channel. The capacity of each channel is limited, so the graphics and their explanatory on-screen text must compete for the same limited visual attention. When the eyes are engaged with on-screen text, they cannot simultaneously be looking at the graphics; when the eyes are engaged with the graphics, they cannot be looking at the on-screen text. Thus, even though the information is presented, learners may not be able to adequately attend to all of it because their visual channels become overloaded (Clark & Mayer, 2008: 100). Also, the psychological advantage of using audio results from the incoming information being split across two separate cognitive channels, which is the words in the auditory channel and pictures from the visual channel, rather than concentrating both words and pictures in the visual channel. Based on the cognitive theory and evidence, Clark & Mayer (2008: 105) asserts that words should be in spoken form rather than in printed form whenever the graphic (animation, video, or series of static frames) is the focus of the words and both are presented simultaneously.

In a study on the modality effect involving paper-based printed materials, Mousavi, Low, and Sweller (1995: 319–334) presented worked-out examples of geometry problems, described with a concurrent oral explanation or described with the same explanation printed on the page. When the words were spoken rather than printed, students performed much better on subsequent problem-solving tests involving geometry problems.

Redundancy Principle

Redundancy principle states that people learn better from concurrent graphics and audio than from concurrent graphics, audio, and on-screen-text. According to the cognitive theory of multimedia, adding redundant on-screen text to a multimedia presentation could overload the visual channel. For example, in a multimedia presentation containing animation,
narration, and concurrent on-screen text, the animation enters the learner's cognitive system through the eyes and is processed in the visual/pictorial channel, whereas the narration enters the learner's cognitive system through the ears and is processed in the auditory/verbal channel. However, the on-screen text also enters through the eyes and must be processed (at least initially) in the visual/pictorial channel. Thus, the limited cognitive resources in the visual channel must be shared in processing both the animation and the printed text. If the pace of presentation is fast and learners are unfamiliar with the material, learners may experience cognitive overload in the visual/pictorial channel. As a result, some important aspects of the animation may not be selected and organized into a mental representation. However, when only narration and animation are presented, the animation enters through the eyes and is processed in the visual/pictorial channel, whereas the narration enters through the ears and is processed in the auditory/verbal channel. The chances for overload are minimized, so the learner is more able to engage in appropriate cognitive processing. Thus, the cognitive theory of multimedia learning predicts that learners will learn more deeply from multimedia presentations in which redundant on-screen text is excluded rather than included (Clark & Mayer, 2008: 117).

In a recent set of studies (Mayer, Heiser, & Lonn, 2001: 187-198; Moreno & Mayer, 2002b: 156–163), some students (non-redundant group) viewed an animation and listened to a concurrent narration explaining the formation of lightning. Other students (redundant group) received the same multimedia presentation, but with concurrent, redundant on-screen text. In this series of four comparisons, students in the non-redundant group produced more solutions (ranging between 43 to 69 percent more) on a problem-solving transfer test than did students in the redundant group. The median effect size was greater than 1, which is considered to be large. More recently, Kalyuga, Chandler, and Sweller (2004: 567–581) found similar results in three additional experiments involving technical trainees learning how to set controls on power machinery for cutting. In this case, simply presenting the text after presenting the narration resulted in better test performance than presenting them at the same time, yielding a median effect size of .8. Overall, these kinds of results support the conclusion that, in some cases, less is more. Because of the limited capacity of the human information processing system, it can be better to present less material (graphics with corresponding narration) than more material (graphics with corresponding narration and printed text).
Coherence Principle

Coherence principle states that people learn more deeply when extraneous words, pictures, and sounds, are excluded rather than included. First, the inclusion of extraneous background music and sounds to a multimedia presentation will be examined. The theoretical rationale against adding music and sounds to multimedia presentations based on the cognitive theory of multimedia learning assumes that working memory capacity is highly limited. According to Clark & Mayer (2008: 133), background music and sounds may overload working memory, so they are most dangerous in situations in which the learner may experience heavy cognitive load, for example, when the material is unfamiliar, when the material is presented at a rapid rate, or when the rate of presentation is not under learner control. Therefore, the cognitive theory of multimedia learning predicts that students will learn more deeply from multimedia presentations that do not contain interesting but extraneous sounds and music than from multimedia presentations that do (Clark & Mayer, 2008: 133). To test this hypothesis, Moreno and Mayer (2000a: 117–125) began with a three-minute narrated animation explaining the process of lightning formation and a 45-second narrated animation explaining how hydraulic braking systems work. They created a music version of each by adding a musical loop to the background. The music was an unobtrusive instrumental piece, played at low volume that did not mask the narration nor make it less perceptually discernible. Students who received the narrated animation remembered more of the presented material and scored higher on solving transfer problems than students who received the same narrated animation along with background music. The differences were substantial—ranging from 20 to 67 percent better scores without music—and consistent for both the lightning and brakes presentations. Clearly, adding background music did not improve learning, and in fact, substantially hurt learning.

Another explanation for the coherence principle is that extraneous graphics can be distracting and disruptive of the learning process. Pictures including color photos and action video clips can make a multimedia experience more interesting. This assertion follows the arousal theory which states that students learn better when they are emotionally aroused. Arousal theory predicts that adding interesting but extraneous pictures will promote better learning. On the other hand, the cognitive theory of multimedia learning assumes that the learner is actively seeking to
make sense of the presented material. If the learner is successful in building a coherent mental representation of the presented material, the learner experiences enjoyment. However, adding extraneous pictures can interfere with the process of sense-making because learners have a limited cognitive capacity for processing incoming material (Clark & Mayer, 2008: 140). According to Harp and Mayer (1998: 414–434), extraneous pictures (and their text captions) can interfere with learning in three ways:

1. Distraction – by guiding the learner's limited attention away from the relevant material and toward the irrelevant material;

2. Disruption – by preventing the learner from building appropriate links among pieces of relevant material because pieces of irrelevant material are in the way; and

3. Seduction – by priming inappropriate existing knowledge (suggested by the added pictures), which is then used to organize the incoming content.

Thus, adding interesting but unnecessary materials including sounds, pictures, or words to a multimedia presentation can harm the learning process by preventing the learner from processing the essential material. The cognitive theory of multimedia learning, therefore, predicts that students will learn more deeply from multimedia presentations that do not contain interesting but extraneous photos, illustrations, or video (Clark & Mayer, 2008: 133-154). In a research conducted by Harp and Mayer (1997: 1–19), some students were asked to read a 550-word, six-paragraph passage containing six captioned illustrations. The passage described the cause-and-effect sequence leading to lightning formation, and the captioned illustrations depicted the main steps (with captions that repeated the key events from the passage). Each illustration was placed to the left of the paragraph it depicted. Other students read the same illustrated passage, along with six color pictures intended to spice up the presentation. Each picture was captioned and was placed to the right of a paragraph to which it was related. For example, next to the paragraph about warm moist air rising, there was a color photo of an airplane being hit by lightning accompanied by the following text: "Metal airplanes conduct lightning very well, but they sustain little damage because the bolt, meeting no resistance, passes right through." In another section of the lesson, a photo of a burned uniform from a football player stuck by lightning was included. Students who received the lightning passage without added color photos performed better on retention and transfer tests than students who received the lightning passage with color photos,
generating about 52 percent more solutions on the transfer test, which translates into an effect size greater than 1 (Clark & Mayer, 2008: 144).

The third explanation for the coherence principle is that adding extra words can interfere with the learning process. Clark and Mayer (2008: 144) addressed three types of extraneous wording. First, additional words may be added for interest. The extra words are related to the topic but are not relevant to the primary instructional goal. Second, extra words may be added to expand on the key ideas of the lesson. A third purpose for extra words is to add technical details that go beyond the key ideas of the lesson. Subject-matter experts like to incorporate considerable amounts of technical information that expands on the basics. Clark & Mayer (2008: 145) recommend against extraneous words added for interest, for elaboration, or for technical depth.

Moreover, Mayer, Heiser, and Lonn (2001: 187-198) asked some students to view a three-minute narrated animation about lightning formation. Other students viewed the same three-minute presentation, but with six additional narration segments inserted at various points. The narration segments were short and fit within the three-minute presentation at points that otherwise were silent. For example, after saying that water vapor forms a cloud, the narrator added: “On a warm cloudy day, swimmers are sitting ducks for lightning.” Similarly, after saying that electrical charges build in a cloud, the narrator added: “Golfers are vulnerable targets because they hold metal clubs, which are excellent conductors of electrical charge.” Students who received the lightning presentation without additional narration segments performed better on transfer tests than students who received the lightning presentation with added narration segments generating about 34 percent more solutions on the transfer test, which translated into an effect size of .66. These result showed that adding interesting but irrelevant material does not help learning, and in this case even hurts learning (Clark & Mayer, 2008: 149).

Segmenting Principle

Segmenting principle states that people learn better when multimedia messages are presented in a user-paced format rather than as a continuous unit. Clark and Mayer (2008: 185) asserted that if a learner is unfamiliar with the material, he or she may need time to
consolidate what was just presented. In short, when an unfamiliar learner receives a continuous presentation containing a lot of interrelated concepts, the likely result is that the cognitive system becomes overloaded—too much essential processing is required. In short, the learner does not have sufficient cognitive capacity to engage in the essential processing required to understand the material. Thus, the rationale for using segmenting is that it allows the learner to engage essential processing without overloading the learner’s cognitive system. In a set of studies (Mayer, Dow, & Mayer, 2003: 806–813), students learned how an electric motor works by watching a continuous narrated animation or by watching a segmented version. In the segmented version, the learner could click on a question and then see part of the narrated animation, click on another question and see the next part, and so on. The material was identical for both the continuous and segmented versions, but learners performed much better on transfer tests if they had received the segmented lesson. Overall, in three out of three studies the results provided strong positive effects for segmenting, yielding a median effect size of about 1.

**Pre-training Principle**

Pre-training principle states that people learn more deeply from a multimedia message when they receive pre-training in the names and the characteristics of the key concepts in a lesson (Clark & Mayer, 2008: 190-193). For example, before viewing a narrated animation on how the digestive system works, learners could receive pre-training in which they learn the names and locations of key body parts such as the esophagus, epiglottis, trachea, pharynx, upper esophageal sphincter, lower esophageal sphincter, and stomach. The pre-training principle is relevant in situations in which trying to process the essential material in the lesson would overwhelm the learner’s cognitive system. In these situations involving complex material, it is helpful if some of the processing can be done in advance.

Mayer, Mathias, and Wetzell (2002: 147–154) constructed a short pre-training episode in which learners saw a labeled diagram of the braking system on the screen and could click on any part. When they clicked on apart, they were told the name of the part and its main characteristics. In three separate studies, learners who received this kind of pre-training performed better on transfer tests than did learners who did not receive pre-training, yielding a median effect
size of .9. Although encouraging preliminary evidences have been conducted for the pre-training principle, Clark & Mayer (2008: 192) suggested additional research should be implemented.

Signaling Principle

Signaling principle states that people learn better when cues that highlight the organization of the essential material are added. According to a cognitive theory of multimedia learning, signaling can help guide the process of making sense of the passage by directing the learner's attention to key events and the causal relations among them. In a study by Mautone and Mayer (2001), students who received a signaled presentation on how airplanes achieve lift performed better on a transfer test than did students who received a non-signaled version.

Personalization Principle

Personalization principle states that people learn better from multimedia presentations when words are in conversational style rather than formal style and pedagogical agents or on-screen characters help guide the learning process. The psychological advantage of conversational style, pedagogical agents, and visible authors is to induce the learner to engage with the computer as a social conversational partner (Clark & Mayer, 2008: 160). According to cognitive theories of learning, humans strive to make sense of presented material by applying appropriate cognitive processes. Thus, multimedia presentations should not only present information but also prime the appropriate cognitive processing in the learner. Research on discourse processing shows that people work harder to understand material when they feel they are in a conversation with a partner, rather than simply receiving information (Beck, McKeown, Sandora, Kucan, & Worthy, 1996: 385-414). Therefore, using conversational style in a multimedia presentation conveys to the learners the idea that they should work hard to understand what their conversational partner (in this case, the course narrator) is saying to them. In short, expressing information in conversational style can be a way to prime appropriate cognitive processing in the learner.
Mayer, Fennell, Farmer, and Campbell (2004: 389–395) conducted a research concerning the use of conversational style in multimedia presentations consisting of narrated animations involving how the human lungs work. The study involved this particular sentence in the lesson: “During exhaling, the diaphragm moves up, creating less room for the lungs, air travels through the bronchial tubes and throat to the nose and mouth, where it leaves the body.” The researchers personalized this sentence by changing “the” to “your” in five places, turning it into: “During exhaling, your diaphragm moves up, creating less room for your lungs, air travels through your bronchial tubes and throat to your nose and mouth, where it leaves your body.” In summary, they created a personalized script for the lungs lesson by changing “the” to “your” in eleven places. As a result, this fairly minor change resulted in improvements on a transfer test yielding a median effect size of .79 which was considered high (Clark & Mayer, 2008: 177).

**Voice Principle**

Voice principle states that people learn better when the words in a multimedia message are spoken by a friendly human voice rather than a machine voice. Mayer, Sobko, and Mautone (2003: 419–425) found that people learned better from a narrated animation on lightning formation when the speaker’s voice was human rather than machine-simulated, with an effect size of .79. More recently, Atkinson, Mayer, and Merrill (2005: 117–139) presented online mathematics lessons in which an on-screen agent named Peedy the parakeet explained the steps in solving various problems. Across two experiments, students performed better on a subsequent transfer test when Peedy spoke in a human voice rather than a machine voice, yielding effect sizes of .69 and .78.

**Image Principle**

Image principle states that people do not necessarily learn more deeply from a multimedia presentation when the speaker’s image is on the screen rather than not on the screen.

In conclusion, these twelve principles are grouped in a framework based on the three types of cognitive load:
- Reducing extraneous processing – coherence, signaling, redundancy, spatial contiguity, and temporal contiguity.
- Managing essential processing – segmenting, pre-training, and modality.
- Fostering generative processing – multimedia, personalization, voice, and image.

It is emphasized that, in applying cognitive theory of multimedia learning, one should carefully consider human cognitive architecture because it may affect learning and ensure that learners will work in an environment that is goal-effective, efficient, and appealing.

**Interactive Multimedia**

Engaging in multimedia presentations as a tool to encourage deep learning was discussed in the previous section. Briefly, multimedia learning requires the use of two separate sensory channels – the auditory/verbal channel and visual/pictorial channel – but the processing capacity available in each channel is limited. Moreover, multimedia learning requires substantial cognitive processing in both channels, as well as in working memory, and therefore could be prone to cognitive overload.

The present section attempts to advance our understanding of digital games as an interactive multimedia. Initially, the concept of interactive multimedia will be defined followed by a review of literature regarding digital games as interactive multimedia.

Multimedia can be divided into two large categories: passive and interactive. Passive or non-participatory multimedia is also known as a linear presentation in which the user has little or no control of the medium. A textbook is basically a form of linear media where users may sit and read the content material. The opposite is an interactive form or a non-linear media where people interact with the media at varying speeds and determines his or her path and progress through the presentation dependent on the choice and sequence of his or her actions.

While the concept of interactivity has been defined and applied in numerous ways to new media technologies, media psychologists and communication researchers have agreed that interactivity is one important feature of multimedia lessons delivered on a computer.
Clark & Mayer (2008: 27-28) distinguished 3 forms of interactive multimedia lessons based on goals:

1. Receptive lessons – are used most frequently if the goal of multimedia is to inform or present information. For learning to occur, it is up to the learner to actively process the content provided.

2. Directive lessons – follow a sequence of “explanation-example-question-feedback” that are used to teach procedures. These lessons incorporate highly structured practice opportunities designed to guide learning in a step-by-step manner. Knowledge construction is overtly promoted by the interactions built into the lessons.

3. Guided discovery – the learner is constantly engaged by clicking on various on-screen objects that provide data or activities related to the lesson. Also, knowledge construction is overtly promoted by the interactions built into the lessons.

For the present study, digital games will be employed as an interactive multimedia in comparison with a booklet which will represent a non-interactive medium.

Digital Games

In this section, the potentials of digital games as an interactive multimedia tool for learning will be discussed. For the purpose of this review, the term digital game refers to video games or computer games that are played on a computer platform.

Definition

There are many definitions in the digital game literature concerning what digital games are including its defining characteristics. Dempsey and colleagues (1993: 173–183) define a game as an activity involving one or more players, with goals, constraints, consequences, which is rule-guided, artificial in some respects and has an element of competition. Further, Oblinger (2006) asserted that digital games are complex requiring collaboration with other learners and involve the development of values, insights, and new knowledge. A wider definition is used by de Freitas (2007) who defines games used for learning as applications using the characteristics of
video and computer games to create engaging and immersive learning experiences for delivering specified learning goals, outcomes, and experiences.

**Digital Games and Learning**

Malone (1981: 333-369), Prensky (2005: 97-122) and Pivec and Kearney (2007: 419-423) advocate the use of digital games in learning processes, arguing that it’s use improves the learning outcomes of students, due to the intrinsic motivation involved in the playing. Moreover, digital games allow the development of new learning strategies, based on new interactivity patterns, like feedback, reflective and critical learning, target levels of understanding semiotics, learning through discovery and exploration, situated learning, role-playing and constructivist learning (Prensky, 2005: 97-122). Gros (2007: 23-38) enhances that for digital games to be used for educational purposes they must be endowed with well defined learning goals, teaching contents to the users or promoting the development of important strategies and skills to increase their intellectual and cognitive abilities.

Mark Prensky (2005: 97-122), one of the leading proponents of digital game-based learning, stated that it is possible to combine digital games with educational content to achieve good or better results as traditional learning methods. He further explained that digital game-based learning works for three reasons:

1. Games are engaging, which motivates people to learn. Although this engagement must be balanced with learning, often traditional teaching methods are not engaging, particularly for younger generations.

2. Games are interactive. They provide movement within the learning experience based on player action and decisions, where the player’s choices have consequences regarding the progression and outcome of the game.

3. Each game provides a unique combination of learning and engagement, which when properly balanced draws the player through the learning experience in a fruitful and productive way.
Characteristics

Identifying essential characteristics of digital games has been the subject of debate over the years. For example, Thornton and Cleveland (1990: 190-199) noted that the essential element of a game is interactivity. Moreover, de Felix and Johnston (1993: 199-233) suggested that the essential features of a game include dynamic visuals, interaction, rules, and a goal. Gredler (1996: 521–539) stated that the essential elements are a complex task, the learner’s role, multiple paths to the goal, and learner control. Furthermore, Malone (1981: 333-369) argued that there are four characteristics of games that make them engaging educational tools: challenge, fantasy, complexity, and control. According to Alessi and Trollip (2001: 3-15), successful digital games consisted of three basic characteristics: the game must have worthwhile learning objectives; the game must be fun; and the game’s goal must reinforce the learning goals.

Based on a review of literatures, digital game characteristics can be described in terms of eight broad categories:

1. Rules and Goals - The rules of a digital game describe the goal structure of the game. Clear, specific, and difficult goals lead to enhanced performance. The rules define the actions and the moves players are allowed to make in order to win the game. Rules depend on a game type and may not be entirely included in the game instructions.

2. Challenge - Success in a game depends on the strategies players take. Players need to consider factors and variables as well as likely consequences and manage their thinking and actions accordingly. During that process, players’ knowledge of phenomena is challenged and mistakes become more educational than success. Failure is a critical precondition for learning. Foreing students to cycle through play and resolve conflicts and gaps in their current understandings. Goals should be clearly specified, yet the possibility of obtaining that goal should be uncertain. Digital games should employ progressive difficulty levels, multiple goals, and a certain amount of informational ambiguity to ensure an uncertain outcome.

3. Control - refers to the exercise of authority or the ability to regulate, direct, or command something. Digital games evoke a sense of personal control when users are allowed to select strategies, manage the direction of activity, and make decisions that directly affect outcomes, even if actions are not instructionally relevant.
4. Fantasy – allow users to interact in situations that are not part of normal experience, yet they are insulated from real consequences. Digital games involve imaginary worlds; activity inside these worlds has no impact on the real world; and when involved in a game, nothing outside the game is relevant. Some research indicates that instructional content that is embedded in fantasy contexts leads to greater student interest and increased learning.

5. Collaboration – digital games can enable learners to collaborate and interact with other learners carrying out team-oriented tasks in a socially and visually stimulating environment.

6. Safety – refers to the lack of consequences of the game in the real world.

7. Interaction and Feedback – digital games usually provide immediate feedback and outcomes (such as lose or win, succeed or fail). Learning outcomes and feedback are crucial to ensure learning. Feedback or knowledge of results is critical to support performance and motivation.

8. Motivation/Engagement – digital games provide fun making learning enjoyable and worthwhile. Engagement is essential to games to make them interesting and engaging. Increased interest leads to increased engagement and thus invested time in the game.

**Learner Control**

Cognitive researchers have claimed that learner control is an important aspect of effective learning (Merrill, 1975: 217–226). Empirical studies have shown that learner control can improve student performance, attitudes, and increases students’ motivation. According to Clark & Mayer (2008: 292-311), learner control falls into three areas:

1. Content Sequencing – learners can control the order of the lessons, topics, and screens within a lesson. For example, a course menu in an e-learning courseware where learners select topics in any sequence they wish. Also, links placed in lessons can lead to additional pages in the course or to alternative websites with related information.

2. Pacing – learners can control the time spent on each lesson page. With the exception of short video or audio sequences, a standard adopted in virtually all asynchronous e-learning, allows learners to progress through the training at their own rate, spending as much or
as little time as they wish on any given screen. Likewise, options to move backward or to exit are made available on every screen. A more extensive form of pacing control allows learners to use slider bars or rollers to move through the content or includes fast forward, rewind, pause, and play buttons.

3. Access to Learning Support - learners can control instructional components of lessons such as examples or practice exercises. Within a given lesson, navigation buttons, links, or tabs lead to course objectives, definitions, additional references, coaches, examples, help systems, or practice exercises. In contrast, a program-controlled lesson provides most of these instructional components by default as the learners click the forward button.

Eternal Story Digital Game

Background

This study used Eternal Story (http://itsgames.cmu.ac.th/eternalstory/), a high quality 3D Massive Multiplayer Online Role Playing Game developed and owned by the Information and Technology Service Center, Chiang Mai University and Thai Cyber University, Commission on Higher Education, since it is considered as the first and one of the game-based learning tools in Thailand used in Higher Education.

Purpose

Eternal Story aims to make learning fun by engaging students so they could improve their knowledge and skills on Fundamental English course. In the game, players take the role of warriors and complete missions by interacting with non-player characters. The engagement part is derived from traveling through a fantasy world environment and gathering rewards by destroying monsters (Laohajaratsang, 2012).

Main Components

The instructional content of Eternal Story consisted of selected lessons in Fundamental English presented using on-screen texts (Picture 1 and 2). The instructional contents were 1) References, 2) Topic, 3) Main Idea, 4) Skimming, 5) Scanning, 6) Context Clues, 7)
Word Analysis, 8) Organization of Text, 9) Supporting Details, 10) Using Dictionary, 11) Making Inferences, 12) Identifying Fact and Opinion, and 13) Transition Words. The instructional contents covered in this study were References, Topic, and Main Idea.

**Learning Taxonomies**

Taxonomies are classification systems based on a set of carefully defined terms, organized from simple to complex and from concrete to abstract. The purpose of taxonomies is to provide a framework of categories into which one may classify educational goals, to understand how to sequence learning tasks in a logical order of difficulty so educational goals may be easier to discuss, construct metrics of achievement, and to evaluate individual achievement. Therefore learning taxonomies are commonly utilized as a way of describing different kinds of learning behaviors and characteristics a learner has developed. One of the best known and applied taxonomies in education is the Taxonomy for Educational Objectives developed by Benjamin Bloom and his colleagues (Bloom et al. 1956). This taxonomy became widely accepted as a standard aid for planning as well as evaluating learning. It is divided into three broad categories or domains: cognitive, affective, and psychomotor domains (Figure 2).

