EFFECTS OF GAMIFICATION OF PRODUCT LIFE CYCLE CONCEPT AS AN ACTIVE LEARNING STRATEGY FOR LEARNING ACHIEVEMENT AND SOFT SKILLS DEVELOPMENT OF THAI UNIVERSITY STUDENTS

BY

W. M. RUVINI M. WEERASINGHE

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE (ENGINEERING AND TECHNOLOGY)
SIRINDHORN INTERNATIONAL INSTITUTE OF TECHNOLOGY
THAMMASAT UNIVERSITY
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A Thesis Presented

By

W. M. RUVINI M. WEERASINGHE

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DECEMBER 2017
Abstract

EFFECTS OF GAMIFICATION OF PRODUCT LIFE CYCLE CONCEPT AS AN ACTIVE LEARNING STRATEGY FOR LEARNING ACHIEVEMENT AND SOFT SKILLS DEVELOPMENT OF THAI UNIVERSITY STUDENTS

by

W. M. RUVINI M. WEERASINGHE

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The purpose of this study was to identify the effects of gamification on learning achievement and soft skills development. Quasi experimental research design and one group pre-test post-test design were used as main methods of research design. This was a mixed method research study which integrated quantitative (experiments), and qualitative (interviews and observations) approaches.

In this study, three experiments were conducted to test the effectiveness of an educational card game. The card game was developed to teach Product Life Cycle (PLC) concept. Selected samples consisted of undergraduate students of Thammasat and Mahidol universities. Pre-tests and Post-tests were conducted to measure learning achievement. Experiment one was divided into two groups; one group received lecture based instruction and the other group played the card game. In both situations, the post-test mean scores have increased. However, the mean score was slightly higher in the lecture group. Knowledge retention test was administered one month after the treatments for all the participants of experiment one. Mean score of knowledge retention test was slightly higher in experimental (game) group.
Experiment two and three were done with different groups of students, considering game based instructions only. In both experiments, post-test scores have increased. Participants may have learned the PLC concept by playing the card game. It was visible from the Post-test results. The test papers were developed considering the first four levels of Bloom’s Taxonomy. Participants’ answers to the tests were analyzed in detail and the PLC game has helped them to answer remembering and understanding levels than other levels of the Bloom’s Taxonomy. Participants’ perception towards soft skills development, engagement, and satisfaction was measured by five-point likert scale. They believe that the PLC game has a potential to develop critical thinking, decision making and interpersonal communication. Findings of this study revealed that, the PLC game can be used as an Active Learning Strategy for university students. The results of this study may help instructors to develop more innovative, and cooperative teaching and learning strategies to create more excitement in the classroom, and thereby increase student performance by engaging them more in classroom activities.

**Keywords:** Gamification, Active Learning Strategy, Product Life Cycle Game, Learning Achievement, Soft Skills Development
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Chapter 1
Introduction

1.1 Background and Motivation

Teaching is becoming more complex and challenging (Meador, 2017). Maintaining the interest of students is becoming a main problem. University students are highly digitally literate nowadays (Pasquini, 2017). They have grown up with digital devices which combines education, communication, shopping and entertainment (Machado, 2017). High attachment to the smartphone and social networking make them distracted from the classroom. According to a survey conducted by Nebraska-Lincoln university, it was found that smart phones and other digital devices are mostly used by college students and they spend more class time (20%) on digital devices (Reed, 2016). They use those devices mainly for emailing, web-surfing, text messaging, checking social media, and playing games. Students have mentioned ‘Boredom’ as the main reason for using digital devices in the classroom (Reed, 2016). Therefore, the responsibility of an instructor is to find out new ways to engage students in classroom activities.

The traditional method of teaching in a university often involves lectures, sometimes accompanied by tutorial classes (Leicester, 2017). However, there are other teaching methods, which can be used effectively in order to achieve learning objectives. Active Learning (AL) is an example for one such method (Morrison, 2015). In AL, students play an active role in their learning. Research studies have shown that student engagement in the learning process motivates them to improve their critical thinking skills, and increases attention and focus. Instructors can improve opportunities for student engagement by adopting student-centered approach for instruction. It will help in achieving learning objectives successfully (Washington, 2017).