![Learning Taxonomies in the Cognitive, Psychomotor, and Affective Domains](image)

**Figure 2** Learning Taxonomies in the Cognitive, Psychomotor, and Affective Domains

Within the cognitive domain, Bloom presented a taxonomy of educational objectives, which consists of six levels. Bloom categorized cognitive learning in a hierarchy
based on the assumption that lower level simple behaviors would be combined or integrated in higher levels.

1. Knowledge — involves the remembering of previously learned material or the recall of facts and information.

2. Comprehension — requires a deeper understanding of the information that allows a person to restate it in their own words (knowledge is a prerequisite behavior).

3. Application — involves the use of the information or skill in a new situation (knowledge and comprehension are prerequisite behaviors).

4. Analysis — involves the deconstruction of the information to determine elements and relationships (knowledge, comprehension, and application are prerequisite behaviors).

5. Synthesis — is the reconstruction of the information in a different way and in relation to other concepts (knowledge, comprehension, analysis are prerequisite behaviors).

6. Evaluation — involves making judgments about the information (knowledge, comprehension, analysis, and synthesis are prerequisite behaviors).

These categories were designed to range from simple to complex and from concrete to abstract. It was assumed that the taxonomy represented a cumulative hierarchy, so that the mastery of each simpler category was a prerequisite to a mastery of the next, more complex one.

In addition to the cognitive taxonomy, Bloom, Krathwohl, and Masia (1964) advocated the taxonomy of the affective domain which is concerned with attitudes, interests, appreciation, and values. This taxonomy comprised of five categories arranged in order of increased internalization. Like the taxonomy of the cognitive domain, it assumed that learning at the lower category was prerequisite to the attainment of the next higher one. In other words, the learner moves from being aware of what they are learning to a stage of having internalized the learning so that it plays a role in guiding their actions. The following categories in this domain are:
1. Receiving – the ability of the learner to show an awareness of an idea or fact or a consciousness of a situation or event in the environment. This level represents a willingness to selectively attend to or focus on data or to receive a stimulus.

2. Responding – the ability of the learner to respond to an experience, at first obediently and later willingly and with satisfaction. This level indicates a movement beyond denial and toward voluntary acceptance, which can lead to feelings of pleasure or enjoyment as a result of some new experience (receiving is a prerequisite behavior).

3. Valuing – the ability of the learner to regard or accept the worth of a theory, idea, or event, demonstrating sufficient commitment or preference to be identified with some experience seen as having value. At this level, there is a definite willingness and desire to act to further that value (receiving and responding are prerequisite behaviors).

4. Organization – refers to the ability of the learner to organize, classify, and prioritize values by integrating a new value into general set of values, to determine interrelationships of values, and to harmoniously establish some values as dominant and pervasive (receiving, responding, and valuing are prerequisite behaviors).

5. Characterization – refers to the ability of the learner to integrate values into a total philosophy or worldview, showing firm commitment and consistency of responses to the values by generalizing certain experiences into a value system or attitude cluster (receiving, valuing, and organization are prerequisite behaviors).

Lastly, an example of a useful taxonomy of the psychomotor domain is Dave’s (1970) adaptation of Bloom’s original Taxonomy. The taxonomy deals largely with motor area skills and the mastery of them. The five categories in this domain are:

1. Imitation – observed actions are followed at this level. The learner’s movements are gross, coordination lacks smoothness, and errors occur. Time and speed required to perform are based on learner’s needs.

2. Manipulation – written instructions are followed at this level. The learner’s coordinated movements are variable, and accuracy is measured based on the skill of using procedures as a guide. Time and speed required to perform vary.
3. Precision – a logical sequence of actions is carried out at this level. The learner’s movements are coordinated at a higher level, errors are minimal and relatively minor. Time and speed required to perform remain variable.

4. Articulation – a logical sequence of actions is carried out at this level. The learner’s movements are coordinated at a high level, and errors are limited. Time and speed required to perform are within reasonable expectations.

5. Naturalization – the sequence of actions is automatic at this level. The learner’s movements are coordinated at a consistently high level, and errors are almost nonexistent. Time and speed required to perform are within realistic limits, and performance reflects professional competence.

This study was conducted to evaluate the effects of an interactive digital game and print media on students’ recall of facts, comprehension of key concepts, and application of learned material as defined by the first three levels of the cognitive domain. Likewise, students’ ability to duplicate learned information and perform certain actions were assessed using the first two levels of the psychomotor domain. Lastly, students’ attitudes were determined in terms of the receiving, responding, and valuing levels of the affective domain.

Related Studies

Effects of Interactive Digital Games

A study conducted by Chen & Yang (2011: 168-175) examined the effects of an online adventure digital game on cognitive achievement. A group of 10 non-English majors and a group of 10 English majors in a Taiwanese university were asked to play a point-and-click digital game. Pretests and posttests using 30 vocabulary items were used to determine if students have learned any new vocabulary words after playing the digital game. In addition, students’ perceptions toward the digital game were explored. Results of the study showed significant differences in the two group’s pretest and posttest vocabulary knowledge. The posttest scores of the two groups indicated a significant increase compared from the pretests. In addition, the
respondents considered the digital game helpful in improving their reading and listening skills. The respondents reported that they enjoyed playing the digital game because of its intriguing storyline and innovative design. These elements sustained their interest in continuing playing the game. Although students pointed out some drawbacks of the game, such as the insufficient hints, unappealing character design, and the fast speed of the dialogues or subtitles, they still held positive attitudes toward playing the video game and believed the game was helpful for language learning.

Another study conducted by Moreno & Mayer (2005: 117–128) investigated whether guidance and reflection would facilitate science learning in an interactive multimedia game. College students learned how to design plants to survive in different weather conditions. In Experiment 1, they learned with an agent that either guided them with corrective and explanatory feedback or corrective feedback alone. Some students were asked to reflect by giving explanations about their problem-solving answers. Guidance in the form of explanatory feedback produced higher transfer scores, fewer incorrect answers, and greater reduction of misconceptions during problem solving. Reflection in the form of having students give explanations for their answers did not affect learning. Experiments 2 and 3 showed that reflection promotes retention and far transfer in non-interactive environments but not in interactive ones unless students are asked to reflect on correct program solutions rather than on their own solutions. Results support the appropriate use of guidance and reflection for interactive multimedia games.

**Achievement in the Cognitive and Psychomotor Domains**

A study by Buaclee (2010) measured the effectiveness of different technical presentations on learning achievement in the cognitive, affective, and psychomotor domains. The study employed three different multimedia educational instructions: text presentation, lecture presentation, and game simulation. The samples were 75 first year vocational certificate students of Faculty of Arts, Phrae Vocational College, Phrae province, Thailand. Data were obtained through computer teaching aid, cognitive and psychomotor domain test, and affective domain test. Results showed a difference in test scores in students' cognitive and psychomotor domain
tests between groups. Specifically, the group involved in the lecture technique obtained the highest scores in the cognitive and psychomotor domain test followed by the group who used a print material and digital game simulation, respectively. Finally, analysis of students' satisfaction toward the three multimedia educational instructions showed no significant differences.

A study conducted by de Haan, Reed & Kuwada (2010: 74-94) investigated the effects of a digital game's interactivity on recall of English vocabulary among undergraduate Japanese students. Eighty randomly selected students were paired based on similar English language and game proficiencies in which one student played an English-language music video game for 20 minutes while the paired student watched the game simultaneously on another monitor. After playing the game, a vocabulary recall test, a cognitive load measure, an experience questionnaire, and a two-week delayed vocabulary recall test were administered. Results were analyzed using paired samples t-tests and analyses of variance. Results of the study showed that both the players and the watchers of the video game recalled vocabulary from the game, but the players recalled significantly less vocabulary than the watchers. The researchers argued that the reason for this seemed to be a result of the extraneous cognitive load induced by the interactivity of the game. On the other hand, the result showed that players perceived the game and its language to be significantly more difficult than the watchers did. Also, the players reported difficulty simultaneously playing the game and vocabulary. Both players and watchers forgot significant amounts of vocabulary over the course of the study.

In another study, deHaan (2011: 46-55) has investigated teaching and learning English through digital game projects. Two completed extracurricular projects, based on constructionist learning and media literacy theories and practices, are described in his paper: game design and game magazine creation. The action research projects aimed to guide students towards a better understanding of games' formal features and technologies through their active creation of games and game related media, and to improve their spoken and written English language skills. In general, students learned and practiced a variety of language and technology skills with the design projects. The projects motivated the students, challenged the students, and provided many opportunities for authentic discussions in the foreign language.
Another study by Yip & Kwan (2006: 233–249) investigated the usefulness of online games in vocabulary learning for selected undergraduate students. Three teachers and 100 engineering students participated in a quasi-experimental study for approximately nine weeks. The experimental group learnt some vocabulary from two carefully selected web sites with games, while the control group learnt the same vocabulary through activity-based lessons. A pretest and posttest were conducted in the first and ninth weeks. The findings indicate that the experimental group outperformed the control group statistically in the posttest. The students in the experimental group generally preferred online learning supplemented with digital educational games to conventional activity-based lessons. The teachers thought highly of the online games, but they expressed concern that extra support was required if the online games were adopted as a core part of their teaching.

Chuang & Chen (2009: 27-30) have studied the effect of digital games on children's cognitive achievement. Their study investigated whether digital games facilitate children's cognitive achievement in comparison to traditional computer-assisted instruction. One hundred fifteen third grade students participated in the study and were randomly assigned into two groups, the control group (n = 58) and the experimental group (n = 57). This study investigated the effect of varied types of instructional treatments (computer-assisted instruction versus computer and video game playing) on individual learning achievement for third-grade students. Participants were asked to take part in two instructional sessions. In the first session, the control group received a unit of computer-assisted instruction about fire-fighting. The experimental group was asked to play the computer game Fire Captain. In the next session, all participants were required to take a quiz to allow assessment of their learning achievements. A multivariate analysis of variance (MANOVA) was performed to analyze the results. Results showed that playing computer based video games was more effective in facilitating third-graders' average learning outcome than text-based computer-assisted instruction. The findings also indicated that computer-based video game playing not only can improve participants' fact differentiation/recall processes, but also promotes problem-solving skills by recognizing multiple solutions for problems.
Wang (2010: 126-142) has studied the effect of using communicative language games in teaching and learning English in Taiwanese primary schools. The aim of his study was to examine the use of communicative language games for teaching and learning English in Taiwanese elementary schools. The participants were 150 teachers teaching in Taiwanese primary schools. The instrument used was a survey questionnaire about participants' perspectives on the use of communicative language games in English lessons. The results of the study provided encouraging evidence to indicate that Taiwanese elementary school teachers generally appreciated the benefits and value of communicative game activities in the teaching of English language. The findings also suggested that when facing students with different backgrounds, learning styles, needs, and expectations, teachers should be aware to take learners' individual variations into account and be more flexible in their use of communicative games in order to maximize educational effect. It is hoped that communicative language games will attract more attention and will be applied more widely in the classroom with more positive attitudes on the part of language teachers.

**Affective and Motivational Outcomes**

Adams (1998: 47-55) conducted an interesting study that exemplifies how digital games can change students' behaviors. He found that SimCity 2000, a commercial video game, could help students to apprehend the complexity of urban geography and planning concepts. His experiments showed significant changes in students' attitudes and beliefs related to urban processes. Students were asked to play SimCity 2000 and were given instructions on how to create a green city and observe the consequences of good and bad urban planning. Students were then required to describe their experience of playing SimCity 2000. After playing the game, most students became more respectful of urban planners and municipal leaders; they also felt that the game helped them to appreciate the complexity involved in urban planning, and they acknowledged that, although some elements of the game were unrealistic, they understood some general basic principles linked to urban planning. Students became more familiar with the world of geographers and planners. They appreciated the process of collecting and allocating municipal revenues, and showed humility toward the complexity linked to the management of urban
planning. Adams (1998) believes that these attitudinal responses are as important as the knowledge imparted during traditional teaching.

Turgut and Irgin (2009: 760-764) have studied young learners’ language learning via computer games in Turkey. This qualitative research based on phenomenological theoretical framework investigates young learners’ experiences of language learning while playing computer games in internet cafes. The data was collected through observations and semi-structured interviews and analyzed through phenomenological data analysis steps. The results indicated that young learners’ playing online games promotes language learning and especially vocabulary skills.

O’Leary and colleagues (2005: 1848–1851) undertook a study to compare learning satisfaction and effectiveness between game-based learning and traditional lectures for third-year medical students. They used a pretest and posttest to evaluate learning and a satisfaction survey. The study showed no difference in learning between the two groups but the group using the game rated it higher for satisfaction.

**Conceptual Framework**

The conceptual framework of this study was developed by incorporating theoretical and methodological concepts. Based from Figure 3, an interactive digital game is a type of interactive multimedia that is composed of graphics, text, audio, animation, immediate feedback, engagement, and learner control elements. On the other hand, the print material is a non-interactive multimedia which is composed of graphics, text, and engagement elements. Pretests and posttests were employed to compare the differences in student achievement and attitudes of student participants upon use of the interactive digital game and the print media.

Learning achievement specifically refers to the cognitive domain and psychomotor domain achievement of students as a result of their use of the assigned learning media. Cognitive domain achievement was assessed using the first three levels of Bloom et al.’s Taxonomy of the Cognitive Domain (1956). Knowledge, the first level, refers to the students’
ability to remember previously learned information. Comprehension, the second level, refers to the students’ ability to grasp the meaning of the material. The third level, application, refers to the students’ ability to use learned material.

Moreover, psychomotor domain achievement was assessed using the first two levels of Dave’s Taxonomy of the Psychomotor Domain (1970). Imitation, the first level, refers to students’ ability to copy or duplicate learned information. The second level, manipulation, refers to students’ ability to perform certain actions by following instructions.

Attitudes refer to the emotional responses of students as a result of their use of the assigned learning media. Attitudes were evaluated using the first three levels of Krathwohl et al.’s Taxonomy of the Affective Domain (1964). The first level, receiving, refers to the emotional responses of students in relation to their selected attention. The second level, responding, refers to reaction of students to a particular phenomenon. The third level, valuing, refers to the worth a student attaches to a particular phenomenon.

Lastly, the level of satisfaction of participants toward the usability, content, engagement, and interface of the assigned learning media were determined. Usability refers to the extent to which a learning media can be used by learners to achieve specified goals with effectiveness, efficiency, and satisfaction. Content denotes both the information that users are exposed to and the tasks that are required to complete during the use of the assigned learning media. Engagement refers to the sustained level of involvement caused by how fun, involving, and motivating a lesson is. Interface refers to the connection between the user and the content. For the print media, interface refers to a thing that enables separate and sometimes incompatible elements to coordinate effectively. For the interactive digital game, interface refers to the visual and auditory aspects that allow the students to interact with the content of the game.
Figure 3 Conceptual Framework of the Study
CHAPTER 3

METHODOLOGY

Research Design

Mixed methods research was employed in this study to evaluate the effects of an interactive digital game and traditional media on student achievement. The researcher focused on PS 103 (International Relations) students since this population is composed of heavy interactive multimedia users and the population’s relatively limited knowledge and skills on the covered material included in the experiment. A pretest posttest control group design was adopted to compare the effects of the interactive digital game and traditional media on students’ cognitive and psychomotor domain achievements. Likewise, qualitative and quantitative methods were used to explore the attitudes of student participants toward the interactive digital game and traditional media. The steps carried out in the experiment were as follows:

1. Randomly assigned sample respondents to experimental and control groups.
2. Conducted pretest to all sample respondents of both groups.
3. Ensured that both groups experience the specified research treatment which is the use of the Eternal Story digital game by the students assigned in the experimental group and the use of print media by students assigned in the control group.
4. Conducted posttest to all sample respondents of both groups.
5. Assessed the amount of change on the value of the dependent variable from the pretest to the posttest for each group separately.

Visually, the research design is presented follows:

\[
\begin{align*}
R &\quad O_1 &\quad X_1 &\quad O_2 \\
R &\quad O_3 &\quad X_2 &\quad O_4
\end{align*}
\]

Where:  
\( R = \) random assignment  
\( O_1 = \) experimental group pretest  
\( O_3 = \) control group pretest  
\( O_2 = \) experimental group posttest
O4 = control group posttest
X = treatment
X1 = Eternal Story digital game
X2 = print-based learning material

Locale of the Study

The study was conducted at Maejo University, Chiang Mai province, Thailand.

Population

The population of the study comprised of Thai undergraduate students studying PS 103 (International Relations) during the Academic Year 2011-2012. The total number of students was 120.

Units of Analysis and Sampling

The units of analysis of the study were PS 103 students enrolled during Academic Year 2011-2012. The samples comprised of 60 students who were selected using the simple random sampling technique. The samples were randomly assigned into two groups: experimental group and control group. Specifically, the following sampling procedures were undertaken:

1. Selection of Maejo University (Chiang Mai campus) as the place of study through purposive sampling since the researcher is currently pursuing her Master’s degree in this university.

2. Selection of PS 103 students as the target population of the study through purposive sampling.

3. Selection of 60 PS 103 students using the simple random sampling technique.

4. Distribution of 30 students in the experimental group and 30 students in the control group using simple random sampling technique.
Research Instruments

Questionnaires

The following questionnaires were developed based on the study’s objectives:

1. To answer the first research objective which is to compare the effects of an interactive digital game and traditional media on cognitive domain achievement, the cognitive domain achievement test was developed by the researcher. This instrument consisted of questions about References and Substitution words, Topic, and Main Idea and was divided into three categories namely knowledge, comprehension, and application.

2. To answer the second objective which is to compare the effects of an interactive digital game and traditional media on psychomotor domain achievement, the psychomotor domain achievement test was developed by the researcher. This instrument consisted of questions concerning the use of References and Substitution words, Topic, and Main Idea and was divided into two categories namely imitation and manipulation.

3. To answer the third research objective, which is to explore the attitudes of student participants toward the interactive digital game and traditional media, the following research instruments were developed by the researcher:

3.1 Attitude questionnaire for the experimental group – this questionnaire consisted of two parts. The first part composed of open-ended questions divided into three categories namely receiving, responding, and valuing. The questions tackled how student participants perceive the digital game’s learning benefits, contents, and features. It also tackled how student participants value the contents of the digital game including its use in education, and participants’ suggestions for further improvements. The second part of the questionnaire composed of a 5-point Likert scale that determined student participants’ level of agreement on statements about the digital game’s usability, content, engagement, and interface. The scales ranging from 1 to 5 corresponded to the following: 1 (strongly disagree), 2 (disagree), 3 (undecided), 4 (agree), and 5 (strongly agree). The questions were all written in English and Thai language to facilitate more accurate responses from the student participants.
3.2 Attitude questionnaire for the control group – this questionnaire consisted of two parts. The first part composed of open-ended questions that were divided into three categories namely Receiving, Responding, and Valuing. The questions tackled how student participants perceive the booklet’s learning benefits, contents, and features. It also tackled how student participants’ value the content of the booklet, and their suggestions for further improvements. The second part of the questionnaire composed of a 5-point Likert scale that determined student participants’ level of agreement on statements about the booklet’s usability, content, engagement, and interface. The scales ranging from 1 to 5 corresponded to the following: 1 (strongly disagree), 2 (disagree), 3 (undecided), 4 (agree), and 5 (strongly agree). The questions were all written in English and Thai language to facilitate more accurate responses from the student participants.

**Interventions**

1. For the experimental group, the Eternal Story digital game (see Appendix C) was used by the student participants. The game is a high quality 3D MMORPG set during medieval times featuring elf-like characters, knights, and magicians on a virtual kingdom named Eternal World. The major goal of the game is to complete all the assigned quests through interactions with other non-player characters. The learning content of the game consists of selected topics from Fundamental English course. The topics include the following: (1) References, (2) Topic, (3) Main idea, (4) Skimming, (5) Scanning, (6) Context Clues, (7) Word Analysis, (8) Organization of text, (9) Supporting details, (10) Using dictionary, (11) Making inference, (12) Identifying fact and opinion, and (13) Transition words. The study focused on the first three topics namely References, Topic, and Main Idea. Eternal Story was developed by the Information Technology Service Center (ITSC), Chiang Mai University and Thailand Thai Cyber University, Commission on Higher Education.

2. For the control group, the Let’s Learn English! Booklet (see Appendix C) was developed by the researcher. This booklet consisted of eight pages that were organized into three main sections. The first section focused on References, the second section focused on Topic,
and the third section focused on Main Idea. The booklet contained written texts and illustrations. All contents and learning objectives of this booklet were similar to the Eternal Story digital game.

**Pretest of Research Instruments**

1. The cognitive domain achievement test included questions that tackled complete range of the types of Reference words, and the definitions and uses of Topic and Main Idea which were the scope of the study. Also, the instructions and questions of the questionnaire were clear and appropriate to the level of knowledge of the participants in the study. This instrument was submitted to a group of subject matter experts for review. Moreover, the researcher conducted a questionnaire try-out among 42 PS 103 students. Out of the 42 response sheets obtained, 40 were selected as the most complete and valid. Scores were calculated and item analysis was conducted to determine the discrimination and difficulty index of individual test items (Appendix Table 1). The difficulty index ($p$) and discrimination index ($r$) of test items were obtained by using the formula below (Chinatrakul, 1995: 237). The acceptable value of $p$ and $r$ was set between 0.2 to 0.8.

$$r = \frac{f_H - f_L}{N_H} \quad p = \frac{f_H + f_L}{N_H + N_L}$$

Note:

- $p$ = item difficulty index
- $r$ = item discrimination index
- $f_H$ = number of students with correct answers in higher scoring group
- $f_L$ = number of students with correct answers in lower scoring group
- $N_H$ = total number of students in higher scoring group
- $N_L$ = total number of students in lower scoring group

Lastly, reliability analysis was conducted on the cognitive domain achievement test using split halves method. Result of the analysis (Appendix Table 1) showed that the cognitive domain achievement test appeared to have good internal consistency, $\alpha = .80$. 
2. The questions included in the psychomotor domain achievement test tackled the use of Reference words, Topic, and Main Idea which were the scope of the study. This questionnaire was submitted to a group of subject matter experts for review.

3. The attitude questionnaire for the experimental and control groups were submitted to a group of subject matter experts for review. The experts deemed it important to include follow-up questions on how student participants perceive the digital game’s learning benefits, contents, and features. Thus, open-ended questions were added. Also, some of the Likert items were found to be unclear and redundant. As a result, those questions were revised and omitted.

**Data Collection Procedures**

Prior the data collection, permission to conduct an experiment from the Office of the Dean of the School of Administrative Studies was secured to ensure cooperation and full support from those involved in the study (see Appendix D). Data gathered from pretest and posttest activities are discussed as follows.

**Pretest Phase**

All 60 sample respondents answered the cognitive and psychomotor domain achievement test to measure their prior knowledge and skills on the lessons covered in the interactive digital game and booklet. The participants’ demographic information was also collected to improve the accuracy of the analysis and provide a better understanding of the obtained results.

The pretest was administered in paper version at a large lecture room with a quiet setting. Student participants were encouraged to ask questions after the instructions were given. Then, the students were given as much time as necessary to answer the test. The course instructor did not intervene in the activities. Also, students were assured of the confidentiality of the results, and that performance on the tests would not affect their course grade in any way. Upon completion, the researcher collected the forms from the participants.
Posttest Phase

The researcher allotted two weeks prior proceeding to the posttest phase so participants would not associate the pretest with the study itself. The posttest phase involved the use of Eternal Story digital game by the experimental group and the Let’s Learn English! booklet by the control group. The same cognitive and psychomotor domain achievement tests were administered after the use of instructional media. Also, the attitude questionnaires were administered.

The posttest activities for the experimental group were carried out in a private internet café located near the university since the available computers in Maejo University, Chiang Mai campus cannot support the system requirements of Eternal Story game. Thirty students agreed to participate in the posttest activities that were conducted at one o’clock in the afternoon. The application software of Eternal Story was installed in 30 computer units prior the start of the experiment. Each of the student participants was assigned to his or her choice of computer station and was given usernames and passwords to access the game. After the briefing session, the student participants played Eternal Story for approximately 40 minutes and then answered the cognitive and psychomotor domain achievement test including the attitude questionnaire.

On the other hand, the posttest activities for the control group were carried out in the same lecture room used during the pretest activities. Thirty students participated in the posttest activities that were conducted at four o’clock in the afternoon, right after the posttest activities of the experimental group. After the briefing session, the control group participants read the booklet for approximately 40 minutes and then answered the cognitive and psychomotor domain achievement test including the attitude questionnaire.

Control of Intervening Variables

The researcher identified fatigue, boredom, and attitudes as potential intervening factors. To gather sufficient data concerning these factors, the attitude questionnaires were administered among all experimental and control group participants to ascertain if there might be
extra-experimental factors that impacted learner responses or behaviors. Also, demographic characteristics such as age, major, GPA, year level, and gender were collected to analyze if these variables would impact the results of the study.

Data Analysis

After the data collection, scores of the cognitive and psychomotor domain achievement tests were encoded using Microsoft Excel and later using the Statistical Package for the Social Sciences (SPSS v.11). On the other hand, responses to Likert scale questions included in the attitude questionnaires were cleaned by the researcher and then encoded using Microsoft Excel. Lastly, written responses were encoded using Microsoft Word. Collected data were analyzed based on the objectives of the study:

1. To compare the effects of the interactive digital game and print media on students’ achievement in the cognitive domain, a cognitive domain achievement test was administered. Scores of student participants were analyzed using Measures of Central Tendency (Mean, Median, and Mode; Standard Deviation; Range and Percentage) and Independent Samples t-test. Values with a p-value lower than .05 were considered statistically significant.

2. To compare the effects of the interactive digital game and print media on students’ achievement in the psychomotor domain, a psychomotor domain achievement test was administered. Scores of student participants were analyzed using Measures of Central Tendency (Mean, Median, and Mode; Standard Deviation; Range and Percentage) and Independent Samples t-test. Values with a p-value lower than .05 were considered statistically significant.

3. To explore the attitudes of student participants toward the interactive digital game and print media, an attitude questionnaire was administered. Written responses to closed and open-ended questions were analyzed using thematic analysis. Moreover, to identify the level of satisfaction of student participants toward the usability, content, engagement, and interface of the interactive digital game and print media, descriptive analysis was conducted. The criteria used to determine the level of agreement or disagreement of students to Likert statements was computed using a 0.8 difference (Pongwichai, 2002: 78-79):
4.21 – 5.00 = strongly agree
3.41 – 4.20 = agree
2.61 – 3.40 = neutral or undecided
1.81 – 2.60 = disagree
1.00 – 1.80 = strongly agree
CHAPTER 4

RESULTS AND DISCUSSIONS

The main purpose of this study was to evaluate the effects of an interactive digital game and traditional media on students' achievement and attitudes. This study assessed and compared the differences in test scores and written reflections following a learning session. Findings from comparisons between the use of interactive digital game and traditional media will be reported in this chapter. This chapter is divided into three parts:

Objective 1: The first part addresses the data analyses of students' cognitive domain achievement test.

Objective 2: The second part addresses the data analyses of students' psychomotor domain achievement test.

Objective 3: The last part of this chapter addresses the data analyses of students' attitudes in the affective domain and students' satisfaction toward the interactive digital game and traditional media in terms of usability, content, engagement, and interface.

General Demographic Information

Table 2 presents the percentage and frequency distribution of participants' gender, age, year level, major, and grade point average (GPA). A number of Pearson Chi-Square tests were run to determine proportional differences on various demographic characteristics between the two groups. The level of significance was set at .05.

Gender

Of the 60 student participants of the study, female participants comprised of 56.70 percent while 43.30 percent were males.

1. In the experimental group, more than half of the samples or 53.30 percent were males while 46.7 percent were females.
2. In the control group, the female participants comprised of 66.70 percent while only 33.30 percent were males.

**Age**

Of the 60 student participants of the study, majority or 76.70 percent were 20 years old while 13.30 percent were 21 years old. Only 10 percent of the participants were 19 years old.

1. In the experimental group, seventy six percent of the participants were 20 years old while 13.30 percent were 19 years old. Only 10 percent were 21 years old.

2. In the control group, majority or 76.70 percent of the student participants were 20 years old while 16.70 percent were 21 years old. Only 6.70 percent were 19 years old.

**Year Level**

Of the 60 student participants of the study, almost all the students or 93.30 percent were in sophomore year in college while 6.70 percent were in junior year.

1. In the experimental group, sophomore year students comprised of 93.30 percent while 6.70 percent were in junior year.

2. In the control group, sophomore year students comprised of 93.30 percent and 6.70 percent were in junior year.

**Major**

Of the 60 student participants of the study, a total of 35 percent were Public Administration majors and 23.30 percent were Economics majors. Agricultural Engineering majors comprised of 11.70 percent while the Renewable Energy majors, Information Technology majors, English majors, and Food Science and Technology majors all comprised of 5 percent of the total sample of the study. Furthermore, the Food Engineering majors comprised of 3.30
percent while the Finance majors, Cooperative Economics majors, Accounting majors, and Computer Science majors all comprised of 1.70 percent.

1. In the experimental group, Public Administration majors comprised of 30 percent while 23.30 percent were Agricultural Engineering majors. Economics majors comprised of 16.70 percent while 6.70 percent were Renewable Energy majors, Food Engineering, and Information Technology majors. Finally, the Finance majors, Cooperative Economics majors, and English majors comprised of 3.30 percent.

2. In the control group, Public Administration majors comprised of 40 percent while 30 percent were Economics majors. Moreover, Food Science majors comprised of 10 percent while the English majors comprised of 6.70 percent. The remaining 3.30 percent were Renewable Energy, Information Technology, Accounting, and Computer Science majors.

GPA

With regard to GPA, a total of 43.30 percent of the student participants had a GPA in the range of 2.51-3.00 while 36.70 percent had a GPA in the range of 2.01-2.50. Also, only 16.70 percent of the participants had a GPA in the range of 3.00 and above while 3.30 percent had a GPA in the range of 2.00 and lower.

1. In the experimental group, half of the participants or 50 percent had a GPA in the range of 2.01-2.50 while 36.70 percent had a GPA in the range of 2.51-3.00. Also, ten percent of the participants had a GPA in the range of 3.00 and above while only 3.30 percent had a GPA in the range of 2.00 and lower.

2. In the control group, half of the participants or 50 percent had a GPA of 2.51-3.00 while 23.30 percent of the participants both had a GPA of 2.01-2.50 and 3.00 above. Only 3.30 percent had a GPA of 2.00 and lower.

Pearson Chi-Square ($\chi^2$) tests were run to quantitatively determine whether the distribution of demographic variables of the experimental and control group participants differ from one another. The tests indicated no significant differences in the demographic variables in terms of gender ($\chi^2 = 2.443, \text{sig} = 0.118$), age ($\chi^2 = 1.167, \text{sig} = 0.558$), major ($\chi^2 = 18.571, \text{sig}$
= 0.069), and GPA ($\chi^2 = 5.124, \text{ sig } = 0.163$). Therefore, any results derived regarding the effects of the interactive digital game and traditional media on student achievement could be generalized to a larger population.

Discussion of Results of General Demographic Information

Results of descriptive analysis of the participants’ general demographic characteristics showed that more than half or 56.70 percent of the student respondents were females while 43.30 percent were males. With regard to age, majority of the participants or 76.70 percent were 20 years old. Also, almost all of the participants or 93.30 percent were in their sophomore year in college. Furthermore, majority of the participants or 35 percent were Public Administration majors while 23.30 percent were Economics majors. Lastly, most of the participants in the study or 43.30 percent have a GPA in the range of 2.51-3.00 while 36.70 percent have a GPA of 2.01-2.50.
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χ² = 18.571

sig = 0.069
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$\chi^2 = 5.124$

$sig = 0.163$
Objective 1: Student Achievement in the Cognitive Domain

This section addresses the differences in cognitive domain achievement of the experimental and control group participants. Independent samples t-test and measures of central tendency (mean, standard deviation, and percentage) were used in data analyses. The level of significance chosen was .05.

Cognitive Domain Achievement

All 60 student participants were asked to answer the cognitive domain achievement test during the pretest and posttest phases of the study. The test consisted of 100 items that was categorized into 3 parts namely knowledge level, comprehension level, and application level. Scores were analyzed using independent samples t-test and descriptive statistics to compare the extent of knowledge acquired between the experimental and control groups.

Pretest Scores

Results of cognitive domain achievement pretest scores between the two groups are presented in Table 3. Out of 100 points, the control group achieved a total mean pretest score of 48.00. Specifically, the students attained a mean score of 33.33 in the knowledge level (total of 60 points), a mean score of 8.83 in the comprehension level (total of 20 points), and 5.83 in the application level (a total of 20 points). On the other hand, the experimental group students attained a total mean score of 44.83 out of 100 points. Specifically, the students attained a mean score of 31.83 in the knowledge level (total of 60 points), a mean score of 7.33 in the comprehension level (total of 20 points), and 5.67 in the application level (total of 20 points). The independent samples t-test indicated no significant difference between the total mean pretest scores of the two groups. This result implied that both groups had equal prior knowledge on the selected topics in Fundamental English presented in the interactive digital game and booklet.
Posttest Scores

Upon use of the interactive digital game by the experimental group and the booklet by the control group, the same cognitive domain achievement test was administered to compare the extent of knowledge acquired. Table 3 presents the percentage and frequency distribution of the cognitive domain posttest scores of the two groups.

Table 3 shows that control group achieved a significant higher posttest scores compared with the experimental group. Specifically, the control group achieved a total mean posttest score of 69.17 (total of 100 points). Particularly, a posttest mean score of 46.33 was attained in the knowledge level (total of 60 points), a mean score of 13.17 in the comprehension level (total of 20 points), and 9.67 in the application level (total of 20 points). On the other hand, experimental group students attained a total posttest score of 57.00 (total of 100 points). In particular, the students obtained a mean score of 38.17 in the knowledge level (total of 60 points), a mean score of 10.50 in the comprehension level (total of 20 points), and 8.33 in the application level (total of 20 points). The independent samples t-test indicated a highly significant difference between the total mean posttest scores of the two groups. This result implied that the students who used the interactive digital game performed significantly poorer in the cognitive domain achievement test compared with the students who used the booklet.

Gain Scores

Table 3 presents the cognitive domain gain scores of the experimental and control group. Gain scores were computed by subtracting the posttest mean scores from the pretest mean scores. Based from the table, the control group attained a significant higher gain scores compared with the experimental group. Specifically, the control group attained a total mean gain score of 21.17 in all 3 levels. In particular, a mean score of 13.00 was obtained in the knowledge level, a mean score of 4.33 in the comprehension level, and 3.83 in the application level. On the other hand, the experimental group students achieved a total mean gain score of 12.17 in all 3 levels. The students attained a mean gain score of 6.34 in the knowledge level, a mean gain score of 3.17 for the comprehension level, and a mean gain score of 2.67 in the application level.
Differences in Cognitive Domain Achievement Scores between Two Groups

An independent samples t-test showed no significant differences on the total pretest scores of the experimental group and control group \((t = -0.851^m, p > 0.05)\). Specifically, no significant differences were found in the knowledge level \((t = -0.446^m, p > 0.05)\), comprehension level \((t = -1.099^m, p > 0.05)\) and application level \((t = -0.125^m, p > 0.05)\). This result indicated that both groups had equal prior knowledge on selected topics of Fundamental English.

On the other hand, an independent samples t-test showed a highly significant difference on the total posttest scores of the experimental and control groups \((t = 3.734^{***}, p < 0.05)\). In particular, a highly significant difference was found in the knowledge level \((t = -3.686^{***}, p < 0.001)\). However, no significant difference was found in the comprehension level \((t = -1.785^m, p > 0.05)\) and the application level \((t = -0.950^m, p > 0.05)\). This result implied that booklet users performed better than the interactive digital game users in terms of remembering previously learned material.

Lastly, an independent samples t-test indicated a significant difference in overall gain scores of the experimental group and control group \((t = -3.169^{**}, p < 0.05)\) with a standard deviation of 12.01 for the control group and 9.87 for the experimental group (Table 3). This result implied that although the use of interactive digital game \((\bar{X} = 12.17, S.D = 9.87)\) made a significant improvement in students' recall, comprehension, and application of learned material, it did not appear to be as effective compared with the use of the booklet \((\bar{X} = 21.17, S.D = 12.01)\). In particular, independent samples t-test showed a significant difference in gain scores of the two groups in the knowledge level \((t = -2.760^{**}, p < 0.01)\). However, no significant differences were found in gain scores in the comprehension level \((t = -1.208^m, p > 0.05)\) and application level \((t = -0.965^m, p > 0.05)\). This result implied that the booklet was effective in helping students remember previously learned lessons but not in terms of helping students understand key concepts and apply learned information.
Distribution of Cognitive Domain Achievement Scores between Two Groups

1. Cognitive Domain Posttest Scores of the Control Group

The cognitive domain achievement test consisted of 100 points. The control group participants achieved a total pretest mean score of 48.00 and an increased posttest mean score of 69.17 (Table 3).

Table 4 shows the percentage and frequency distribution of the cognitive domain posttest scores of the control group. In the knowledge level, half of the students attained posttest scores in the range of 46-60 points while 40 percent attained scores in the range of 31-45 points. Only 10 percent of the students attained posttest scores in the range of 16-30 points.

In the comprehension level, a total of 33.30 percent of the students achieved posttest scores in the range of 11-15 points while 30 percent obtained scores in the range of 6-10 points. Also, about 23.30 percent of the students attained posttest scores in the range of 16-20 points while only 13.30 percent achieved posttest scores in the range of 0-5 points.

In the application level, a total of 36.70 percent of the students attained posttest scores in the range of 0-5 points while 33.30 percent got scores in the range of 11-15 points and 26.70 percent attained scores in the range of 6-10 points. Only 3.30 percent of the students obtained posttest scores in the range of 16-20 points.

2. Cognitive Domain Posttest Scores of the Experimental Group

The experimental group participants obtained a total pretest mean score of 44.83 in the cognitive domain achievement test and an increased posttest mean score of 57.00 (Table 3).

Table 4 shows the percentage and frequency distribution of cognitive domain posttest scores of the experimental group students. In the knowledge level, sixty percent of the students attained posttest scores in the range of 31-45 points while 26.70 percent attained posttest scores in the range of 16-30 points. Only 13.30 percent achieved posttest scores in the range of 46-60 points.

In the comprehension level, thirty percent of the students achieved posttest scores in both the ranges of 0-5 points and 6-10 points while 26.70 percent achieved scores in the range of 11-15 points. Only 13.30 percent achieved posttest scores in the range of 16-20 points.
In the application level, a total of 43.30 percent of the students attained posttest scores in the range of 0-5 while 33.30 percent attained scores in the range of 6-10 points. Furthermore, twenty percent of the participants attained posttest scores in the range of 11-15 points while 3.30 percent attained scores in the range of 16-20 points.

**Objective 2: Student Achievement in the Psychomotor Domain**

This section addresses the differences in psychomotor domain achievement of the experimental and control group participants. Independent samples t-test and measures of central tendency (mean, standard deviation, and percentage) were used in data analyses. The level of significance chosen was .05.

**Psychomotor Domain Achievement**

All 60 student participants were asked to answer the psychomotor domain achievement test during the pretest and posttest phases of the study. The test consisted of 100 items and categorized into two parts: imitation level and manipulation level. Student scores were analyzed using independent samples t-test and descriptive statistics to determine the extent of skills acquired by the experimental and control group students.

**Pretest Scores**

Results of psychomotor domain pretest scores between the two groups are presented in Table 5. Out of 100 points, the control group attained a total mean score of 32.83 (total score of 100 points). Specifically, the students attained a mean score of 7.83 in the imitation level (total of 20 points) and a mean score of 25.00 in the manipulation level (total of 80 points). On the other hand, the experimental group students attained a total mean score of 29.34 (total score of 100 points). Specifically, the students attained a mean score of 6.67 in the imitation level (total of 20 points) and a mean score of 22.67 in the manipulation level (total of 80 points). Results of an independent samples t-test showed no significant difference between the total pretest mean scores of the two groups. This result implied that students in both groups had equal
skills related to the selected topics in Fundamental English presented in the interactive digital game and booklet.

**Posttest Scores**

Upon the use of the interactive digital game by the experimental group and booklet by the control group, the same psychomotor domain achievement test was administered among the student participants to compare the extent of skills acquired. Table 5 shows the percentage and frequency distribution of psychomotor domain posttest scores of the two groups. The table shows that the control group achieved higher posttest scores compared with the experimental group. The control group attained a total posttest mean score of 57.16 (total score of 100 points). Specifically, a mean score of 15.83 was attained in the imitation level (total of 20 points) and 41.33 in the manipulation level (total of 80 points). On the other hand, the experimental group attained a total posttest mean score of 47.50 (total score of 100 points). Specifically, participants obtained a mean score of 10.83 in the imitation level (total of 20 points) and 36.67 in the manipulation level (total score of 80 points).

An independent samples t-test showed a significant difference between the total posttest mean scores of the two groups. This result implied that the students who used the interactive digital game performed significantly poorer in the psychomotor domain achievement test compared with the students who used the booklet.

**Gain scores**

Table 5 shows the psychomotor domain achievement gain scores of the experimental group and control group. Gain scores were computed by subtracting the posttest mean scores from pretest mean scores. Based from the table, the control group attained higher psychomotor domain gain scores compared with the experimental group. Specifically, the control group students attained a total mean score of 24.33 in all levels. In particular, a mean score of 8.00 was attained in the imitation level and 16.33 in the manipulation level. On the other hand, experimental group students achieved a total mean score of 18.17 in all levels. Specifically, students attained a mean score of 4.17 in the imitation level and a 14.00 in the manipulation level.
Differences in Psychomotor Domain Achievement Scores between Two Groups

An independent samples t-test showed no significant differences in the total pretest scores of the experimental and control groups ($t = -0.756^a$, $p > 0.05$). Specifically, no significant differences were found in the imitation level ($t = -0.779^a$, $p > 0.05$) and the manipulation level ($t = -0.658^a$, $p > 0.05$). This result indicated that both groups had equal prior skills related to selected topics in Fundamental English.

On the other hand, an independent samples t-test revealed a significant difference in the total posttest scores of the experimental group and control group ($t = -2.475^*$, $p < 0.05$). In particular, a highly significant difference was found in the posttest scores of the two groups in the imitation level ($t = -4.002^{***}$, $p < 0.001$) but no significant difference were found in the posttest scores of the two groups in the manipulation level ($t = -1.621^a$, $p > 0.05$). This result implied that booklet users performed better in terms of following or imitating learned information compared to interactive digital game users.

Finally, an independent samples t-test showed a significant difference in the overall gain scores of the experimental group and control group ($t = -2.282^*$, $p < 0.05$) with a standard deviation of 11.20 for the control group and 9.69 for the experimental group (Table 4). A review of descriptive statistics showed that although the use of the interactive digital game ($\bar{X} = 18.17$, S.D = 9.69) made an improvement in students' ability to duplicate and perform learned information, it did not appear to be as effective compared with the use of the booklet ($\bar{X} = 24.33$, S.D = 11.20). Specifically, independent samples t-test showed a significant difference in gain scores in the imitation level ($t = -2.755^{**}$, $p < 0.01$). However, no significant difference were found in gain scores in the manipulation level ($t = -1.114^a$, $p > 0.05$). This result implied that the use of the booklet was more effective in terms of students' ability to duplicate learned information but not in terms of students' ability to perform certain actions by following instructions.
Distribution of Psychomotor Domain Achievement Posttest Scores of the Two Groups

1. Psychomotor Domain Posttest Scores of the Control Group

The psychomotor domain achievement test consisted of 100 items. The control group participants achieved a total pretest mean score of 32.83 and an increased posttest mean score of 57.16 (Table 5).

Table 6 shows the percentage and frequency distribution of control group’s psychomotor domain posttest scores. In the imitation level, forty percent of the students attained posttest scores both in the ranges of 11-15 points and 16-20 points while 16.70 percent attained scores in the range of 6-10 points. Only 3.30 percent of the control group students attained posttest scores in the range of 0-5 points.

In the manipulation level, a total of 63.30 percent of the students achieved posttest scores in the range of 21-40 points while 33.30 percent obtained posttest scores in the range of 41-60 points. Only 3.30 percent of the students attained posttest scores of 0-20 points.

2. Psychomotor Domain Posttest Scores of the Experimental Group

The experimental group students obtained a total pretest mean score of 29.34 in the psychomotor domain test and an increased total posttest mean score of 47.50 (Table 4).

On the other hand, table 6 also shows the percentage and frequency distribution of psychomotor achievement posttest scores of experimental group students. In the imitation level, a total of 33.30 percent of the students attained posttest scores both in the range of 0-5 points and 6-10 points while 16.70 percent attained posttest scores both in the range of 11-15 points and 16-20 points.

In the manipulation level, a total of 53.30 percent of the experimental group students obtained posttest scores in the range of 21-40 points while 30 percent attained posttest scores in the range of 41-60 points. Only 16.70 of the students attained posttest scores in the range of 0-20 points.
Discussion of Results of Cognitive Domain and Psychomotor Domain Achievement of the Two Groups

This study compared students’ scores after the use of the interactive digital game, designed to motivate students and present instructional messages using on-screen texts, and a print media which presented instructional messages using texts and pictures. Results of data analysis indicated that the use of the interactive digital game did not significantly improve participants’ cognitive and psychomotor domain achievement when compared with the use of the booklet. This result coincided with the study conducted by Buaclee (2010) which found that participants exposed to a traditional lecture presentation obtained higher cognitive and psychomotor domain test scores compared students who used a print media and digital game simulation respectively.

The first explanation for the significant difference of cognitive and psychomotor domain achievement between the two groups might be taken from the multimedia principle of the cognitive theory of multimedia learning (Mayer, 2001). The multimedia principle states that people learn more deeply from words and graphics than from words alone (Mayer, 2003: 297-313). Also, meaningful learning occurs when words and pictures in a lesson are transformed and processed through the learner’s working memory so that they are incorporated into the existing knowledge in long-term memory (Clark & Mayer, 2008: 37). Previous research has provided evidence on learning gains that resulted from combining text and relevant graphics in multimedia lessons. For example, in an experimental study conducted by Mayer (1989) and Mayer & Gallini (1990), students who read a text containing captioned illustrations placed near the corresponding words generated about 65% more useful solutions on a subsequent problem-solving transfer test than students who simply read the text. In this present study, the learning content of the interactive digital game was presented using plain and unformatted texts without supporting graphics (Appendix Figure 14). Also, the contents did not include visual signals such as highlights, formatted texts, or symbols to emphasize important information that could help students to process information better (Appendix Figure 15). As a result, the experimental group did not engage in active learning – cognitive processes that are intended to help the students make sense of the material such as the construction of coherent mental representations. In contrast, the
booklet presented the learning content using texts and illustrations (Appendix Figure 3 to 8). The texts were formatted or styled and the illustrations supported the learning objectives. Thus, the chance of learning a lesson using words alone would be lower compared with a lesson that is presented involving words and relevant pictures.