To further strengthen the understanding about the usage of Active Learning Strategies in university education, a background survey was conducted in Sri Lanka. The following section summarizes the findings of the survey.
1.1.1 Survey Results Summary - Use of Active Learning Strategies in University Education (an example from Sri Lanka)

An online survey was conducted to identify AL strategies used by faculty members. The survey details can be summarized as follows.

The main objective of the survey was to identify the usage of Active Learning Strategies (ALSs) in engineering education. Though the undergraduate education in government universities is free, it is highly competitive in Sri Lanka (Justine D’Souza, 2017). A limited number of qualified students get admitted to government universities. Only a limited number of top ranked students get admitted to the state engineering faculties of Sri Lanka. This study was done based on the responses of faculty members of a state technical university in Sri Lanka.

- Sample Composition

Hundred and twenty-nine respondents (which were nearly 40% of the target population), participated in the survey. Majority of the respondents (62%) were male and the rest (38%) were female. Furthermore, 62% of the faculty members who responded were Senior Lecturers, 26%, Lecturers, and 12% of them were Senior Professors or Professors. More than 70% of the respondents were PhD holders.

The selected active learning strategies (based on a pilot study) were role-playing, case study method, project based learning, clickers, discussions, presentations, and educational games.

- Summary of the Results

Respondents were asked to assess the ALSs they use during lectures. Case study method, Project Based Learning (PBL), discussions, and presentations were the most commonly used ALSs among the selected departments of the Engineering Faculty. The case study method was popular in the Chemical Engineering department, whereas PBL was popular in the Computer Engineering department.
Remarkably, all the respondents of Chemical, Computer, Electronics, and Mechanical Engineering departments use presentations. Educational games, clickers and role playing were the least used strategies among the respondents.

Educational games were rarely used by the respondents of the Engineering Faculty. The respondents of the Computer Engineering department tend to focus more on video games as an ALS. Educational games were not implemented by any respondents of the Civil, Electrical, Electronic, and Mechanical Engineering departments. Among the respondents, the majority (68%) did not use games, whereas 23% used computer games, 7% used board or card games, and 2% used other games (puzzles, competitions, etc.). Respondents of the Engineering Faculty (67%) were willing to use “educational games” as an ALS. Identified barriers for implementing educational games as an ALS were; Large class size (42% of the respondents stated that), time restriction (unable to cover the syllabus within the given period of time (25%), Inability to find suitable games (12%), and non-availability of time for game designing (12%).

However, there was no significant difference in gender with the ALSs use. Furthermore, case study method, and games were used more by females than males. Role playing, clickers, and games were less popular for both genders. Further, there was no significant difference in selected ALS with age group or class size.

- Conclusion of the Survey

There are many opportunities for educational game developers to develop games, which can be used especially for engineering education. A gaming environment may create an exciting and challenging atmosphere, with a lot of entertainment inside a class. To reduce mental and physical stress, and to avoid boredom, innovative ALSs like educational games, can be used effectively.
1.1.2 Implications of the Survey on this Study

From the above-mentioned survey findings, it was clear that faculty members have positive attitudes to use educational games as an ALS. The survey was conducted with the hope of obtaining opinions towards various ALSs (including educational games), from the point of view of faculty members. It is interesting to know the perception of the university students regarding the use of educational games as an ALS.

As for the survey, ALSs are considered as effective for the teaching and learning process. Some of the ALSs such as discussions and presentations are extensively used in teaching. Games are not used as an ALS by most of the lecturers. Therefore, it is of interest to investigate whether games could be used as an effective ALS. It was decided to gamify a lesson which is usually taught to the undergraduate students by lecture method. Marketing is one of the common subjects taught for Engineering, Management and IT students in Sri Lanka. Similar pattern could be seen in Thai University curricula as well. Therefore, *Marketing* was selected as the base subject. Product Life Cycle (PLC) concept is one of the basic topics usually covered under any marketing or business course. Furthermore, the PLC strategies need to be tailored (or selected) as for the stage of the life cycle of a product. This lesson appears to be an ideal choice for gamification. Therefore, it was decided to design and develop a game to teach PLC concept. Once the game was tested, it was decided to test the attitudes of the participants towards educational games. Undergraduate students of Thai universities were emphasised in this study.