Secondly, the explanation of the result may reside in the participants' prior knowledge and skills of the learning content. There is evidence that the use of texts and graphics is particularly important for learners who have low knowledge and skills of the learning content (novices) rather than learners who have high knowledge and skills of the learning content (experts) (Clark & Mayer, 2008: 68). Previous studies on a series of three experiments involving lessons on brakes, pumps, and generators reported that "novices" learned better from text and illustrations than from words alone, but "experts" learned equally well from both conditions (Mayer and Gallini, 1990: 64-73). The more experienced learners were able to create their own mental images as they read the text about how the pump works, whereas the less experienced learners need help in relating the text to a useful pictorial representation. In this present study, a review of descriptive statistics showed that the control group achieved a total mean pretest score of 48.00 out of 100 points in the cognitive domain achievement test while the experimental group attained a total mean pretest score of 44.83. Moreover, the control group attained a total mean pretest score of 32.83 out of 100 points in the psychomotor domain achievement test while the experimental group attained a total mean pretest score of 29.34. Based from these results, the participants were considered novices or learners with low knowledge and skills of the learning contents presented in the interactive digital game and booklet. Thus, students with low knowledge on the learning content will learn more with texts and graphics than texts alone.

Finally, the results of the study may be related to the limited capacity assumption of the cognitive theory of multimedia learning. This assumption states that learners undergo three cognitive processing demands when presented with multimedia lessons: extraneous, essential, and generative processing. But if a multimedia presentation promoted all of these cognitive processing demands, learning will be hindered because learner's cognitive system will be overloaded (Mayer, 2003: 57). In order not to overload the mind's capacity for processing
information, multimedia presentations should enable learners to carry out active processes by managing essential processing, reducing extraneous processing, and fostering generative processing for meaningful learning to occur (Mayer, 2003: 57).

Managing essential processing can be accomplished by applying the segmenting, pre-training, and modality principles of the cognitive theory of multimedia learning. Specifically, the segmenting principle states that people learn better when multimedia messages are presented in a user-paced format rather than as a continuous unit. Clark and Mayer (2008: 185) asserted that when an unfamiliar learner receives a continuous presentation containing a lot of interrelated concepts, the likely result is that the cognitive system becomes overloaded. The reason is because the learner does not have sufficient cognitive capacity to engage in the essential processing required to understand the material. In the case of the interactive digital game used in the present study, the segmenting principle was applied since participants learned References, Topic, and Main Idea by reading on-screen texts in a segmented version. In the presentation, the participants could click a “Next” button to see a part of the whole content (Appendix Figure 19). Since most of the participants were unfamiliar with the material, they were able to control the time and consolidate what was just presented. Next, the pre-training principle states that learning occurs from a multimedia presentation when people learn essential information in advance especially if the contents are considered complex (Clark & Mayer, 2008: 190-193). The interactive digital game used in this study did not present the key terms or essential material in the lesson in advance. Since the student participants have a low prior knowledge on the content, their cognitive system was overwhelmed. Lastly, the modality principle states that people learn better from animation and audible narration than from animation and on-screen or printed text. This relates directly to the Theory of Dual Coding (Paivio, 1969: 241-263) which suggests that we have two types of working memory, one verbal and one visual, and that we learn best when both channels are used together, rather than overloading one or the other. The interactive digital game used in this study did not apply the modality principle since on-screen texts alone were used to present information. In the case of the design of the interactive digital game in the present study, essential processing was not managed well.

Aside from managing essential processing, multimedia presentations should also aim to reduce extraneous processing by applying the coherence, signaling, redundancy, and
contiguity principles (Mayer, 2003: 297-313). The coherence principle states that people learn better when extraneous material such as irrelevant video, animation, pictures, narration, and sounds are excluded. The interactive digital game used in the study presented the learning content using on-screen texts but with extraneous animation, narratives, and pictures that were not considered relevant to the content to be learned. Therefore, students' working memory was overloaded by the entertainment and activities before the students got to the lesson to be learned. Next, the signaling principle states that people learn better when cues that highlight the organization of the essential material are added. The interactive digital game used in this study did not apply the signaling principle since the learning contents were presented using on-screen texts without visual cues such as highlights, symbols, or arrows to emphasize certain information (Appendix Figure 20). As a result, students had difficulty organizing information into coherent models. On the other hand, the redundancy principle states that people learn better when animation and narration are not combined with printed text. The interactive digital game used in this study applied this principle since the presentation of contents did not involve concurrent animation, narration, and printed text. Finally, the contiguity principle states that people learn better when corresponding words and pictures are presented simultaneously, both temporally and spatially. Temporal contiguity means that corresponding words and pictures should be presented at the same time, while spatial contiguity means that corresponding words and pictures should be presented near rather than far from each other on a page or screen. The interactive digital game used in this study did not apply this principle since the on-screen texts, which were divided into chunks, lacked pictures that may help describe the learning content being presented. In the case of the design of the interactive digital game in the present study, extraneous processing was not reduced effectively.

Aside from managing essential processing and reducing extraneous processing, multimedia presentations should also foster generative processing by applying the personalization and voice principles (Mayer, 2003: 297-313). The personalization principle states that people learn better when words are in conversational style rather than formal style and pedagogical agents or on-screen characters to help guide the learning process. The interactive digital game used in this study applied the personalization principle by using a fantasy world setting with attractive graphics. Interactions with non-player characters, like the great master of Eternia,
soldier of Eternia, the oldest tree, Olsha the blacksmith, and the bartender, also provided a 
friendly learning environment to the participants. These design elements motivated players and 
made them feel like they were in a conversation with a partner. Finally, the voice principle states 
that people learn better when the words in a multimedia message are spoken by a friendly human 
voice rather than a machine voice. The interactive digital game used in this study did not follow 
the voice principle since the learning contents were presented using on-screen texts. In the case of 
the design of the interactive digital game in the present study, generative processing was fostered. 

The use of the interactive digital game in this present study did not significantly 
improve participants’ cognitive and psychomotor domain achievement when compared with the 
use of the booklet. Therefore, based from the discussion above, this result supported the idea that 
multimedia presentations that manage essential processing, reduce extraneous processing, and 
foster generative processing will help students understand content by engaging in relevant 
cognitive processing such as attending to the relevant information in the lesson, mentally 
organizing the information into a coherent cognitive representation, and mentally integrating the 
information with their existing knowledge.
Table 3 Cognitive domain achievement scores of experimental and control group participants

<table>
<thead>
<tr>
<th>Cognitive Domain</th>
<th>n</th>
<th>Pretest Scores</th>
<th>Posttest Scores</th>
<th>Gain Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>n</td>
<td>X</td>
<td>S.D.</td>
</tr>
<tr>
<td>1. Knowledge Level</td>
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<td>30</td>
<td>33.33</td>
<td>12.34</td>
</tr>
<tr>
<td>(60 points)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Group</td>
<td></td>
<td>30</td>
<td>31.83</td>
<td>13.68</td>
</tr>
<tr>
<td>Experimental Group</td>
<td></td>
<td>30</td>
<td>31.83</td>
<td>13.68</td>
</tr>
<tr>
<td>2. Comprehension Level</td>
<td></td>
<td>30</td>
<td>8.83</td>
<td>5.03</td>
</tr>
<tr>
<td>(20 points)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Group</td>
<td></td>
<td>30</td>
<td>7.33</td>
<td>5.53</td>
</tr>
<tr>
<td>Experimental Group</td>
<td></td>
<td>30</td>
<td>7.33</td>
<td>5.53</td>
</tr>
<tr>
<td>3. Application Level</td>
<td></td>
<td>30</td>
<td>5.83</td>
<td>4.93</td>
</tr>
<tr>
<td>(20 points)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Group</td>
<td></td>
<td>30</td>
<td>5.67</td>
<td>5.37</td>
</tr>
<tr>
<td>Experimental Group</td>
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<td>30</td>
<td>5.67</td>
<td>5.37</td>
</tr>
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<td>Total Score of 3 Levels</td>
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<td>13.49</td>
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<tr>
<td>(100 points)</td>
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<td></td>
</tr>
<tr>
<td>Control Group</td>
<td></td>
<td>30</td>
<td>44.83</td>
<td>15.28</td>
</tr>
<tr>
<td>Experimental Group</td>
<td></td>
<td>30</td>
<td>44.83</td>
<td>15.28</td>
</tr>
</tbody>
</table>
Note

\( ns \quad = \quad \text{value is not statistically significant at the .05 level of probability} \)

\( * \quad = \quad \text{value is statistically significant at } p < .05 \text{ level of probability} \)

\( ** \quad = \quad \text{value is statistically significant at } p < .01 \text{ level of probability} \)

\( *** \quad = \quad \text{value is statistically significant at } p < .001 \text{ level of probability} \)

Control group = randomly selected students who were introduced to a booklet

Experimental group = randomly selected students who were introduced to an interactive digital game
### Table 4  Percentage and frequency distribution of cognitive domain posttest scores of experimental and control group participants

<table>
<thead>
<tr>
<th>Levels</th>
<th>Knowledge</th>
<th>Levels</th>
<th>Comprehension</th>
<th>Application</th>
<th>Control Group</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>0 – 15</td>
<td>-</td>
<td>-</td>
<td>4</td>
<td>13.30</td>
<td>11</td>
<td>36.70</td>
</tr>
<tr>
<td>15 – 30</td>
<td>3</td>
<td>10.00</td>
<td>6 – 10</td>
<td>9</td>
<td>30.00</td>
<td>8</td>
</tr>
<tr>
<td>31 – 45</td>
<td>12</td>
<td>40.00</td>
<td>11 – 15</td>
<td>10</td>
<td>33.30</td>
<td>10</td>
</tr>
<tr>
<td>46 – 60</td>
<td>15</td>
<td>50.00</td>
<td>16 – 20</td>
<td>7</td>
<td>23.30</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>100</td>
<td>30</td>
<td>100</td>
<td>30</td>
<td>100</td>
</tr>
</tbody>
</table>

- $\bar{x} = 46.33$
- $\bar{x} = 13.17$
- $\bar{x} = 9.67$
- $\bar{x} = 38.17$
- $\bar{x} = 10.50$
- $\bar{x} = 8.33$
- $S.D. = 8.40$
- $S.D. = 5.33$
- $S.D. = 5.40$
- $S.D. = 8.76$
- $S.D. = 6.21$
- $S.D. = 5.47$
- Min = 25
- Min = 0
- Min = 0
- Min = 20
- Min = 0
- Min = 0
- Max = 60
- Max = 20
- Max = 20
- Max = 60
- Max = 20
- Mode = 50
- Mode = 15
- Mode = 15
- Mode = 35
- Mode = 15
- Mode = 10
Note

\( \bar{x} \) = average score
S.D. = standard deviation
Min = lowest score
Max = highest score
Mode = most occurring score
Total score of 3 cognitive domain levels = a total of 100 points
Control group = randomly selected students who were introduced to a booklet
Experimental group = randomly selected students who were introduced to an interactive digital game
Table 5 Psychomotor domain achievement scores of experimental and control group participants

<table>
<thead>
<tr>
<th>Psychomotor Domain</th>
<th>N</th>
<th>Pretest Scores</th>
<th>Posttest Scores</th>
<th>Gain Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>( \bar{x} )</td>
<td>S.D.</td>
<td>( r )-value</td>
</tr>
<tr>
<td>1. Imitation Level</td>
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<td></td>
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<tr>
<td>(20 points)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Group</td>
<td>30</td>
<td>7.83</td>
<td>6.91</td>
<td>-.779**</td>
</tr>
<tr>
<td>Experimental Group</td>
<td>30</td>
<td>6.67</td>
<td>4.42</td>
<td></td>
</tr>
<tr>
<td>2. Manipulation Level</td>
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<td></td>
</tr>
<tr>
<td>(80 points)</td>
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<td></td>
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<td></td>
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<tr>
<td>Control Group</td>
<td>30</td>
<td>25.00</td>
<td>14.08</td>
<td>-.656**</td>
</tr>
<tr>
<td>Experimental Group</td>
<td>30</td>
<td>22.67</td>
<td>13.37</td>
<td></td>
</tr>
<tr>
<td>Total Score of</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Psychomotor Levels</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(100 points)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Group</td>
<td>30</td>
<td>32.83</td>
<td>18.83</td>
<td>-.756**</td>
</tr>
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<td>Experimental Group</td>
<td>30</td>
<td>29.34</td>
<td>17.01</td>
<td></td>
</tr>
</tbody>
</table>
Note

ns  =  value is not statistically significant at the .05 level of probability
*  =  value is statistically significant at p < .05 level of probability
** =  value is statistically significant at p < .01 level of probability
*** =  value is statistically significant at p < .001 level of probability

Control group  =  randomly selected students who were introduced to a booklet
Experimental group =  randomly selected students who were introduced to an interactive digital game
Table 6 Percentage and frequency distribution of psychomotor domain posttest scores of experimental and control group participants

<table>
<thead>
<tr>
<th>Levels</th>
<th>Imitation</th>
<th>Levels</th>
<th>Manipulation</th>
<th>Levels</th>
<th>Total Score of Psychomotor Domain (2 Levels)</th>
<th>Imitation</th>
<th>Levels</th>
<th>Manipulation</th>
<th>Levels</th>
<th>Total Score of Psychomotor Domain (2 Levels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scores</td>
<td>n</td>
<td>%</td>
<td>Scores</td>
<td>n</td>
<td>%</td>
<td>Scores</td>
<td>n</td>
<td>%</td>
<td>Scores</td>
<td>n</td>
</tr>
<tr>
<td>0 - 5</td>
<td>1</td>
<td>3.30</td>
<td>0 - 20</td>
<td>1</td>
<td>3.30</td>
<td>0 - 25</td>
<td>1</td>
<td>3.30</td>
<td>0 - 5</td>
<td>10</td>
</tr>
<tr>
<td>6 - 10</td>
<td>5</td>
<td>16.70</td>
<td>21 - 40</td>
<td>19</td>
<td>63.30</td>
<td>26 - 50</td>
<td>8</td>
<td>26.70</td>
<td>6 - 10</td>
<td>10</td>
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<tr>
<td>11 - 15</td>
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<td>41 - 60</td>
<td>13</td>
<td>33.30</td>
<td>51 - 75</td>
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<td>5</td>
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<td>2</td>
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<td>100</td>
<td>30</td>
<td>100</td>
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<td>100</td>
</tr>
</tbody>
</table>

$$\bar{x} = 15.83$$

$$\bar{x} = 41.33$$

$$\bar{x} = 57.17$$

$$\bar{x} = 10.83$$

$$\bar{x} = 36.67$$

$$\bar{x} = 47.50$$

S.D = 4.17

S.D = 9.37

S.D = 12.30

S.D = 5.43

S.D = 12.69

S.D = 17.51

Min = 5

Min = 20

Min = 25

Min = 5

Min = 10

Min = 15

Max = 20

Max = 60

Max = 80

Max = 20

Max = 50

Max = 70

Mode = 15

Mode = 40

Mode = 55

Mode = 5

Mode = 40

Mode = 50
Note:

\[ \bar{x} = \text{average score} \]

S.D. = standard deviation

Min = lowest score

Max = highest score

Mode = most occurring score

Total score of 2 psychomotor domain levels = a total of 100 points

Control group = randomly selected students who were introduced to a booklet

Experimental group = randomly selected students who were introduced to an interactive digital game
Objective 3: Attitudes toward the Interactive Digital Game and Traditional Media

This study explored the attitudes of student participants toward the interactive digital game and print media. Attitude questionnaires composed of two parts were used to gather data. The first part of the questionnaire contained open-ended questions while the second part contained Likert scale statements. This section presents the results of thematic analysis concerning participants’ written responses to open-ended questions followed by the results of descriptive analysis concerning participants’ responses to the 5-point Likert scale.

Affective Domain

For the experimental group, ten open-ended questions were developed asking participants what they learned from the experience; how they perceive the interactive digital game’s learning benefits, contents, and features; how they value the contents of the game; how they see the use of digital games in education; and their suggestions for further improvements.

For the control group, the open-ended questions tackled participants’ perceptions toward the booklet’s learning benefits, contents, and features. It also tackled how the participants value the contents of the booklet. Suggestions for further improvements were also collected.

A thematic analysis was employed to analyze students’ responses and detailed results for each of the questions are as follows.

Qualitative Exploration into the Attitudes of Student Participants toward the Interactive Digital Game

Responding and Receiving Level

1. Perceived Benefits of the Digital Game

1.1 Almost all experimental group participants reported that the interactive digital game was effective in teaching them new English vocabulary.
"I learned new English words and vocabulary after playing Eternal Story."
(Agricultural Engineering major, 30 April 2012. written response)

"I gained experience in playing digital educational games. At the same time, I learned new English words."
(Economics major, 30 April 2012. written response)

"I was able to practice my English language skills and learn new vocabulary through my experience in playing the digital game."
(Information Technology major, 30 April 2012. written response)

1.2 Some of the participants responded that the use of digital games in schools makes learning more creative and productive.

"Learning through digital educational games promotes students’ creativity and imagination."
(Public Administration major, 30 April 2012. written response)

"Digital games used in learning a subject are new and fun. It is a new learning media that combines education and entertainment."
(Information Technology, 30 April 2012. written response)

"Digital games could be used in schools so that we could improve our knowledge of a subject and at the same time improve our ICT skills."
(Economics major, 30 April 2012. written response)

1.3 Some of participants responded that the immediate feedback of the interactive digital game (through the form of rewards and encouragement) encouraged them to learn the contents better.
"I was able to practice my English language skills and learn new vocabulary because of the feedback I get from the game."

(Renewable Energy major, 30 April 2012. written response)

1.4 Some of the participants responded that interacting with other players in the game using the chat feature was useful in improving their English language skills.

"The chat function of the game encouraged me to talk to other players. I could also use it to interact with my classmates so that we could help each other solve the challenges."

(Food Engineering major, 30 April 2012. written response)

2. Perceived Ease and Difficulty of Contents

2.1 Almost all of the participants responded that the contents of the game were difficult to understand because they were not familiar with most of the English words used, they do not know how to play the game, and the game instructions were not very clear.

"The contents in the game were difficult to understand because I am not familiar with most of the English words used. But if a student is familiar with the English words used, then I may say that the game would be easy."

(Renewable Energy major, 30 April 2012. Written response)

"The contents of the game were difficult to understand because I don’t have enough knowledge of the English language."

(Agricultural Engineering major, 30 April 2012. written response)

"I really cannot understand the words and even the terms used in some contents."

(Information Technology major, 30 April 2012. Written response)

"There were many unfamiliar words."

(Public Administration major, 30 April 2012. Written response)
"I had difficulty understanding the contents because the game contained messy and confusing things."

(Renewable Energy major, 30 April 2012. Written response)

"There were always challenges."

(Finance major, 30 April 2012. Written response)

"There were too many tasks and challenges."

(Economics major, 30 April 2012. Written response)

"I had difficulty understanding the contents because I haven’t experienced playing this game before or any MMORPG."

(Cooperative Economics major, 30 April 2012. written response)

"The contents of the game were difficult to understand because the instructions were not clear."

(Agricultural Engineering major, 30 April 2012. written response)

"It was hard to distinguish what the purpose of the game was."

(Public Administration major, 30 April 2012. written response)

2.2 On the other hand, three students responded that the contents were easy to understand because of the game type and the use of simple English words.

"The contents in the digital game were easy to understand because simple English words were used."

(Food Engineering major, 30 April 2012. written response)

"The English vocabulary used was not so confusing."

(Cooperative Economics major, 30 April 2012. written response)
"The contents were easier to understand because of the game type. Usually, MMORPGs are easy to play.

(Public Administration major, 30 April 2012. written response)

3. Perceived Features of the Digital Game

3.1 Almost all of the participants responded that the attractive design, pictures, fantasy context, sound, and interface of the game increased their interest and motivation to study the contents.

"It (Eternal Story) has 3D graphic illustrations, fantasy in the story, a colorful background, and lively sounds that is why it was interesting for me."

(English major, 30 April 2012. written response)

"The interesting format and attractive design helped us understand the contents of the game easily."

(Economics major, 30 April 2012. written response)

"The attractive colors make it more interesting and it can attract the readers. The interface of the game was also motivating."

(Public Administration, 30 April 2012. written response)

3.2 Some of the participants responded that embarking on the game’s quests, the challenge involved in completing a quest, and accomplishing the tasks were motivating.

"Completing the game missions and figuring out the steps to finish the quests motivated me to continue playing. Increasing my character’s level was also motivating."

(Information Technology major, 30 April 2012. written response)
"A part of the game which I think was motivating was the quiz one has to complete. Answering quizzes challenges the players."

(Economics major, 30 April 2012. written response)

"I am motivated by the new English words I encounter while playing Eternal Story and it was fun to talk to the other characters to search for the answers."

(Economics major, 30 April 2012. written response)

"I consider the tools trading feature interesting."

(Agricultural Engineering major, 30 April 2012. written response)

"Although the story of the game was quite confusing, the game was also, in a way, motivating because of the various activities a player has to complete."

(Food Engineering major, 30 April 2012. written response)

3.3 Some of the participants agreed that their interactions with the non-player characters helped them gain knowledge and motivated them to practice their English conversation skills.

"I am motivated to continue playing because of the new English words I encountered; and it was fun to talk to the other characters to search for the answers."

(Public Administration major, 30 April 2012. written response)

"I gained knowledge from my interactions with the wizard, the soldier, and the other characters."

(English major, 30 April 2012. written response)

"It was fun playing Eternal Story. I felt relaxed and willing to learn more."

(Economics major, 30 April 2012. Written response)
"Eternal Story is fun and attractive to play."

(Food Engineering major, 30 April 2012. Written response)

3.4 Two participants reported that the click-and-point feature of the game was not motivating.

"The click and point feature of the game was not really motivating, it should be more varied that this."

(Renewable Energy major, 30 April 2012. written response)

"It was not because I do not know how to play an online game, but every time I click the mouse my character does not follow. It just goes back and forth. It's better to read a magazine."

(Food Engineering major, 30 April 2012. written response)

4. Use of Digital Educational Games in Education

4.1 Almost all participants agreed that their instructors would use digital games to engage students in learning English more and make lectures more interesting. Youths of this generation like to play online games because it helps them to relax and lessen stress or boredom.

"Use of digital games can catch the attention of students because it’s fun to play."

(English major, 30 April 2012. written response)

"Yes they can, because I could remember lessons better if we use digital games."

(Economics major, 30 April 2012. Written response)

"The contents of this game are similar to the ones our instructors are teaching so I think they can also use Eternal Story in their lectures."

(Public Administration major, 30 April 2012. written response)
“My professors could use this digital game to help students become skilled in the English language.”

(Cooperative Economics, 30 April 2012. written response)

“My professors in MJU will use digital games because it is a media that is absorbing and it can encourage learning.”

(Public Administration major, 30 April 2012. written response)

“My professors should use it to enable students to understand subjects easily. Digital games are now used in modern education.”

(Public Administration major, 30 April 2012. written response)

“I think they should use it because adopting the latest technologies in learning means being included in the development of the world.”

(Economics major, 30 April 2012. written response)

“My professors could use this game because playing digital games allows a person to learn and at the same time have fun.”

(Economics major, 30 April 2012. written response)

“The use of digital games in schools could motivate students and increase their skills of using new technologies.”

(English major, 30 April 2012. written response)

“Playing digital games makes lessons easier to remember.”

(Agricultural Engineering major, 30 April 2012. written response)

“The use of digital educational games in schools could teach a subject and help motivate students.”

(Finance major, 30 April 2012. written response)
4.2 On the other hand, four participants responded that their instructors would not use digital games to teach because students could be distracted and that games are mainly suited among elementary and high school students.

"My professors will not use digital games to teach because these games are only suitable among elementary or high school students."

(Food Engineering major, 30 April 2012. written response)

"The use of digital games by professors could cause distraction to students."

(Economics major, 30 April 2012. written response)

"My professors will not use digital games to teach because a lot of students could be distracted in learning the subject when they start to play games."

(Renewable Energy major, 30 April 2012. written response)

"No. Because if we play games too much, we could be addicted to it and we’ll have lesser time to study other subjects."

(Economics major, 30 April 2012. written response)

Valuing Level

5. Value of Learning the Contents of the Digital Game

5.1 All participants responded that the contents of the digital game could help improve their knowledge of the English language. Learning the English language may help them in their studies and broaden their understanding of English.

"Studying the contents was beneficial for me because we have to speak English to talk to foreigners."

(Finance major, 30 April 2012. written response)
"My English language skills would improve and it would be useful especially when talking to foreigners."

(Public Administration major, 30 April 2012. written response)

"I could read foreign books."

(Public Administration major, 30 April 2012. written response)

"English is very important. Everyone should not only study it but also use it in their daily lives."

(English major, 30 April 2012. written response)

"Learning the contents of the game was important for me because it was related to our lessons in English course."

(English major, 30 April 2012. written response)

"Learning the selected topics in Fundamentals English was important because it could improve our grades."

(Public Administration major, 30 April 2012. written response)

5.2 Some of the participants agreed that learning the contents may be useful in future careers.

"Learning the topics in the game would be useful in one's career because it would encourage proper conversation in the workplace."

(Economics major, 30 April 2012. written response)

5.3 Some of the participants responded that learning the selected topics in the game was important because the knowledge gained may be used to teach other members of the family and at the same time converse with them.
“Learning the contents of the game was important because I could use the knowledge to teach my younger siblings.”

(Economics major, 30 April 2012. written response)

“I could have conversations with my relatives living abroad.”

(Information Technology major, 30 April 2012. written response)

5.4 All participants answered that learning the selected topics in the game was important because the knowledge gained may be used to teach friends.

“I could use the knowledge I gained by helping to teach my friends so they may also improve their grades in English course.”

(Public Administration major, 30 April 2012. written response)

“I could use this knowledge to teach my friends. We could help one another by exchanging ideas so that we could improve our knowledge of English and develop better communication skills.”

(Economics major, 30 April 2012. written response)

6. Comments for Further Improvement

6.1 Almost all of the students agreed that there should be a clear tutorial explaining the game objectives, missions, and how the game works before actual play.

“A video tutorial should be included so that the game story and objectives would be clearer for the players.

(Food Engineering major, 30 April 2012. written response)

“There should be a clear tutorial explaining the game objectives, missions, and how the game works before the actual play.”

(Finance major, 30 April 2012. written response)
“The instructions and explanations of objectives in each quest must be improved to make the game more motivating to play.”

(Public Administration major, 30 April 2012. written response)

6.2 Some of the participants responded that the game design should be enhanced. It should consist of clear texts, organized content, non-technical words, and varied game environments.

“The passages contain too many sentences that could lead to confusion and deviation from the real meaning.”

(Information Technology major, 30 April 2012. written response)

“Language used in daily life must be used instead of words used in a fantasy world.”

(Economics major, 30 April 2012. written response)

Qualitative Exploration into the Attitudes of Student Participants toward the Traditional Media

Responding and Receiving Level

1. Perceived Benefits of the Booklet

1.1 Almost all of the participants responded that the booklet taught them additional knowledge on the definition and use of references, topic, and main idea.

“I was able to learn the correct use of references and I was able to identify topic and main idea in passages.”

(Economics major, 30 April 2012. written response)

“I learned the proper use of references and the method of identifying the topic and main idea.”

(Accounting major. written response. 20 April 2012)
“I was able to learn the words used as references and the method of identifying the topic and main idea.”

(Food Science and Technology major, 30 April 2012. written response)

“I learned how to identify reference words, topic, and main idea from sentences. I was able to understand faster.”

(Public Administration major, 30 April 2012. written response)

“I learned references (learn how to use demonstrative words), topic (learn the method of writing), and main idea (learn how to observe the main idea in the passages) which I can use in the future.”

(Accounting major, 30 April 2012. written response)

“I learned how to identify the main idea clearly which was important in understanding a passage.”

(Economics major, 30 April 2012. written response)

“I learned to identify the use of references and the steps to identify the topic and main idea, which are usually difficult.”

(Renewable Energy major, 30 April 2012. written response)

2. Perceived Ease and Difficulty of Contents

2.1 Majority of the participants responded that the design of the booklet made it easier for them to understand the contents.

“The lay-out, illustrations, and the lively colored pictures lead to easier understanding of the contents.”

(Public Administration major, 30 April 2012. written response)
“The contents have been written and arranged well for better understanding.”
(Economics major, 30 April 2012. written response)

2.2 A few of the participants responded that the availability of Thai translations helped them understand the contents.

“The availability of Thai explanations helped me understand the contents better.”
(Renewable Energy major, 30 April 2012. written response)

“I usually do not like to read English magazines but there were Thai translations in this booklet that is why reading it leads to easy understanding.”
(Computer Science major, 30 April 2012. written response)

3. Perceived Features of the Booklet
3.1 Almost all of the participants were motivated to learn the contents of the booklet because of its attractive design.

“The lively colors and pictures in the booklet made it easier to understand the contents.”
(Food Science and Technology major, 30 April 2012. written response)

“The fonts and text used encouraged easy reading.”
(Renewable Energy major, 30 April 2012. written response)

“The front cover was interesting that’s why I was motivated to read the contents.”
(Economics major, 30 April 2012. written response)

“The concept of the booklet prevented boredom.”
(Public Administration major, 30 April 2012. written response)
"The concept of the booklet was motivating for me. It encourages students to read more English magazines in the future."

(Economics major, 30 April 2012. written response)

"That is like things that are interesting and colorful and texts that are arranged properly."

(Information Technology major, 30 April 2012. written response)

3.2 Some of the participants reported that the use of simple English words motivated them to learn the contents of the booklet.

"The booklet contained simple and clear words to explain the contents. It can be understood by anyone."

(Economics major, 30 April 2012. written response)

3.3 The availability of Thai explanations motivated some of participants to learn the contents of the booklet.

"The booklet contained explanations in Thai. This made me understand the contents better."

(Renewable Energy major, 30 April 2012. written response)

"The contents were easy to learn because of the examples, pictures, and Thai explanations."

(Public Administration major, 30 April 2012. written response)

Valuing Level

4. Value of Learning the Contents of the Booklet

4.1 Almost all of the participants responded that the contents of the booklet may help improve their grades in school. Learning the contents of the booklet is also important for communication and self-development.
“Learning the contents can be an added knowledge for me to improve my grades.”

(Food Science and Technology major, 30 April 2012. written response)

“I could improve my knowledge so that I could read more English books.”

(Economics major, 30 April 2012. written response)

“The knowledge obtained from this booklet could encourage us to practice and use English.”

(English major, 30 April 2012. written response)

“Learning to identify the topic could help me improve my understanding of English texts.”

(Accounting major, 30 April 2012. written response)

“English is an important language that every Thai has to learn.”

(English major, 30 April 2012. written response)

“For me, being good at English is very important. It allows me to communicate more to other people, especially to foreigners.”

(Public Administration major, 30 April 2012. written response)

4.2 Almost all of the participants agreed that learning the contents of the booklet may be useful in future careers because the use of proper English would improve business activities and establish better relationship especially among foreigners.

“Proper use of English language could be useful in improving business activities and establishing better relations especially with foreigners.”

(English major, 30 April 2012. written response)
4.3 Learning the selected topics covered in the booklet were important to almost all of the participants because the knowledge gained may be used to teach their family.

"The contents of the booklet can be taught to other members of my family."

(Agricultural Engineering major, 30 April 2012. written response)

4.4 Learning the selected topics in the booklet was important to majority of the participants because the knowledge gained may be used to teach friends.

"I could teach the knowledge I gained to my friends. We could review together; practice our skills in speaking, pronunciation, or translating. These are all parts of the process of learning a language."

(English major, 30 April 2012. written response)

5. Comments on Further Improvement

5.1 Some of the participants suggested that colors and illustrations in the booklet should be enhanced.

"The colors should be enhanced and more interesting illustrations should be added."

(Computer Science major, 30 April 2012. written response)

"The illustrations outnumbered the text."

(Accounting major, 30 April 2012. written response)

5.2 Almost all of the participants agreed that drills or exercises could be included in the booklet.

"Exercises/drills at the end of every section must be added. Answers with detailed explanations should also be provided."

(Public Administration major, 30 April 2012. written response)
"A section displaying difficult words with their meanings should be included."

(Food Science and Technology major, 30 April 2012. written response)

Discussion of Results of Qualitative Exploration on the Attitudes of Student Participants toward the Interactive Digital Game

Receiving and Responding Levels

Almost all of the participants responded positively to the benefits, features, and use of the interactive digital game. Regarding the game’s benefits, most participants reported that the game was effective in teaching them new English vocabulary. One explanation for this was because the game required the participants to explore the game’s fantasy environment, interact with non-player characters, and accomplish tasks and game quests that consisted of English words that were new to majority of them. The participants also responded that the use of digital games to learn a subject were new and fun. Most of them agreed that using digital games in school may help improve students’ knowledge of a subject and their ICT skills. Moreover, the immediate feedback feature of the game encouraged the participants to learn the contents better. Interacting with other players in the game using the chat feature was also useful to the participants in terms of improving their English language skills.

With regard to the content of the interactive digital game, almost all participants had difficulty understanding the contents because they do not know how to play the game, they were not familiar with most of the English words used, and the game instructions were not clear.

For the perceived features of the game, almost all of the participants were motivated by the attractive design, pictures, fantasy context, sound, and interface. Also, some of the participants responded that the game quests, challenges, and goals were motivating. Moreover, some of the participants agreed that their interactions with the non-player characters helped them gain knowledge of the contents and motivated them to practice their English conversation skills. On the other hand, two participants reported that the click and point feature of the game was not motivating and may sometimes cause learners to get bored and frustrated.

Majority of the participants agreed that their instructors would use digital games to teach because it could motivate students and increase their knowledge and skills. Youths of this
generation like to play online games because playing games can help one relaxed and prevent stress or boredom. On the other hand, there were a few participants who responded that their instructors would not use digital games to teach because students could be distracted and that games are mainly suited among elementary and high school students.

**Valuing Level**

Concerning the value of learning the contents of the digital game, all participants responded that the contents of the game could help improve their knowledge and skills of the English language. Learning the English language may help them in their studies and broaden their understanding. Also, some of the participants responded that learning the contents of the game was important because the knowledge gained may be used to teach their friends and other members of the family and at the same time converse with them.

Finally, almost all of the students suggested that there should be a clear tutorial explaining the game’s controls, objectives, and missions before actual play. Also, some of the participants responded that the game design should be enhanced. It should consist of clear texts, organized content, non-technical words, and varied game environments.

**Discussion of Results of Qualitative Exploration on the Attitudes of Student Participants toward the Print Media**

**Receiving and Responding Levels**

Almost all of the participants responded positively to the benefits, features, and use of the booklet. With regard to the benefits of the booklet, majority of the participants responded that the booklet taught them additional skills and knowledge of references, topic, and main idea. Also, majority of the participants understood the contents in the booklet because of its lay-out, illustrations, and clear texts that were organized for better understanding. Lastly, the participants were motivated by the booklet’s attractive colors, styled fonts, lay-out, use of non-technical words, and availability of Thai translations.
Valuing Level

Concerning the value of learning the contents of the booklet, almost all of the participants responded that the contents of the booklet could help improve their grades in school. Learning the contents is also important for communication and self-development. Moreover, the participants agreed that learning the contents of the booklet could be useful in their future careers. The use of proper English could improve business activities and establish better relationships with others, especially among foreigners. The knowledge gained could also be used to teach family and friends. Finally, the participants suggested that the colors should be enhanced. More interesting illustrations should be added, and drills or exercises should be included in the booklet.

Students’ Level of Satisfaction toward the Interactive Digital Game and Traditional Media

The second part of the attitude questionnaire comprised of a 5-point Likert scale that sought to measure the level of student’s agreement or disagreement with the usability, content, engagement, and interface aspects of the interactive digital game and booklet. Respondents were asked to indicate their level of disagreement or agreement with the Likert statements by choosing either 1 as “strongly disagree”, 2 as “disagree”, 3 as “undecided”, 4 as “agree”, and 5 as “strongly agree”.

Experimental Group

All 30 student participants responded to a 5-point Likert scale included in the attitude questionnaire. The questionnaire consisted of 30 statements that were divided into four parts: usability, content, engagement, and interface (Table 7). The usability part contained three statements which focused on the effectiveness, efficiency, and satisfaction toward the use of the interactive digital game. Based on the analysis, the participants strongly agreed that it was fun to play Eternal Story which corresponded to the highest mean value of 4.30. Also, the participants agreed that the digital game is an effective learning media in teaching selected topics in Fundamental English which corresponded to a mean value of 4.13. Moreover, the participants agreed that playing the digital game is worth the time and effort which corresponded to a mean
value of 3.93. Lastly, the participants agreed that it is motivating to learn the contents of the digital game which corresponded to the lowest mean value of 3.67.

The content part of the questionnaire contained five statements which focused on the interactive digital game's goal appropriateness, integration, scaffolding, extensibility, and media matching elements. Based from the analysis, the participants strongly agreed that the digital game helps learners develop better writing and reading comprehension skills which corresponded to the highest mean value of 4.63. Second, the participants strongly agreed that their attitudes toward digital educational games changed for the better after playing Eternal Story with a mean value of 4.33. Third, the participants agreed that the positive feedback of the game is rewarding corresponding to a mean value of 4.13. Fourth, the participants agreed that their attitudes toward English changed for the better after playing Eternal Story corresponding to a mean value of 4.00. Fifth, the participants agreed that learning English was easier by playing Eternal Story with a mean value of 3.93 while the rewards after completing a quest are motivating corresponding to a mean value of 3.77. Finally, the participants agreed that the knowledge learned from the digital game could be applied in real life with the lowest mean value of 3.63.

The engagement part of the questionnaire contained nine statements which focused on the interactive digital game's goals, rules, competition, challenge, fantasy, safety, and entertainment elements. Based from the analysis, the participants strongly agreed that the game setting adds excitement corresponding to the highest mean value of 4.27. Second, the participants strongly agreed that the digital game is entertaining corresponding to a mean value of 4.23. Third, the participants agreed that playing the digital game makes learners comfortable even after failing challenges corresponding to a mean value of 3.83. Fourth, the participants agreed that it is not embarrassing to try again after failing a challenge corresponding to a mean value of 3.80. Fifth, the participants agreed that the goals are motivating corresponding to a mean value of 3.70. Sixth, the participants had a neutral reaction that the goals of the game are achievable and clear corresponding to a mean value of 3.40. Seventh, the participants also had a neutral reaction that the digital game is challenging corresponding to a mean value of 3.37. Eighth, the participants had a neutral reaction that the digital game is competitive corresponding to a mean value of 3.27. Lastly, the participants had a neutral reaction that the rules are clear and the game characters are interesting which corresponded to the lowest mean value of 3.23.
Finally, the interface part of the questionnaire contained nine statements which focused on the interactive digital game’s graphics, text, animation, digital audio, multi-user dialogues, chat, and control button elements. Based from the analysis, the participants strongly agreed that the animation enhances the presentation of information corresponding to the highest mean value of 4.40. Second, participants strongly agreed that the graphics was eye-catching corresponding to a mean value of 4.27. Third, the participants agreed that the game site is well organized and easy to navigate corresponding to a mean value of 3.87. Fourth, the participants agreed that the chat function is useful and the appropriate font is used corresponding to a mean value of 3.67. Fifth, the participants agreed that interacting with the non-player characters is motivating corresponding to a mean value of 3.50. Sixth, the participants agreed that there are too many words on the screen which corresponded to a mean value of 3.43. Seventh, the participants had a neutral reaction that the sound effects keep users motivated corresponding to a mean value of 3.40. Finally, the participants had a neutral reaction that the quality of sound was excellent which corresponded to the lowest mean value of 3.20.

Control Group

All 30 control group participants responded to a 5-point Likert scale included in the attitude questionnaire. The Likert scale consisted of 15 statements that was divided into four parts: usability, content, engagement, and interface (Table 8). The usability part of the questionnaire contained three statements which focused on the effectiveness, efficiency, and satisfaction toward the use of the booklet. Results of the analysis showed that the participants agreed that the booklet is an effective learning media in teaching the selected topics in Fundamentals of English. Likewise, the participants also agreed that reading the booklet is worth the time and effort. These two statements corresponded to the highest mean value of 4.03. Second, the participants agreed that learning the contents of the booklet is motivating corresponding to the lowest mean value of 3.83.

The content part of the questionnaire contained five statements which focused on the booklet’s goal appropriateness, integration, scaffolding, extensibility, and media matching elements. Results of the analysis showed that the participants agreed that their attitudes toward
English changed for the better after reading the booklet corresponding to the highest mean value of 3.90. Second, the participants also agreed that their views toward reading changed for the better after reading the booklet with a mean value of 3.83. Third, the participants agreed that the knowledge learned from the booklet could be applied in real life with a mean value of 3.77. Fourth, the participants agreed that the booklet is interesting and at the same time provides knowledge which obtained a mean value of 3.60. Lastly, the participants agreed that learning English is easier by reading the booklet which received the lowest mean value of 3.47.

The engagement part of the questionnaire contained three statements which focused on the booklet's goals and entertainment element. Results of the analysis showed that the participants agreed that the booklet is entertaining corresponding to the highest mean value of 3.83. Second, the participants agreed that the learning goals are motivating with a mean value of 3.70. Lastly, the participants agreed that the learning goals are achievable and clear which received the lowest mean value of 3.53.

Lastly, the interface part of the questionnaire contained three statements which focused on the booklet's graphics and text elements. Based from the results, the participants agreed that the appropriate font is used corresponding to the highest mean value of 4.03. Second, the participants agreed that the graphics are eye-catching which received a mean value of 3.90. Lastly, the participants have a neutral reaction that there are too many words on the booklet which received the lowest mean value of 3.03.

**Top Five Statements on Students' Satisfaction toward the Use of Interactive Digital Game and Traditional Media**

The top five statements regarding students' satisfaction toward the use of interactive digital game and traditional media were identified using descriptive statistics (Table 10). For the experimental group, the statement "the digital game helps learners develop better writing and reading comprehension skills" received the highest mean value of 4.63. Second, the statement "the animation enhances the presentation" attained a mean value of 4.40. Third, the statement "attitudes toward digital educational games changed for the better after playing Eternal Story" attained a mean value of 4.33. Fourth, the statement "the digital game is fun" had a mean
value of 4.30. Finally, the statement "the game setting adds excitement" and "the graphics are eye-catching" both obtained a mean value of 4.27.

For the control group, the statements "the booklet is an effective learning media in teaching the selected topics in Fundamentals of English", "reading the booklet is worth the time and effort" and "the appropriate font is used" obtained the highest mean value of 4.03. Second, the statements "attitudes toward English changed for the better after reading the booklet" and "the graphics are eye-catching" attained a mean value of 3.90. Third, the statements "the booklet is fun", "learning the contents is motivating because of the booklet", "attitudes toward reading changed for the better after reading the booklet", and "the booklet is entertaining" attained a mean value of 3.83. Fourth, the statement "the knowledge learned from reading the booklet could be applied in real life" attained a mean value of 3.77. Finally, the statement "the learning goals are motivating" obtained the lowest mean value of 3.70.

Discussion of Results of Student Satisfaction toward the Interactive Digital Game and Traditional Media

All experimental and control group participants responded to the 5-point Likert scale included in the attitude questionnaire to determine students' level of satisfaction toward the use of the interactive digital game and booklet. Descriptive analysis showed that the experimental group, or the students who played the digital game, had a higher level of satisfaction compared with the control group, or the students who read the print media. Specifically, the experimental group attained a total mean value of 4.07 while the control group attained a total mean value of 3.77 (Table 9). This result coincided with the study conducted by O'Leary and colleagues (2005: 1848–1851).
Table 7 Level of satisfaction of experimental group toward the interactive digital game

<table>
<thead>
<tr>
<th>Statements</th>
<th>1 Strongly Disagree</th>
<th>2 Disagree</th>
<th>3 Neutral</th>
<th>4 Agree</th>
<th>5 Strongly Agree</th>
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2. Content

2.1 Target/Goal

Appropriateness

2.1.1 Attitudes toward English changed for the better after playing Eternal Story.
**Table 7 (continued)**

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<td>Neutral: 12</td>
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**3. Engagement**

**3.1 Goals**

**3.1.1 The goals of the game are achievable and clear.**
**Table 7 (continued)**

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<td>3.5.2 The game characters are interesting.</td>
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<td>Strongly agree</td>
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<td>9</td>
<td>16</td>
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<td>4.7 Control Buttons/Navigation</td>
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### Table 8 Level of satisfaction of control group students toward the booklet

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<td>1. Usability</td>
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<td>1.1 Effectiveness</td>
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<tr>
<td>1.1.1 The booklet is an effective learning media in teaching the selected topics in Fundamentals of English.</td>
</tr>
<tr>
<td>1.2 Efficiency</td>
</tr>
<tr>
<td>1.2.1 Reading the booklet is worth the time and effort.</td>
</tr>
<tr>
<td>1.3 Satisfaction</td>
</tr>
<tr>
<td>1.3.1 Reading the booklet is fun.</td>
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<tr>
<td>1.3.2 Learning the contents is motivating because of the booklet</td>
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<td>Total</td>
</tr>
<tr>
<td>2. Content</td>
</tr>
<tr>
<td>2.1 Target/Goal</td>
</tr>
<tr>
<td>Appropriateness</td>
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<tr>
<td>2.1.1 Attitudes toward English changed for the better after reading the booklet.</td>
</tr>
<tr>
<td>2.1.2 Attitudes toward reading changed for the better after reading the booklet.</td>
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<tr>
<td>Strongly disagree</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>22</td>
<td>5</td>
<td>4.03 &amp; 9.14</td>
<td>agree</td>
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<tr>
<td>Disagree</td>
<td>-</td>
<td>-</td>
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<td>3.83 &amp; 7.58</td>
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<td>3.83 &amp; 8.16</td>
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Total: 3.93 & 8.39 agree
Table 8 (continued)

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<td>2.2.1 The booklet helps learners develop better writing and reading comprehension skills.</td>
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<td>2.4 Extensibility</td>
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<td>2.4.1 The knowledge learned from the booklet could be applied in real life.</td>
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<td>2.5 Media matching</td>
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### Table 8 (continued)

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<th>Q.D</th>
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<td>Neutral</td>
<td>Agree</td>
<td>Strongly agree</td>
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<td><strong>4. Interface</strong></td>
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Table 9 Summary of level of satisfaction of student participants toward the interactive digital game and booklet

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<tr>
<td>1. Usability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Effectiveness</td>
<td>4.03</td>
<td>9.14</td>
</tr>
<tr>
<td>1.2 Efficiency</td>
<td>4.03</td>
<td>8.69</td>
</tr>
<tr>
<td>1.3 Satisfaction</td>
<td>3.83</td>
<td>7.87</td>
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<tr>
<td></td>
<td>3.93</td>
<td>8.39</td>
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<td>2. Content</td>
<td></td>
<td></td>
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<td>2.1 Target/Goal</td>
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<td>2.2 Integration</td>
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<tr>
<td>2.3 Scaffolding</td>
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<td>-</td>
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<td>2.4 Extensibility</td>
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<td>5.96</td>
</tr>
<tr>
<td>2.5 Media Matching</td>
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<tr>
<td></td>
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<td>8.45</td>
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<td>3. Engagement</td>
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<tr>
<td>3.1 Goals</td>
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<td>7.41</td>
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<tr>
<td>3.2 Rules</td>
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<td>-</td>
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<tr>
<td>3.3 Competition</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3.4 Challenge</td>
<td>-</td>
<td>-</td>
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<td>3.5 Fantasy</td>
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<td>-</td>
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<tr>
<td>3.6 Safety</td>
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<tr>
<td>3.7 Entertainment</td>
<td>3.83</td>
<td>6.44</td>
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### Table 9 (continued)

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<th>Experimental Group</th>
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<td>$\bar{x}$</td>
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<td>Q.D.</td>
<td>$\bar{x}$</td>
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<tr>
<td>4. Interface</td>
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<tr>
<td>4.1 Graphics</td>
<td>3.90</td>
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<td>agree</td>
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<td>-</td>
<td>-</td>
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<td>4.4 Digital Audio</td>
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<td>4.5 Multi-user Dialogues</td>
<td>-</td>
<td></td>
<td>-</td>
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<td>4.6 Chat</td>
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<td>-</td>
<td>-</td>
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<tr>
<td>4.7 Control Buttons</td>
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<td>-</td>
<td>-</td>
<td>3.87</td>
</tr>
<tr>
<td></td>
<td>3.65</td>
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<td>7.07</td>
<td></td>
<td>3.71</td>
</tr>
<tr>
<td>Total</td>
<td>3.77</td>
<td></td>
<td>7.68</td>
<td>agree</td>
<td>4.07</td>
</tr>
</tbody>
</table>

**Note:**
- $\bar{x}$ - weighted average
- S.D - standard deviation
- Q.D - qualitative description
- Range of scores for qualitative description:
  - 4.21-5.00 (strongly agree)
  - 3.41-4.20 (agree)
  - 2.61-3.40 (neutral)
  - 1.81-2.60 (disagree)
  - 1.00-1.80 (strongly disagree)
Table 10 Means and standard deviation of the level of satisfaction of the two groups toward the interactive digital game and booklet

<p>| Statements | Control Group | | | | Experimental Group | | | |
|------------|---------------|---|---|---|---------------------|---|---|
|            | $\bar{x}$ | S.D. | Q.D |            | $\bar{x}$ | S.D. | Q.D |
| 1. The booklet is an effective learning media in teaching the selected topics in Fundamentals of English. | 4.03 | 9.14 | agree | 1. The digital game helps learners develop better writing and reading comprehension skills. | 4.63 | 8.69 | strongly agree |
| 2. Reading the booklet is worth the time and effort. | 4.03 | 8.69 | agree | 2. The animation enhances the presentation of information. | 4.40 | 6.61 | strongly agree |
| 3. The appropriate font is used. | 4.03 | 9.14 | agree | 3. Attitudes toward digital educational games changed for the better after playing Eternal Story. | 4.33 | 7.48 | strongly agree |
| 4. Attitudes toward English changed for the better after reading the booklet. | 3.90 | 10.75 | agree | 4. Playing the digital game is fun. | 4.30 | 7.04 | strongly agree |
| 5. The graphics are eye-catching. | 3.90 | 5.70 | agree | 5. The game setting adds excitement. | 4.27 | 7.18 | strongly agree |
| 6. Reading the booklet is fun. | 3.83 | 7.58 | agree | 6. The graphics are eye-catching. | 4.27 | 6.60 | strongly agree |
| 7. Learning the contents is motivating because of the booklet. | 3.83 | 8.16 | agree | 7. The digital game is entertaining. | 4.23 | 7.38 | strongly agree |</p>
<table>
<thead>
<tr>
<th>Statements</th>
<th>Control Group</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\bar{x}$</td>
<td>S.D.</td>
</tr>
<tr>
<td>8. Attitudes toward reading changed for the better after reading the booklet.</td>
<td>3.83</td>
<td>10.84</td>
</tr>
<tr>
<td>9. The booklet is entertaining.</td>
<td>3.83</td>
<td>6.44</td>
</tr>
<tr>
<td>10. The knowledge learned from reading the booklet could be applied in real life.</td>
<td>3.77</td>
<td>5.96</td>
</tr>
<tr>
<td>11. The learning goals are motivating.</td>
<td>3.70</td>
<td>7.71</td>
</tr>
<tr>
<td>12. The booklet helps learners develop better writing and reading comprehension skills.</td>
<td>3.60</td>
<td>7.62</td>
</tr>
<tr>
<td>13. The learning goals are achievable and clear.</td>
<td>3.53</td>
<td>7.11</td>
</tr>
<tr>
<td>14. Learning English is easier by reading the booklet.</td>
<td>3.47</td>
<td>7.17</td>
</tr>
<tr>
<td>8. The digital game is an effective learning media in teaching the selected topics in Fundamentals of English.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. The positive feedback is rewarding.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Attitudes toward English changed for the better after playing Eternal Story.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Playing the game is worth the time and effort.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Learning English is easier by playing Eternal Story.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. The game site is well organized and easy to navigate.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Playing the digital game makes learners comfortable even after failing challenges.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statements</td>
<td>Control Group</td>
<td>Experimental Group</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>---------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>15. There are too many words on the booklet.</td>
<td>( \bar{x} ) 3.03, S.D. 6.36, Q.D. neutral</td>
<td>15. It is not embarrassing to try again after failing a challenge. ( \bar{x} ) 3.80, S.D. 6.36, Q.D. agree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16. The rewards after completing a quest are motivating. ( \bar{x} ) 3.77, S.D. 6.16, Q.D. agree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17. The goals are motivating. ( \bar{x} ) 3.70, S.D. 7.036, Q.D. agree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18. It is motivating to learn the contents because of the digital game. ( \bar{x} ) 3.67, S.D. 8.94, Q.D. agree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19. The appropriate font is used. ( \bar{x} ) 3.67, S.D. 6.33, Q.D. agree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20. The chat function is useful. ( \bar{x} ) 3.67, S.D. 6.52, Q.D. agree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21. The knowledge learned from the digital game could be applied in real life. ( \bar{x} ) 3.63, S.D. 8.69, Q.D. agree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22. Interacting with the non-player characters is motivating. ( \bar{x} ) 3.56, S.D. 7.84, Q.D. agree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>23. There are too many words in the screen. ( \bar{x} ) 3.43, S.D. 4.30, Q.D. agree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24. The goals of the digital game are achievable and clear. ( \bar{x} ) 3.40, S.D. 7.036, Q.D. neutral</td>
</tr>
<tr>
<td>Statements</td>
<td>Control Group</td>
<td></td>
</tr>
</tbody>
</table>

**Note:**

\[ \bar{x} = \text{weighted mean} \]

\[ \text{S.D.} = \text{standard deviation} \]

\[ \text{Q.D.} = \text{qualitative description} \]

Score ranges for qualitative description:

\[ 4.21 - 5.00 = \text{strongly agree} \]

\[ 1.41 - 4.20 = \text{agree} \]

\[ 1.61 - 3.40 = \text{neutral} \]

\[ 1.81 - 2.60 = \text{disagree} \]

\[ 1.00 - 1.80 = \text{strongly disagree} \]
CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter summarizes the significant results of the study and indicates the conclusions derived from the gathered data. Implications of research and recommendations for further study are also included at the end of this chapter.

Purpose of Study

The main purpose of the study was to evaluate the effects of an interactive digital game and traditional media on students’ achievement and satisfaction. Specifically, the study aimed to:

1. Compare the effects of an interactive digital game and traditional media on students’ achievement in the cognitive domain.

2. Compare the effects of an interactive digital game and traditional media on students’ achievement in the psychomotor domain.

3. Determine the attitudes of student participants toward the interactive digital game and booklet in terms of the affective domain and identify students’ level of satisfaction toward the use of the interactive digital game and traditional media in terms of usability, content, engagement, and interface.

Summary of Results

Research Methodology

Mixed methods research was employed in this study following a pretest posttest control group design. The target population comprised of Thai undergraduate students of Maejo University, Chiang Mai enrolled in PS 103 during the Academic Year 2011-2012. Simple random
sampling technique was used to select sample respondents of the study. Sixty students were selected and were randomly divided into two groups namely, experimental and control group. Each group consisted of 30 students. The experimental group participants were introduced to an interactive digital game to learn selected topics in Fundamental English. The selected topics were References, Topic, and Main Idea. On the other hand, the control group participants were introduced to a booklet to learn similar lessons.

Pretest activities for both groups were conducted at a large lecture room in the School of Administrative Studies, Maejo University, Chiang Mai. The posttest activities for the control group were conducted at the same lecture room where the pretest has been conducted. The posttest activities for the experimental group were carried out in a private internet café located near the vicinity of the university. The internet café contained more than thirty, relatively new computers running Windows 2000 with accelerated 3D graphics support, and audio output through stereo headphones. The Eternal Story’s application software was installed in 30 computers.

Research Instruments

The study involved a pretest, a detailed orientation of research activities, use of learning media, and a posttest. Research instruments were designed, refined, and administered as both pretest and posttest treatment measures.

During the pretest phase, all student participants were asked to answer a cognitive and psychomotor domain achievement test to measure their existing knowledge and skills on the covered lessons prior use of learning media.

The posttest activities were conducted 2 weeks after the pretest. During the posttest phase, the experimental group participants played Eternal Story for approximately 40 minutes and were given about 40 to 60 minutes to answer the posttest questionnaires. On the other hand, the control group participants read the Let’s Learn English! Booklet for approximately 40 minutes and were also given about 40 to 60 minutes to answer the posttest questionnaires.
Another dimension of the study was a survey of the attitudes of participants toward the use of interactive digital game and traditional media. Participants' opinions and feelings toward the interactive digital game and the booklet were assessed in terms of the affective domain. Also, a 5-point Likert scale was used to determine participants' satisfaction toward the use of the interactive digital game and print media in terms of usability, content, engagement, and interface. Lastly, participants' gender, age, year level, major, and GPA were collected.

Descriptive analysis, independent samples t-test, and Pearson Chi-square tests were used to analyze collected data. Specifically, students' pretest and posttest scores on the cognitive and psychomotor domain achievement tests were analyzed using measures of central tendency (means and standard deviations) and independent samples t-test. The level of significance chosen was .05. Moreover, students' written responses to open-ended questions were analyzed using thematic analysis while students' responses to 5-point Likert scale were analyzed using measures of central tendency (mean and standard deviation). Finally, the proportional differences in students' demographic characteristics were analyzed using the Pearson Chi-Square test.

**General Demographic Information**

A profile of participants' demographic characteristics indicated that female students comprised of 56.70 percent of the total sample population while 43.30 percent were male. Majority of the participants were 20 years old and in their sophomore year in college. Public Administration majors comprised of 35 percent of the total sample population while 23.30 percent were Economics majors. Most of the participants in the study or 43.30 percent have a GPA of 2.51 - 3.00 while 36.70 percent have a GPA of 2.01 - 2.50.

Pearson Chi-Square tests indicated no significant differences between the demographic variables of the experimental and control group students in terms of gender, age, major, and GPA.
Comparison of Media Effects on Learning in the Cognitive and Psychomotor Domains

This study compared the students’ scores in achievement tests after the use of the interactive digital game, designed to motivate students and present instructional messages using on-screen texts, and a print media which presented instructional messages using texts and pictures. Results of data analysis indicated that the use of the interactive digital game did not significantly improve participants’ cognitive and psychomotor domain achievement when compared with the use of the booklet. The first explanation for the significant difference of cognitive and psychomotor domain achievement between the two groups might be taken from the multimedia principle of the cognitive theory of multimedia learning which states that people learn more deeply with words and pictures rather than with words alone. The learning content of the interactive digital game in this study was presented using plain and unformatted texts without supporting graphics. Also, no visual signals such as highlights, formatted texts, or symbols were used to emphasize important information which in turn could help students to process information better. As a result, the experimental group did not engage in active learning – cognitive processes that are intended to help the students make sense of the material such as the construction of coherent mental representations. In contrast, the booklet presented the learning content with texts and illustrations. The texts were formatted or styled and the illustrations supported the learning objectives. Thus, the chance of learning a lesson using words alone would be lower compared with a lesson that is presented involving words and relevant pictures.

Secondly, the explanation of the result may reside in the participants’ prior knowledge and skills of the learning content. The use of texts and graphics is particularly important for learners who have low knowledge and skills of the learning content rather than learners who have high knowledge and skills of the learning content. In this present study, the participants were considered novices or learners with low knowledge and skills of the learning contents. Thus, students with low knowledge on the learning content will learn more with texts and graphics than texts alone.

Finally, the results of the study may be related to the limited capacity assumption of the cognitive theory of multimedia learning. Learners undergo three cognitive processing demands when presented with multimedia lessons. These are extraneous, essential, and generative
processing. In order not to overload the mind's capacity for processing information, multimedia presentations should enable learners to carry out active processes by managing essential processing, reducing extraneous processing, and fostering generative processing for meaningful learning to occur. In the case of the design of the interactive digital game in the present study, essential processing was not managed well. Although the game allowed the participants to control the time and consolidate what was just presented in the lesson, it did not present the key terms or essential material in the lesson in advance. Also, the contents were presented using on-screen texts without supporting pictures. As a result, participants' cognitive system was overwhelmed since they have a low prior knowledge on the content.

Moreover, extraneous processing was not reduced effectively. The learning contents of the game were presented with on-screen texts but with extraneous animation, narratives, and pictures that were not considered relevant to the content to be learned. Therefore, students' working memory was overloaded by the entertainment and activities before the students got to the lesson to be learned. Furthermore, the learning contents of the interactive digital game lacked visual cues such as highlights, symbols, or arrows to emphasize certain information. As a result, students had difficulty organizing information into a coherent model.

Lastly, generative processing was fostered since the digital game was designed using a fantasy world setting with attractive graphics. Interactions with non-player characters also provided a friendly learning environment to the participants. These design elements motivated players and made them feel like they were in a conversation with a partner.

**Attitudes toward the Interactive Digital Game**

**Receiving and Responding**

Attitudes of participants toward the interactive digital game were collected using open-ended questions. Almost all of the participants responded positively to the benefits, features, and use of the interactive digital game. The participants perceived the digital game effective in teaching new English vocabulary since exploring the game environment, interacting with non-player characters, and reading game missions contained words that were new to most of them. Also, the participants responded positively to the immediate feedback feature of the game since it
informed them how to accomplish goals and motivated them to learn the contents. Furthermore, the participants perceived the digital game was effective in promoting enjoyment. With regard to the content of the interactive digital game, almost all participants had difficulty understanding the contents because they do not know how to play the game, they were not familiar with most of the English words used, and the game instructions were not clear. However, majority of them responded that they were attracted to the colorful graphics, lively sounds, challenges or quests, and non-player interactions. Only a few students reported that the click-and-point feature of the game was boring. Overall, the participants believed that their instructors would use digital games to teach a lesson because digital games could motivate students at the same time could promote knowledge acquisition and skills development.

Valuing Level

The participants considered the contents of the digital game important because it could help them improve their grades and they could use the knowledge and skills acquired to their friends and family members. Finally, the participants suggested that there should be a clear tutorial explaining the game’s controls, objectives, and missions before actual play. Also, some of the participants responded that the game design should be enhanced. It should consist of clear texts, organized content, non-technical words, and varied game environments.

Participant Satisfaction towards the Use of Interactive Digital Game

All 30 experimental group participants responded to a 5-point Likert scale comprised of 30 statements about usability, content, engagement, and interface of the interactive digital game. Descriptive analysis showed that the interactive digital game users attained a higher level of satisfaction compared with the booklet users. The experimental group attained a total mean value of 4.07 while the control group attained a total mean value of 3.77.

Specifically, the usability part included in the questionnaire tackled the effectiveness, efficiency, and satisfaction toward the use of the interactive digital game. Overall, the participants strongly agreed that it was fun to play Eternal Story. Also, the participants agreed that the digital game was effective in teaching selected topics in Fundamentals of English.
Moreover, the participants agreed that playing the digital game was worth the time and effort. Lastly, the participants agreed that it was motivating to learn the contents of the digital game.

The content part tackled the game's goal appropriateness, integration, scaffolding, extensibility, and media matching. The participants strongly agreed that the digital game helped them develop better writing and reading comprehension skills. Likewise, the participants strongly agreed that their attitudes toward digital educational games changed for the better after playing Eternal Story. Also, the participants agreed that the positive feedback of the game was rewarding and their views toward English changed for the better after playing Eternal Story. Furthermore, the participants agreed that learning English was easier by playing Eternal Story and receiving rewards after completing a quest were motivating. Lastly, the participants agreed that the knowledge learned from the digital game could be applied in real life.

The engagement part tackled the game's goals, rules, competition, challenge, fantasy, safety, and entertainment. The participants strongly agreed that the digital game was entertaining and the game setting adds excitement. The participants also agreed that playing the digital game made learners comfortable even after failing challenges. Moreover, the participants agreed that the game's goals were motivating. However, the participants had a neutral reaction when asked if the goals of the game were achievable and clear. Likewise, the participants had a neutral reaction when asked if the digital game was challenging and competitive. Lastly, the participants had a neutral reaction when asked if the rules were clear and if the game characters were interesting.

Finally, the interface part tackled the game's graphics, text, animation, digital audio, multi-user dialogues, chat, and control buttons. The participants strongly agreed that the animation enhanced the presentation of information and that the graphics were eye-catching. Also, the participants agreed that the game site was well organized and easy to navigate. Moreover, the participants agreed that the chat function was useful and the appropriate font was used. The participants agreed that there were too many words on the screen. However, the participants had a neutral reaction when asked if the sound effects kept users motivated. Finally, the participants had a neutral reaction when asked if the quality of sound was excellent.
Attitudes toward Traditional Media

Receiving and Responding Levels

The attitudes of participants toward the booklet were also collected using open-ended questions. Almost all of the participants responded positively to the benefits, features, and use of the booklet. The participants perceived the booklet effective in increasing their knowledge and understanding of references, identifying topic, and identifying main idea. Moreover, majority of the participants responded that the contents of the booklet were easy to understand because of the organization, lay-out, design, and availability of Thai translations. Also, the participants were attracted to the booklet’s lively colors, fonts, arranged texts, and concept.

Valuing Level

The participants considered the contents of the booklet beneficial because it could improve their knowledge of the content material. It could also improve their communication skills especially in the workplace. Finally, the participants suggested that the relevant pictures may be added, texts should be more organized and divided into sections, exercises and definition of key terms should be included, and detailed explanations corresponding to the drills may be added.

Participant Satisfaction towards the Use of Booklet

Aside from the experimental group participants, the control group also responded to a 5-point Likert scale comprising of 15 statements about the booklet’s usability, content, engagement, and interface. Descriptive analysis showed that the booklet users attained a lower level of satisfaction compared with interactive digital game users. The control group attained a total mean value of 3.77 while the experimental group attained a total mean value of 4.07.

Specifically, the usability part included in the questionnaire tackled the effectiveness, efficiency, and satisfaction toward the use of the booklet. The participants agreed that the booklet was effective in teaching the selected topics in Fundamental English. Likewise, the participants agreed that reading the booklet was worth their time and effort. Lastly, the participants agreed that it was motivating to learn the booklet’s contents.
The content part tackled goal appropriateness, integration, scaffolding, extensibility, and media matching. The participants agreed that their views toward English changed for the better after reading the booklet. Also, the participants agreed that their attitudes toward reading changed for the better after reading the booklet. Likewise, the participants agreed that the knowledge learned from the booklet could be applied in real life. Also, the participants agreed that the booklet was interesting and at the same time provided knowledge. Lastly, the participants agreed that learning English was easier by reading the booklet.

The engagement part tackled the booklet’s goals and entertainment aspects. The participants agreed that the booklet was not only entertaining but also its learning goals were motivating, achievable and clear.

Finally, the interface part tackled the booklet’s graphics and text. The participants agreed that the appropriate font was used and the graphics were eye-catching. Also, the participants had a neutral reaction when asked if there were too many words on the booklet.

Conclusion

In conclusion, the present findings demonstrate that:

1. The interactive digital game was not as effective at increasing cognitive domain achievement of students when compared with a print media. Members of the control group attained significant higher cognitive domain gain scores compared with the experimental group.

2. Members of control group attained significant higher cognitive domain gain score in the knowledge level, or their ability to recall previously learned material, compared with the experimental group. However, no significant differences were found in the gain scores of the two groups in terms of comprehension of key concepts and ability to apply learned information in new contexts.

3. The interactive digital game was not as effective at increasing psychomotor domain achievement of students when compared with a print media. Members of the control group attained significant higher psychomotor domain gain scores compared with the experimental group.
4. Members of the control group attained significant higher psychomotor domain gain score in the imitation level, or the students’ ability to duplicate learned information, compared with the experimental group. However, no significant differences were found in the gain scores of the two groups in terms of the ability to perform certain actions by following instructions.

5. The experimental group participants had a positive attitude toward the benefits, contents, and features of the interactive digital game including its use in education. The participants believed that the interactive digital game could improve the quality of the learning experience by providing motivation and immediate feedback, personalizing student learning, and giving learners the ability to control the time spent on each lesson.

6. The control group participants had a positive attitude toward the benefits, contents, and features of the booklet. The participants believed that the booklet could help improve learning because of its organization, lay-out, and visual design.

7. The experimental group participants attained a higher level of satisfaction toward their use of the interactive digital game compared with the control group participants who used the booklet.

**Recommendations**

**Recommendations on Learning Media Use**

1. People learn more deeply from words and graphics than from words alone.

1.1 Instructional designers, learning technologists, or teachers who intend to develop and use digital games as an instructional tool should present the learning content with words and graphics, rather than words alone. Words can be printed text or audio narrations while graphics can be static illustrations such as photos, drawings, charts, graphs, or maps and dynamic graphics such as animation or video.

1.2 Instructional designers, learning technologists, or teachers who intend to develop and use digital games as an instructional tool should identify what type of content (whether a fact, concept, procedure, process, or a principle) would be included in digital
educational games to take full advantage of useful graphic types that could help learners process information effectively. If the learning content is a fact, it is better to use representational and organizational graphics. If the learning content is a concept, it is better to use representational, organizational, and interpretive graphics.

2. The use of words and graphics in a multimedia presentation is particularly important for learners who have low prior knowledge and skills of the learning content.

2.1 Instructional designers, learning technologists, or teachers who intend to develop and use digital games as an instructional tool should be sensitive to the level of prior knowledge of learners to provide needed supports. For learners with low prior knowledge and skills of the subject matter, the lesson should be presented with texts and coordinated graphics.

3. Multimedia presentations that aims to manage essential cognitive processing, reduce extraneous cognitive processing, and foster generative cognitive processing promote learning.

3.1 For long or complex texts and passages, the use of bold texts or headings conveys important information on the computer screen or page. Also, using visual signals such as highlights, arrows, or circles draw the learners' attention to the important contents.

3.2 Related elements may be put closer to each other rather than far from each other. For example, multimedia elements like still pictures or on-screen graphics are moved directly underneath or near the text or passage it relates to. This way, the text functions as a label to the image and the learner has much easier time selecting and processing information.

3.3 Related texts and pictures must be presented at the same time on the same screen or page so that information can be processed in working memory at any given time.

3.4 Lessons must be organized into topics and topics into pages so that learners could process information more effectively. Segmenting or chunking multimedia contents helps learners process information and learn in a comfortable pace.

3.5 Prior presentation of content material in a multimedia presentation may provide a brief and clear discussion of critical concepts or terms that will be covered in the lesson to enhance the working memory of that concept or term.

3.6 Lessons must be presented in second person such as the use of "we" or by referring to the learner as "you" or friendly images that support the instructional goals of the
lesson may be included. These help personalize learning experience for the learner and create a friendly non-threatening environment.

3.7 Learners should be provided with the ability to select topics in any sequence they prefer. Links must be placed in lessons that lead to additional pages or to alternative websites with related information. Also, learners should be provided with the ability to progress through the course at their own rate.

3.8 Learners must be provided with the ability to control instructional components such as additional references, definitions to key words, examples, or exercises.

4. Digital games that are highly exploratory can provide a great deal of activity and enjoyment to learners but can also overload or distract them. This is because game goals can lead to behaviors that are antagonistic to the instructional goals. Instructional designers, learning technologists, or teachers who intend to develop and use digital games as an instructional tool should design digital games that are not only enjoyable but also achieves the learning objectives and reduces learners' mental overload and distraction.

4.1 Digital game elements such as goals, activities, feedback, fantasy, and interface must be aligned with the desired learning outcomes or objectives.

4.2 Learning objectives should be integrated into the game's storyline so that the learning content is relevant to the progression of the game.

4.3 Digital games must provide explanatory feedback rather than corrective-only feedback.

4.4 Digital games must encourage reflection on correct answers that will enable learners to actively summarize or extract the important information learned from the game.

4.5 Digital games must provide learners with game instructions, memory support, and game play aids. For example, a non-player character can start the game with a tour or example of how the goals are achieved by manipulation of the various game control elements.
Recommendations on Study Variables

Sample Participants

The participants were conveniently recruited from a population of college students, who may not be representative of all digital game players. Also, the sample of the study was dominated by students who are 20 years old (76.70) who are in their sophomore year in college (93.30). To generally cover the concern of interactive digital games and its effect on student achievement, the same study design should be re-conducted among undergraduate students with a more age-balanced and year level-balanced sample.

Recommendations on Data Collection Procedures

Data collection tool

The attitude questionnaire and the psychomotor domain achievement test were validated by a group of subject-matter experts. To increase the validity and reliability of these instruments, a pretest should be conducted among randomly selected students of the target population. Moreover, focus group discussions should be conducted to determine the clarity and structure of open-ended questions. Lastly, item analysis should be employed to determine the difficulty and discrimination index of closed questions.

Recommendations for Future Research

Research Topics

1. Further evaluation studies should be conducted on the effects of interactive digital games on long-term retention of information.

2. Further empirical research should be conducted on the effects of learner control on learning performance of students.

3. Further empirical research should be conducted on the effects of interactive digital games on student achievement that involves information presented in narrated words, animation, graphics, and sounds.
4. Further investigations should be employed that looks into whether the multimedia principle of the cognitive theory of multimedia learning depends on whether the graphics are static (photos or illustrations) or dynamic (video clips or animations).

5. Future studies should be conducted to assess learning achievement among students with high prior knowledge versus low prior knowledge.

Research Variables

1. Future studies should be conducted to test the possibility of various demographic variables such as gender, age, major, year level, GPA, or digital game playing habits and its relationship to increased achievement scores.

2. Further studies should be conducted to determine how different populations of students perceive interactive digital games to discover the factors that make interactive digital games appropriate for learning in different student populations.

Data Collection

1. Further research should be conducted on exploring the effects of interactive digital games on student achievement using higher levels of Bloom et. al.’s Taxonomy of the Cognitive Domain (1956) such as analysis, synthesis, and evaluation.

2. More research should be conducted on exploring the effects of interactive digital games on student achievement using higher levels of Dave’s Taxonomy of the Psychomotor Domain (1970) such as precision, articulation, and naturalization.

3. More in-depth qualitative studies should be conducted focusing on the effects of interactive digital games on student achievement using Krathwohl et. al.’s Taxonomy of the Affective Domain (1964) such as organization and characterization.
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APPENDIX A

Item Analysis
Appendix Table 1 Item difficulty index ($p$), discrimination index ($r$), and reliability coefficient ($\alpha$) of individual test items in the cognitive domain achievement test.

<table>
<thead>
<tr>
<th>Item</th>
<th>$\alpha$</th>
<th>$p$</th>
<th>$r$</th>
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<tr>
<td>5</td>
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<tr>
<td>6</td>
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<tr>
<td>7</td>
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<td>0.48</td>
<td>0.22</td>
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<tr>
<td>8</td>
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<tr>
<td>9</td>
<td>0.81</td>
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</tr>
<tr>
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</tr>
<tr>
<td>11</td>
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<tr>
<td>12</td>
<td>0.79</td>
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<tr>
<td>13</td>
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<tr>
<td>20</td>
<td>0.80</td>
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</table>

Reliability coefficient ($\alpha$) = 0.80
APPENDIX B

Research Instruments
COGNITIVE DOMAIN ACHIEVEMENT TEST

This is a test of your knowledge about references, substitutions, and the identification of topic and main idea in passages. Please answer each question.

1. Name ชื่อ: ...........................................................................................................

2. Major สาขาวิชา: ........................................................................................................

3. Faculty คณะ: ........................................................................................................

4. Student ID Number รหัสนักศึกษา: ...........................................................................

I. References

A. Instructions: Read the following questions and put a circle to the letter of your answer.

1. Which of the following best defines References?
   a. References are words that an author uses to refer to a word, phrase, or sentence previously mentioned in the passage. It is used to avoid repetition of words and links sentences to create a meaningful text.
   b. References are words that give an example of something just mentioned.
   c. References are words that restate the information the writer has given.

2. Which of the following are examples of References?
   a. Furthermore, In addition, Additionally
   b. alike, similar, compared to
   c. her, she, he, him, it, them

3. Which of the following best defines Substitutions?
   a. Substitutions refer to words, phrases, or clauses that have been mentioned previously in a passage.
   b. Substitutions are words that give an example of something just mentioned.
   c. Substitutions are words that restate the information the writer has given.

4. Which of the following are examples of Substitutions?
   a. one, ones, do, does, here, that
   b. alike, as, similar
   c. so that, in order to, to
B. Instructions: Identify what the underlined word or phrase refers to. Put a circle to the letter of your answer.

They sing better than I do.

5. _do_ refers to:
   a. sing
   b. They
   c. better

The Thais believe in the next life. The Greeks believed so.

6. _so_ refer to:
   a. Thais
   b. Greeks
   c. in the next life

Two of my friends like collecting stamps. Some of _them_ cost a lot of money.

7. _them_ refers to:
   a. collecting
   b. stamps
   c. Two

I phoned the receptionist a moment ago. _I_ did several times and I couldn't get through.

8. _did_ refers to:
   a. receptionist
   b. phoned
   c. times

The three students from Asia have been in New York for two weeks now. They are going to start school on Monday. They have been looking for an apartment near their college, and they have finally found _one_.

9. _one_ refers to:
   a. New York
   b. their college
   c. an apartment
Do you think John knows about the bad news? - I think he does.

10. does refers to:
   a. bad news
   b. knows
   c. you

I like to do jogging every evening. By doing this, my body always keeps fit.

11. this refers to:
   a. keeps fit
   b. jogging every morning
   c. my body

When putting the film into the camera, always be careful to hold the film by the edges. Otherwise, you will spoil it.

12. it refers to:
   a. camera
   b. film
   c. careful

II. Topic and Main Idea

A. Instructions: Read the questions and put a circle to the letter of your answer.

13. What is a topic?
   a. A topic is the general subject of a paragraph. It is what the author is writing about.
   b. A topic is the central thought or the most important idea of a paragraph.
   c. A topic connects ideas together.

14. What is a main idea?
   a. The main idea is the general subject of a paragraph. It is what the author is writing about.
   b. The main idea is the central thought or the most important idea of a paragraph.
   c. The main idea connects ideas together.
B. Instructions: Read the passages and answer the questions that follow. Put a circle to the letter of your answer.

Many big cities have large-scale programs for urban renewal. In St. Louis, a huge downtown area was destroyed. In Detroit, modern apartments have replaced several slum areas. In San Francisco, many decaying city blocks are being redeveloped.

15. What is the topic of this passage?
   a. Programs to renew big cities
   b. Programs to redevelop city blocks
   c. Programs to replace slum areas

16. What is the main idea of the passage?
   a. In St. Louis, a huge downtown area was destroyed.
   b. In Detroit, modern apartments have replaced several slum areas.
   c. Many big cities have large-scale programs for urban renewal.

Water is essential for good health. It is necessary for every process of the body like digestion and absorption of food. In addition, water helps control the temperature of the body. It keeps the temperature at 37° C. Water also cleans the tissues. Water is found in all foods. For instance, fresh vegetables are 90 percent water, eggs are 74 percent water, and hamburger is 60 percent water.

17. What is the topic of the passage?
   a. Water
   b. Good Health
   c. Food

18. What is the main idea of the passage?
   a. Water is found in all foods.
   b. Different kinds of food contain different amounts of water.
   c. Water is necessary for every process of the body.

The new sport of windsurfing is popular on the beaches in Thailand. In Pattaya, Phuket, and Ko Samui you can see people standing on their small boards as the wind blows them across the water. In August of 1987, a young man from France did something different with windsurfing. He used a special windsurfer to sail across the Atlantic Ocean alone instead of sailing in the sea for sport. It took him 46 days to go from New York, across the Atlantic Ocean, to France. He is the only person to sail a windsurfer across the Atlantic Ocean. After he arrived in France he said he would never do it again. He said once is enough.
19. What is the topic of this passage?
   a. The Greatest Windsurfer
   b. The New Sport and a Young Man
   c. A Strange Young Man

20. What is the main idea of the passage?
   a. Windsurfing is popular on the beaches where it is windy.
   b. A young man from France is the only person who has sailed a windsurfer across the Atlantic Ocean.
   c. It took a young man 46 days to sail a windsurfer across the Atlantic Ocean.

-End-
PSYCHOMOTOR DOMAIN ACHIEVEMENT TEST

A. Instructions: Read the passages and answer the questions that follow.

A study at one prison showed that owning a pet can change a hardened prison inmate into a more caring person. Another study discovered that senior citizens, both those living alone and those in nursing homes, became more interested in life when they were given pets to care for. Even emotionally disturbed children have been observed to smile and react with interest if there is a cuddly kitten or puppy to hold. Animals, then, can be a means of therapy for many kinds of individuals.

1. What is the topic of this passage?
   ...........................................................................................................................................
   ...........................................................................................................................................

2. What is the main idea of this passage?
   ...........................................................................................................................................
   ...........................................................................................................................................

Americans' favorite pizza toppings include pepperoni and sausage. In Japan, people put tuna on their pizza. Australians like to top their pizza with shrimp and pineapple. Many British prefer their pizza with sweet corn sprinkled on top. And some Thais are fond of their pizza with spicy seafood.

3. What is the topic of this passage?
   ...........................................................................................................................................
   ...........................................................................................................................................

4. What is the main idea of this passage?
   ...........................................................................................................................................
   ...........................................................................................................................................
If you have ever met people who like to tinker with machines, you know they are constantly taking things apart—radios, computers, cars, and other devices—just to “see how they work.” Indeed, taking a thing apart and examining the separate parts is a good way to understand or explain anything from an electronic gadget to a concept in philosophy. Such a process is called analysis.

5. What is the topic of this passage?

6. What is the main idea of this passage?

B. Instructions: Choose one (1) topic and write a short story about it using what you have learned about references, topic, and main idea.

Topics:

▸ My Town: If an out-of-town visitor was coming to visit, where would you take your visitor? Describe the best places around your town and why they are so interesting. Write about parks, museums, lakes, stores, restaurants, and other places you enjoy.

▸ My Family: Write about the members of your family. Describe each person and what they mean to you.

▸ My Favorite Sport: What is your favorite sport? Why do you like it, and what do you like best about it?

▸ Free Vacation Trip: If someone offered to give you a free vacation trip anywhere in the world, where would you go? Why do you want to go to this place? What would you do when you got there?

▸ My Favorite Holiday: What is your favorite holiday? Describe what you like to do on this holiday, who you like to be with at that time, and why you enjoy it so much.

▸ A Person You Admire: Who do you admire the most? Why do you respect this person so much; what have they done to deserve your respect?
SURVEY QUESTIONNAIRE (Digital Media)

Thank you for taking the time and making the effort to complete this survey. The answers you provide will help inform and improve the use of learning media in higher education learning.

To start, please answer the following demographic inquiries.

ขอขอบคุณสำหรับการเสียเวลาและความพยายามที่จะให้การส่งข้อมูลที่เหมาะสม สรุปที่คุณให้ไว้จะช่วยเร่งและ ปรับปรุงการใช้เทคโนโลยีในการเรียนรู้ในระดับอุดมศึกษา เพื่อเป็นการเตรียมการคำนวณ ที่เหมาะสมในการตอบข้อมูลประชำการตัดสิน

Demographic Profile

1. Name: ___________________________________________________________
2. Age: ___________________________________________________________
3. Major: _________________________________________________________
4. Faculty: _______________________________________________________
5. GPA: __________________________________________________________
6. Gender
   Male ------01☐
   Female ------02☐
7. Year level
   1st year (freshman) ------01☐
   2nd year (sophomore) ------02☐
   3rd year (junior) ------03☐
   4th year (senior) ------04☐
RECEIVING LEVEL
1. What have you learned from the game? คุณได้เรียนรู้อะไรบ้างจากการเล่นเกมชื่อ (Eternal Story)?

RESPONDING LEVEL
2. Were the contents in the game easy or difficult to understand? เนื้อหาในเกมเป็นง่ายหรือยากที่จะเข้าใจ?

   a. Why? ทำไม?

3. Which content was easy to understand? (References, Identifying Topic, or Identifying Main Idea) เนื้อหาอันไหนที่เข้าใจได้ง่าย?

   a. Why? ทำไม?

4. Which content was difficult to understand? (References, Identifying Topic, or Identifying Main Idea) เนื้อหาอันไหนที่ยากต่อการเข้าใจ?

   a. Why? ทำไม?
5. Do you think the story of the game is interesting and motivating? คุณคิดว่าเรื่องราวของเกมนี้ที่น่าสนใจและสร้างแรงจูงใจหรือไม่?

a. Why? ทำไม?

6. Do you think your professors in Maejo University will use digital educational games to teach their students? (Yes or No) คุณคิดว่าอาจารย์ในมหาวิทยาลัยของคุณควรนำมาใช้ในการศึกษาไม่ใช่หรือไม่?

a. Why? ทำไม?

7. Which features or parts of the game do you think are interesting and motivating? คุณคิดว่าเกมมีสิ่งใดหรือส่วนไหนที่น่าสนใจและสร้างแรงจูงใจ?

a. Why? ทำไม?

8. Which features or parts of the game do you think are NOT interesting and motivating? คุณคิดว่าเกมมีสิ่งใดหรือส่วนไหนที่น่าเบื่อหรือไม่สร้างแรงจูงใจ?

__________________________________________________________________________________________
VALUING LEVEL

9. Do you think it is important to learn the contents of the game? (Yes or No) คุณคิดว่านั้น
สำคัญหรือเปล่าที่จะเรียนรู้เนื้อหาของเกมหรือไม่ (ใช่หรือไม่)

a. If yes, in what way is it important or can be useful to you in your studies, family,
friends, classmates, your future career, or in your life? ถ้าใช่ นั้นสำคัญในการเรียน
หรือจะมีประโยชน์กับคุณในด้านการทำงาน ครอบครัว เพื่อน เพื่อนร่วมชั้น อาชีพ
หรือในชีวิตวันวันๆ ของคุณหรือไม่
- ประโยชน์ต่อตนเอง
  ด้านการเรียน

- ประโยชน์ต่อชีวิต

- ประโยชน์ต่อครอบครัว

- ประโยชน์ต่ออาชีพ
- ประโยคนี้คือเพื่อน
- ประโยคโดยรวมรวมเช่นเรียน

b. If no, why do you think it is NOT important to learn the contents of the game? ถ้า
ไม่ใช่ ทำไมคุณจึงคิดว่า มันไม่สำคัญที่จะเรียนรู้เนื้อหาของเกมถึง?

10. Would you recommend the Eternal Story digital game to others? (Yes or No) คุณจะ
แนะนำเกมนี้ให้กับคนอื่นหรือไม่? (แนะนำหรือไม่แนะนำ)

a. Why? ทำไม

11. What are your suggestions to improve the Eternal Story digital game? คุณมีข้อเสนอแนะ
อะไรบ้างคือ การปรับปรุงเกมฟิชชิงเรื่องนั้น


Place a check mark (✓) in the spaces in the columns that most closely align with your feelings about the factors.

กรุณาทำเครื่องหมาย (√) ในช่องวาง ในคอลัมน์ที่ใกล้เคียงกับความรู้สึกของคุณเกี่ยวกับปัจจัย
และผลกระทบ

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<tr>
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<th>strongly disagree</th>
<th>disagree</th>
<th>not sure</th>
<th>agree</th>
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<tr>
<td><strong>Usability</strong></td>
<td></td>
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</tr>
<tr>
<td>1. The game is an effective learning media in helping me learn English.</td>
<td></td>
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<tr>
<td>2. Playing the game is worth my time and effort.</td>
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<tr>
<td>3. I enjoyed playing the game.</td>
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</tr>
<tr>
<td>4. The use of the game makes learning the topic more motivating and fun.</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

| **Content** | | | | | |
| 5. My views toward English have changed for the better after being taught using the game. | | | | | |
| 6. My views toward playing digital educational games have changed for the better after playing Eternal Story. | | | | | |
| 7. I have learned a lot from the game that will help me develop better writing and reading comprehension skills. | | | | | |
| 8. The positive feedback in the game makes me feel rewarded for my effort. | | | | | |

ข้อเสนอแนะในช่องว่างในแบบฟอร์มให้คุณส่งให้ข้อมูลที่คุณรู้สึกได้รับผลกระทบ
ตามที่คุณมีความพึงพอใจของคุณ.
<table>
<thead>
<tr>
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<th>strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. The rewards I get after completing a quest keeps me motivated to</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<td>5</td>
</tr>
<tr>
<td>play the game.</td>
<td></td>
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<tr>
<td>10. I can apply the knowledge I learned from the game into the real</td>
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<tr>
<td>world.</td>
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<tr>
<td>11. It is easier to learn English by playing Eternal Story.</td>
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**Engagement**

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>12. The goal of the game is achievable and clear.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>13. The goal of the game is motivating.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>14. The rules of the game are well explained and well presented.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>15. The game is very competitive.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>16. The game is challenging.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>17. The setting of the game adds excitement.</td>
<td>1</td>
<td>2</td>
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<td>5</td>
</tr>
<tr>
<td>18. The characters of the game helped keep my attention.</td>
<td>1</td>
<td>2</td>
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<tr>
<td>19. I am comfortable playing the game and do not fear if I fail to</td>
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<tr>
<td>complete the quests.</td>
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<td>20. I am not ashamed or shy to try again when I fail to complete the</td>
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<tr>
<td>quests in the game.</td>
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<tr>
<td>21. Overall, the game is very entertaining.</td>
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### Interface

<table>
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<tbody>
<tr>
<td>22. Overall, the graphics of the game was eye-catching.</td>
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<tr>
<td>23. The appropriate font is used.</td>
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<tr>
<td>24. There were too many words on the screen.</td>
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<tr>
<td>25. The animation in the game enhanced the presentation of information.</td>
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<tr>
<td>26. The sound effects enrich the game to keep me motivated.</td>
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<tr>
<td>27. The quality of sound in the game is excellent.</td>
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<tr>
<td>28. Interacting with the non-player characters in the game keeps me motivated.</td>
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<td>29. The chat function in the game is very useful.</td>
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<tr>
<td>30. Overall, the game site is well organized and easy to navigate.</td>
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</tbody>
</table>

- End -

Thank you very much for your time and responses!

ขอบคุณมากค่ะ กรุณาช่วยให้เราสามารถพิจารณาและดูแบบสอบถามของคุณได้
SURVEY QUESTIONNAIRE (Traditional Media)

Thank you for taking the time and making the effort to complete this survey. The answers you provide will help inform and improve the use of learning media in higher education learning. To start, please answer the following demographic inquiries.

ขอขอบคุณค่ะ สำหรับการเข้ามาตอบแบบสอบถามนี้ให้กับการสำรวจที่ได้รับความรู้สึกจากนักเรียนที่มีส่วนร่วมในกิจกรรมการเรียนรู้ในระดับอุดมศึกษา เพื่อเป็นการบันทึกข้อมูลการสำรวจสำหรับการตัดสินใจในช่วงชีวิตของคุณดังนี้

Demographic Profile

1. Name: ...................................................................................................................................................................
2. Age: ....................................................................................................................................................................
3. Major: ............................................................................................................................................................
4. Faculty: ..........................................................................................................................................................
5. GPA: ...............................................................................................................................................................
6. Gender

   Male -------01☐
   Female -------02☐
7. Year level

   1st year (freshman) -------01☐
   2nd year (sophomore) -------02☐
   3rd year (junior) --------03☐
   4th year (senior) -------04☐
RECEIVING LEVEL

1. What have you learned from the booklet? คุณได้เรียนรู้อะไรบ้างจากหนังสือคู่มือ?

RESPONDING LEVEL

2. Were the contents in the booklet easy or difficult to understand? เมื่อหากิจวัตรในหนังสือคู่มือง่ายหรือยากจะทำตามข้อใด?

   a. Why? ทำไม?

3. Which content was easy to understand? (References, Identifying Topic, or Identifying Main Idea) เมื่อหาข้อมูลที่เข้าใจง่าย?

   a. Why? ทำไม?

4. Which content was difficult to understand? (References, Identifying Topic, or Identifying Main Idea) เมื่อหาข้อมูลที่เข้าใจยาก?

   a. Why? ทำไม?
5. Do you think the concept of the booklet is interesting and motivating? คุณคิดว่าแนวคิดของหนังสือคู่มือมีความน่าสนใจและสร้างแรงจูงใจหรือไม่?

a. Why? ทำไม?

6. Which features or parts of the booklet do you think are interesting and motivating? คุณเล่าถึงใดหรือส่วนไหนของหนังสือคู่มือที่คุณคิดว่ามีความน่าสนใจและสร้างแรงจูงใจ?

a. Why? ทำไม?

7. Which features or parts of the booklet do you think are NOT interesting and motivating? คุณเล่าถึงใดหรือส่วนไหนของหนังสือคู่มือที่คุณคิดว่าไม่มีความน่าสนใจและไม่สร้างแรงจูงใจ?

a. Why? ทำไม?
VALUING LEVEL

8. Do you think it is important to learn the contents of the booklet? (Yes or No) คุณคิดว่ามันสำคัญหรือเปล่าที่จะเรียนรู้เกี่ยวกับเนื้อหาในหนังสือคู่มือ? (ใช่หรือไม่)

a. If yes, in what way is it important or can be useful to you in your studies, family, friends, classmates, your future career, or in your life? ถ้าใช่ มันสำคัญในด้านไหนหรือมันสามารถเป็นประโยชน์กับคุณทั้งในด้านการเรียน การครอบครัว เพื่อน คนรัก เพื่ออาชีพในอนาคตหรือในชีวิตประจำวันหรือไม่?

- ประโยชน์ต่อตนเอง
  ด้านการเรียน

- ในชีวิตประจำวัน

- ด้านอาชีพ

- ประโยชน์ต่อครอบครัว

- ประโยชน์ต่อเพื่อน
b. If no, why do you think it is NOT important to learn the contents of the booklet? ถ้าไม่ใช่ ทำไมคิดว่าไม่ที่จะเป็นสิ่งสำคัญที่จะเรียนรู้เกี่ยวกับเนื้อหาของหนังสือคู่มือ?

9. Would you recommend the booklet to others? (Yes or No) คุณจะแนะนำหนังสือคู่มือให้กับคนอื่นหรือไม่? (ใช่หรือไม่)

a. Why? ทำไม?

10. What are your suggestions to improve the booklet? คุณมีข้อเสนอแนะอะไรบ้างเพื่อให้ปรับปรุงหนังสือคู่มือ?
Place a check mark (✓) in the spaces in the columns that most closely align with your feelings about the factors.

กรุณาทิ้งคำตอบในช่องที่เหมาะสมกับความรู้สึกของคุณเกี่ยวกับปัจจัยและผลกระทำ

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<th>Factors</th>
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<th>strongly agree</th>
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</thead>
<tbody>
<tr>
<td><strong>Usability</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>1. The booklet is an effective learning media in helping me learn English.</td>
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<tr>
<td>2. Reading the booklet is worth my time and effort.</td>
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<tr>
<td>3. I enjoyed reading the booklet.</td>
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<tr>
<td>4. The use of the booklet makes learning the topic more motivating and fun.</td>
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</tbody>
</table>

<p>| <strong>Content</strong> | | | | | |
| 5. My view toward English has changed for the better after being taught using the booklet. | | | | | |
| 6. My view toward reading has changed for the better after reading the booklet. | | | | | |
| 7. I have learned a lot from the booklet that will help me develop better writing and reading comprehension skills. | | | | | |
| 8. I can apply the knowledge I learned from the booklet into the real world. | | | | | |</p>
<table>
<thead>
<tr>
<th>Factors</th>
<th>strongly disagree</th>
<th>disagree</th>
<th>not sure</th>
<th>agree</th>
<th>strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. It is easier to learn English using the booklet.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**Engagement**

10. The learning goals of the booklet are achievable and clear.

11. The learning goals of the booklet are motivating.

**Interface**

12. Overall, the booklet is very entertaining.

13. Overall, the graphics of the booklet are eye-catching.

14. The appropriate font is used.

15. There are too many words on the booklet.

- End -

Thank you very much for your time and responses!

ขอขอบคุณสำหรับการเสียเวลาและการแสดงความคิดเห็นของคุณ
APPENDIX C

Print Media

Interactive Digital Game
Appendix Figure 1  Cover page of the Let’s Learn English! Booklet
Introduction

This booklet has been designed as a supplementary learning material for Fundamentals of English course. It has been compiled as a print-based learning material covering the use of reference words and the identification of the topic and main idea in a reading passage. It is hoped that once students acquire these knowledge, they will be able to improve their writing and reading skills in the English language.
Learning Objectives
Learners will be able to:
1. Define References.
2. Tell which word or Reference word refers to.
3. Use references words to form a sentence.

References เป็นส่วนหนึ่งของเนื้อหาที่เกี่ยวกับการเรียนรู้
ความคิด (idea) หรือข้อมูลจริง (fact) เพื่อเพิ่มเนื้อหาที่มีความ
สำคัญด้านภาษา หรือข้อเท็จจริง ในเรื่องที่ได้

1. A surprising fact about sailboats is that they can move against the wind.
When they're reference, they refer to the fact that sailboats can move against the wind.
2. Mike gave Paula a letter. This gave her food for thought.
This refers to the fact that Mike gave Paula a letter, which gave her food for thought.
3. To the men who build them, modern skyscrapers are tools for the use of office workers.
These refer to the fact that modern skyscrapers are tools for office workers.

Examples:

Of all the torment that women have suffered in the name of beauty, few can
match those of foot-binding. This extraordinary fashion was practiced until the
last Chinese Emperor was overthrown is an evidence of the inferior status of
women in Imperial China. No one seems to know the exact origin of this
curious custom. One story says that it began around 500 A.D.
References ทบทวนโดยผู้สอนiders 7 ประเภท ได้แก่

1. Pronouns and adjectives เช่น he, she, it, we, they, him, her, us, them, his, hers, ours, theirs เป็นต้น
   As soon as my daughter arrived home, she called me.
   She was the one who had met my daughter.

2. Relative pronouns เช่น that, which, who, whom, whose, where, when, why
   This book is very useful for students who score low on vocabulary tests.
   Some Thai teenagers start dating when they are about 18, but some start when they are
   in high school.

3. Decimal numbers เช่น one, another, the other, others, some, those เป็นต้น
   Some Thai teenagers start dating when they are about 18, but some start when they are
   in high school.

4. Synonymous terms
   The majority of my friends enjoy bungee jumping, but I am too scared to try this dangerous sport.
   This dangerous sport is called bungee jumping.

5. Pro-formas เช่น so, that, it, this, those
   Srisa has an extra class on Saturday. This disappoints her.
   The fact that Srisa has an extra class on Saturday

6. Arithmetic pronouns เช่น one, two, three, first, second, third เป็นต้น
   What are the differences between this oven and that one?
   One oven is

7. Sequence of two items เช่น the former, the latter
   Some students work hard but are not clever; others are clever but do not work hard. Most teachers
   prefer the former rather than the latter.
   The former students who work hard but are not clever.
   The latter students who are clever but do not work hard.

Appendix Figure 4 Third page of the Let’s Learn English! Booklet
การหา Topic จากเรื่องที่อ่านเริ่มต้นด้วยความรู้จากเรื่องที่อ่าน และวิเคราะห์เรื่องของหัวข้อที่มี ในการหา Topic จากเรื่องที่อ่าน เราต้องมีความเข้าใจในเรื่องที่อ่านเป็นอย่างดี จึงสามารถคาดการณ์ได้ว่า Topic เกี่ยวกับอะไร ในขณะที่เราอ่าน เก็บและทำที่ในการสังเกต หรืออ่านเพื่อขยายประโยชน์ที่สามารถ obrach Topic ได้เท่าที่นั้น มีหลักในการหา Topic ดังนี้

1. Topic ไม่มีทางที่จะมาก่อนเรื่องเริ่ม
2. Topic ต้องปรากฏอยู่ในประโยคทั้งหมด และหรือ ประโยคสุดท้ายของเรื่อง ซึ่ง ปรากฏในคำของเรื่องเริ่มมักจะที่น่าจะเป็นสิ่งที่เป็นการแนะนำให้ผู้อ่านเริ่มประเด็นหลักของเรื่อง ที่คุณต้องสนใจ สำหรับประโยคของเรื่องที่เป็นประโยคที่น่าสนใจ ประเด็นหลัก อะไรที่เจาะจงกว่าในเรื่องเริ่ม
3. สรุปความจำกภาพการอ่าน ในการนี้ เราต้องมีความเข้าใจในเรื่องที่อ่าน ซึ่งจะสามารถสรุปได้

**Appendix Figure 5** Fourth page of the Let's Learn English! Booklet
Main Idea

Learning Objectives
Learners will be able to:
1. Identify the main idea in reading passages.

Main idea is a key concept in reading, where learners are expected to identify the main idea of a passage or text. It involves understanding the overall meaning and purpose of the content. To identify the main idea:

- Read the entire text to get a general sense of the content.
- Focus on the introductory and concluding parts, which often summarize the main points.
- Highlight key phrases and sentences that convey the central theme.
- Consider the author's purpose and the audience's expectations.

Once identified, learners can practice summarizing the main idea, paraphrasing, or answering questions based on the main idea. This skill is crucial for effective reading comprehension and academic success.

Appendix Figure 6 Fifth page of the Let’s Learn English! Booklet
Washington, DC is a big and beautiful city. It is the capital of the US. There are lots of things to see there. The first place that tourists should not miss is the National Mall. There is a statue of Abraham Lincoln there, the Lincoln Memorial, and a very beautiful monument called the Washington Monument. Another famous area in this city is Georgetown. There are lots of old houses and restaurants there. Other busy places in Washington are the Capitol and the White House. The Capitol is famous for its beautiful dome while the White House has gained its reputation because it is where the President of the US lives. Washington, DC is a wonderful city and a great place for a trip.

Appendix Figure 7 Sixth page of the Let’s Learn English! Booklet
ในผ่อนนี้ ไม่มีการวิเคราะห์ข้อมูลการวิจัยที่ Washington, DC ซึ่งกล่าวไปที่ 2 ครั้งต่อเนื่อง.

ในผ่อนนี้มีการใช้คำว่า reference แทนเนื้อหาผลิตภัณฑ์ คำว่า 3 ในบรรทัดแรก, คำว่า there ในบรรทัดที่ สอง และคำว่า this city ในบรรทัดที่ 4 เป็นต้น. เพื่ออธิบาย Washington, DC เป็นการยกตัวอย่างการใช้คำข้าม ๆ กันตามสำเนา.

ในผ่อนนี้ คำว่า Washington, DC ปรากฏมาในเรื่องประเภทของเมื่อเรื่อง ซึ่งทำให้เกิดการจำกัดและทำให้ผู้ชมรู้ว่าประโยคนี้ของเรื่องมีความสำคัญ.
(Washington, DC is a big and beautiful city. It is the capital of the US. There are lots of things to see there.) และประโยกต่อหน้าของเนื้อเรื่อง ซึ่งทำให้เกิดการมีแสดงสิ่งต่าง ๆ เช่น ผู้ชมไม่ได้เห็นเรื่องราว ประกาศสถานะการ์ให้เห็นเวลาก่อนเรื่องราว เรื่องราวที่เกิดขึ้นในเนื้อเรื่อง (Washington, DC is a wonderful city and a great place for a trip.) ดังนั้น ผ่อนนี้ Topic ที่เกี่ยวกับ Washington, DC ทั้งหมดหลายคำ แต่ไม่ควรที่เกี่ยวกับเรื่องราวที่เกี่ยวกับ Topic ได้ที่ แต่ควรที่เกี่ยวกับเรื่องราวที่เกี่ยวกับ main idea ในเนื้อเรื่อง ดังนั้น ผ่อนนี้ Topic ได้มีการปรากฏอยู่ในประโยคหลาย แต่ไม่ควรที่ปรากฏอยู่ในเนื้อเรื่อง.

สำหรับการหา Main idea ของผ่อนนี้ นั้นมีการกล่าวถึงการหา Topic เพราะข้ามการกล่าวถึงการหา Main idea (Washington, DC is a big and beautiful city.) และประโยกต่อหน้า (Washington, DC is a wonderful city and a great place for a trip.) ของผ่อนนี้ในส่วนที่มีการกล่าวถึงผู้ข้ามไม่ได้ข้าม Washington, DC อาจเป็นเนื้อหาของแต่ละส่วน.

ดังนั้น การวิเคราะห์ผ่อนนี้ Topic ที่เกี่ยวกับ Washington, DC ดังนั้นควรจะเข้าใจว่า ผู้ชมไม่ได้เรียนรู้จากข้อมูลที่หลากหลายหลาย ๆ ที่ต้องใช้ในการวิเคราะห์ Main idea ไม่ถูกต้องการจะเข้าใจควบคุมการเรียนรู้เนื่องจากความเข้าใจผ่อนนี้ Topic ไม่ได้ถูกเข้าใจจากผ่อนนี้ Topic ซึ่งข้ามที่ทำให้ผ่อนนี้ ทำให้ผ่อนนี้ไม่สามารถที่จะต้องการเรียนรู้จากสุดท้าย ผ่อนนี้มีความสับสนและความเข้าใจผ่อนนี้ ผ่อนนี้ไม่มีการเข้าใจในผ่อนนี้ ผ่อนนี้มีความเข้าใจผ่อนนี้.

Appendix Figure 8 Seventh page of the Let’s Learn English! Booklet
This booklet is designed for research purposes only. The contents and character illustrations are adapted from *Ethereal Shores*, a high-quality digital educational game developed and owned by the Information Technology Service Center (ITSC), Chiang Mai University and the Thai Cyber University, Commission of Higher Education. All Rights Reserved.

You may visit the ITSC game-based learning website at: www.itscgames.cmu.ac.th

For any questions and inquiries, you may contact the researchers:

Ethnie Jalis
Faculty of Information and Communication
Maejo University
63 Sansai-Phracao Road, Nongharn, Sansai, Chiang Mai, Thailand 50290
Mobile Number: 0854400458
Email: jalisue@gmail.com

**Appendix**  **Figure 9**  Back cover of the Let’s Learn English! Booklet
Appendix Figure 10 A Screenshot of the Log-in Page of Eternal Story
accessed from: http://itscgames.cmu.ac.th/eternalstory/index.php
Appendix Figure 11 A screenshot of the game environment of Eternal Story
accessed from: http://itscgames.cmu.ac.th/eternalstory/index.php
Appendix Figure 12 A Screenshot of the first quest of Eternal Story
accessed from: http://itscegames.cmu.ac.th/eternalstory/index.php
Appendix Figure 13 A Screenshot of an interaction with non-player characters in Eternal Story
accessed from: http://itscgames.cmu.ac.th/eternalstory/index.php
Appendix Figure 14  A screenshot of a lesson about “References” included in Eternal Story (1)

accessed from: http://itscgames.cmu.ac.th/eternalstory/index.php
Appendix Figure 15 A screenshot of a lesson about “References” included in Eternal Story (2)
accessed from: http://itscgames.cmu.ac.th/eternalstory/index.php
5. Pro-clauses ๑ฯ so, that, it, this เป็นต้น
Srirapat has an extra class on Saturdays. This disappoints her.
this ๑ๆ the fact that Srirapat has an extra class on Saturdays
6. Anthemic pronouns ๑ฯ one, two, three, first, second, third เป็นต้น
What is the differences between this oven and that one?
one ๑ๆ oven
7. Sequence of two items ๑ฯ the former, the latter
Some students work hard but are not clever; others are clever but do not work
hard. Most teachers prefer the former rather than the latter;
the former ๑ๆ students who work hard but are not clever
the latter ๑ๆ students who are clever but do not work hard

Of all the torments that women have suffered in the name of beauty, few can
equal those of ๑ๆ foot-binding. This extraordinary fashion was practiced until the last
Chinese Emperor was overthrown is evidence of the inferior status of women in Imperial
China. No one seems to know the exact origin of this curious custom. One story says
that ๑ๆ began around 500 A.D.

Appendix Figure 16  A Screenshot of a Lesson about “References” included in
Eternal Story (3)
accessed from: http://itscgames.cmu.ac.th/eternalstory/index.php
Appendix Figure 17 A screenshot of a quiz about “References” included in Eternal Story accessed from: http://itscgames.cmu.ac.th/eternalstory/index.php
Appendix  Figure 18 A screenshot of a feedback included in Eternal Story
accessed from: http://itscgames.cmu.ac.th/eternalstory/index.php
Appendix Figure 19 A screenshot of a lesson about “Topic” included in Eternal Story
generated from: http://itscgames.cmu.ac.th/eternalstory/index.php
Main idea

Main idea คือความคิดหลัก หรือ สรุปใจความสำคัญของเรื่องในรูปแบบประโยคสั้นๆ โดยขยายความเพิ่มเติมจาก Topic เป็นแนวเนื้อหาความคิดเห็นว่า ในเรื่องที่เราอ่านเข้าไปผู้เขียน อยากบอกอะไรมาที่เท่ากับ Topic ซึ่งแสดงว่า ทั้ง Topic และ Main idea จะต้องสอดคล้องเรื่องเดียวกัน ดังนั้น ตัวแปรที่เป็น Topic ก็ควรปรากฏอยู่ใน Main idea ด้วย เช่น ถ้า Topic ของเราที่ ต้องเหลือ Online games แปลว่า Main idea ก็ต้องเป็นอะไรที่ผู้เรียนจะบอกมาเพื่อเกี่ยวกับ Online games เช่น There are several disadvantages of playing an online game.

Appendix Figure 20 A screenshot of a lesson about “Main Idea” included in Eternal Story accessed from: http://itscgames.cmu.ac.th/eternalstory/index.php
Appendix Figure 21 A screenshot of a quiz about “Topic” and “Main Idea” included in Eternal Story

accessed from: http://iiscgames.cmu.ac.th/eternalstory/index.php
APPENDIX D

Experiment Pictures
Appendix Figure 22  Distribution of cognitive domain and psychomotor domain achievement test among control group participants during the pretest phase of the study (1)

Appendix Figure 23  Distribution of cognitive domain and psychomotor domain achievement test among control group participants during the pretest phase of the study (2)
Appendix Figure 24 An experimental group participant playing Eternal Story during the posttest phase (1)

Appendix Figure 25 An experimental group participant playing Eternal Story during the posttest phase (2)
Appendix Figure 26  Experimental group participants answering the cognitive and psychomotor domain achievement test and attitude questionnaire during the posttest phase of the study (1)

Appendix Figure 27  Experimental group participants answering the cognitive and psychomotor domain achievement test and attitude questionnaire during the posttest phase of the study (2)
Appendix Figure 28  Control group participants reading the Let’s Learn English! Booklet during the posttest phase of the study

Appendix Figure 29  Control group participants answering the cognitive and psychomotor domain achievement test and attitude questionnaire during the posttest phase of the study
APPENDIX E

Letters
Maejo University  
63 Sansai-Phrao Rd., Nongham  
Sansai, Chiang Mai  
Thailand 50290

ASSOC. PROF. DR. THANOMPORN LAOHAJARATSANG  
Director, Information Technology Service Center  
Chiang Mai University  
Chiang Mai, Thailand 50290

August 19, 2011

Madam:

I am presently pursuing advanced education at Maejo University under the Master of Arts program in Digital Communication. I am now in my last year of studies and currently in the process of writing my thesis proposal about Digital Game-based Learning. During my research, I have come to learn about your Eternal Story educational game project and your specialization on Game-based Learning. In regard to this, I am writing to request an informational meeting with you.

Your background and experience in Game-based Learning will be invaluable to me as I pursue my research and my future career as a communication practitioner. At your convenience, I would like to schedule a 20 to 25 minute informational meeting with you. The purpose of the meeting is to ask permission if I could use the Eternal Story educational game as part of my Master’s thesis. One of my thesis objectives is to study the game’s learning effectiveness among Maejo University students enrolled under the Bachelor of Arts in English program. I would also like to gather additional information that will better assist me with my research.

Thank you very much for considering my request. I look forward to your reply.

Very respectfully,  

RIZZLA SALAS

Noted by:  

ASSOC. PROF. DR. WITTAYA DAMRONGKTIATTISAK  
Dean, Faculty of Information and Communication  
Maejo University  
63 Sansai-Phrao Rd., Nongham  
Sansai, Chiang Mai, Thailand 50290
Information Technology Service Center, Chiang Mai University
239, Huay Kaew Road, Muang District, Chiang Mai, Thailand, 50200
Tel. +66 53 943811 Fax. +66 53 216747, 9453818 e-mail: itsc@chiangmai.ac.th
November 22, 2011

Re: Request to Use Eternal Story Digital Game for Master’s Research Study

Dear Ms. Rizza Salas:

Thank you for contacting ITSC to use the Eternal Story. We are honored that you requested to use our game. Your request is granted. However, there are a few conditions which we would like to clarify and some conditions to use the game.

According to your letter and the thesis outline, there are a few things needed to be changed and needed you to agree with the conditions to use Eternal Story.

**Thesis outline**

The contents used in Eternal Story are mainly about reading and writing skills so please change the details as follows.

**Page 5:** Please remove or change 1.1.3 because the Eternal Story does not include the speaking skills so it cannot be measured.

**Page 9:** Please remove the words “and speaking skills” in Psychomotor Domain.

**Page 34:** The same as page 9.

**Conditions to use Eternal Story**

1. Upon the completion of your research, please give full citation to Information Technology Service Center, Chiang Mai University (ITSC CMU) and Thailand Cyber University (TCU) as the co-product owner.
2. As the Eternal Story is an award-winning high quality game-based learning product and already had the research to prove its effectiveness, we need your detailed plans to conduct your research plan.
3. Your responsibilities to use Eternal Story
   a. Preparing appropriate hardware such as computer lab, high performance PCs, the staff, etc.
   b. Studying the guideline to use the game from the ITSC CMU administrator.
   c. Responsible for controlling any factors while using this game for research.

If you agree with the details above, please sign your name (Ms. Rizza Salas)

Best Regards,

Assoc. Prof. Dr. Thanompong Lualjarattraeng
Director, Information Technology Service Center
Chiang Mai University
Maemo University  
63 Sansai-Phrao Road, Nongharn  
Sansai, Chiang Mai  
Thailand 50290  

DR. SOMKID KAEWTIP  
Dean, School of Administrative Studies  
Maemo University  
Chiang Mai, Thailand 50290  

March 8, 2012  

Sir:  

My name is Ms. Rizza Salas, a resident of the Philippines and a second year graduate student of Maemo University under the Master of Arts program in Digital Communication. I am now in my last year of studies and currently in the process of conducting my thesis about digital game-based learning.  

I am writing to request permission from your good office to approach 120 students from your faculty to participate in my research activities to be conducted during the summer classes. If approval is granted, student participants will be distributed into two groups. The first group will be introduced to Eternal Story, a high-quality educational game designed to teach Fundamentals of English. This digital game has been developed by the Information and Technology Service Center of Chiang Mai University and the Thai Cyber University, Commission of Higher Education. On the other hand, the second group will be introduced to a print-based learning material with the same learning objective.  

My thesis entitled “Effects of Digital Game-based and Print-based Media on Learning Effectiveness” aims to determine the knowledge gained by university students using the two learning media. This thesis will be conducted under the supervision of Associate Professor Dr. Witaya Damrongkiattsak, Dr. Udornluck Thampanya, and Assistant Professor Dr. Siriwan Chaiyana.  

My research activities will be conducted in approximately two to three days. All student participants shall answer questionnaires and respond to interviews in a classroom or other quiet setting on the school sites. The results collected for this thesis project will remain confidential and anonymous. Should this study be published, only collected results will be documented. No costs will be incurred by either your faculty or the student participants.
I would be happy to answer any questions or concerns that you may have. You may contact me at 082-4406458 or at rizzlas@gmail.com.

Thank you very much for your time and consideration in this matter. Your approval to conduct this study will be greatly appreciated.

Respectfully yours,

RIZZLA SALAS

Noted by:

ASSOC. PROF. DR. WITTAYA DAMRONKLIATTISAK
Thesis Chairperson and Dean, Faculty of Information and Communication
Maejo University
INFORMATION LETTER
for a Research Study entitled
"Effects of Game-Based and Print-Based Media on Learning"

You are invited to participate in a research study to attempt to investigate the effects digital educational games and print-based media on learning. Additionally, we would like to know the attitudes of students toward the use of digital technology in higher education learning. The study is being conducted by Ms. Rizlala Salas, Master of Arts Candidate, under the supervision of Dr. Wittaya Damrongkiattisak, Associate Professor and Dean of the Faculty of Information and Communication, Maejo University. You are selected as a possible participant because you are enrolled in the course selected to be surveyed in this study.

If you decide to participate in this research study, you will be asked to complete a pretest, receive instruction via a reading material or digital educational game, complete a post-test. Your time commitment will be approximately 40 to 60 minutes.

Your participation is completely voluntary. If you change your mind about participating, you can withdraw any time during the study. Your decision about whether or not to participate or to stop participating will not affect your future relations with Maejo University or any of the departments involved in this study. The data collected through your participation are used to fulfill the educational requirements for M.A in Digital Communication and may be used in journal publications or presentations at professional meetings.

If you have additional questions about this study, please contact Ms. Rizlala Salas at rizzlas@gmail.com or at (082-440-6458).

HAVING READ THE INFORMATION, KINDLY DECIDE IF YOU WANT TO PARTICIPATE IN THIS RESEARCH PROJECT. IF YOU DECIDE TO PARTICIPATE, THE DATA YOU PROVIDE WILL SERVE AS YOUR AGREEMENT TO DO SO.

______________________________________  __________________________  __________________________
Researcher’s signature                  Date                                    Print Name
APPENDIX F

Curriculum Vitae
**VITA**

**NAME:** Miss Rizza Irabagon Salas

**DATE OF BIRTH:** 29 October 1984

**EDUCATION:**
- 2012: M.A candidate in Digital Communication, Faculty of Information and Communication, Maejo University, Chiang Mai, Thailand
  Thesis Title: Effects of Interactive Multimedia and Traditional Media on Student Achievement: An Experimental Study. Defended on November 8, 2012
- 2005: A.B Development Communication, College of Arts and Sciences, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines

**RESEARCH INTERESTS:**
- Digital Media Effects
- Digital Game-based Learning
- Use of Information and Communication Technologies in Agriculture/Sustainable Development

**RESEARCH, DEVELOPMENT AND EXTENSION EXPERIENCES:**
- Rice Sufficiency Officer, PhilRice Location-Specific Technology Development program (2010 - 2013), September 2008 to May 2010
- Resource Person and co-implmenter, PhilRice Isabela Hybrid Rice Youth Camp project, April 2009 to May 2009
- Trainer, PhilRice Isabela Farmers’ ICT Training, October 2009 to March 2010
PROFESSIONAL EXPERIENCE:

September 2008 – present
Senior Science Research Specialist, Philippine Rice Research Institute

March 2008 – September 2008
Account Sales Assistant, Pilipinas Shell Petroleum Corporation

November 2005 – February 2008
Account Service Representative, Aegis-PeopleSupport (Philippines) Incorporated