Business simulation games have been used in business schools since 1957 (Faria, 1987) and widely used in management training programs. Games have been used to teach various aspects of marketing. Alves (2016) introduced a classroom game to teach brand management. To teach the students about dynamics of new markets, Nunes and Xexeo (2015) have introduced a game called “New Space Race”. Most of the previous researches have introduced many marketing games to be used in the classroom. Chuang, Ho, and Hsiao (2014) introduced an international business game called, “Asia Marketing”. It was regarding a small size laptop manufacturing industry. Players were given a challenge of making synergies, related to logistic and international competition
in the Asian region. Though many researchers have proposed innovative games to be used in the area of marketing, a game to teach the PLC concept could not be found in the literature.

1.2 Problem Statement

Millennials or the generation Y students, are armed with great technical skills (hard skills) which means their knowledge and ability to perform job related tasks successfully (Biro, 2015). Employers expect hard skills (technical knowhow), as well as soft skills from the employees (Lorenz, 2017). Hard skills determine a person’s suitability for a job. Millennials are tech savvy (Ice, 2009), but lack of soft skills (Tulgan, 2015). The more traditional soft skills are leadership, communication and collaboration. Attention (conscientiousness), agility (ability to overcome) and humility (admitting when you do not know stuff and asking for help when you need it) are other important soft skills which are expected by employers (Beaton, 2017). The other common soft skills are good common sense, empathy, collaboration, negotiation, teamwork, time management, ability to work under pressure, work ethic (hard working, willingness to work, self-motivation, loyalty, imitativeness, punctuality, better attendance), and much more (Doyle, 2017).

According to the National Statistics Office (NSO) report of Thailand 2016, the youth age group (15-24 years old) use internet mostly (85.9%). Internet is mostly used for social networking (91.5%), and 88% use internet for downloading movie/video/music/game or play game. Technology distraction in classroom is becoming an ongoing global issue faced by many educational institutions (Goundar, 2014). High addiction to the smart phones and digital devices, and spending more of the class time for non-class activities may have an adverse effect on student learning (McCoy, 2016). Several recent studies have found that there is a negative relationship between smartphone usage and academic performance (Lepp, Barkley, & Karpinski, 2015). Faculty members of the 21st century should be the designers of innovative learning experiences. Therefore, they should think about innovative teaching pedagogies in order to get student attention and increase their involvement. If so, students can get subject knowledge as well as they
can improve soft skills which will help them to perform better in the industry in the near future.

1.3 Significance of the Study

University education of the 21st century is becoming more challenging day by day because of the advancements of technologies and the nature of students. Traditional teaching methodologies are becoming obsolete (Clark, 2009), and new forms of pedagogies (like Active Learning), moving students away from traditional approaches. Undergraduates are encouraged to be discoverers rather than receptacles of knowledge (Hainline, Gaines, Feather, Padilla, & Terry, 2010). Faculty members need to be more sensitive to the diversity of students (Felder & Silverman, 1988), and develop innovative teaching pedagogies to get students engaged in the classroom activities. Gamification is an innovative pedagogy which helps to maintain student interest and engagement (Cahyani, 2016). This study will be helpful for educational game developers to understand the impact of gamification as an Active Learning Strategy (ALS). Faculty members can apply gamification concept with their respective discipline and it may help to create more engaged learning environment, satisfied learners, and finally improved academic performance.

1.4 Objectives of the study

1. To measure learning achievement of gamification by conducting three experiments as follows.
   1.1 By comparing mean scores between pre-test and post-test of undergraduate students who participated the lecture session (control group) and game session (experimental group) - *Experiment One*

   1.2 By comparing post-test mean scores between control group and experimental group (*Experiment One*)

   1.3 By comparing knowledge retention test mean scores between control group and experimental group (*Experiment One*)

6
1.4 By comparing mean scores between pre-test and post-test of undergraduate students (Experiment Two and Three)

1.5 By analyzing the level of achievement according to Bloom’s Taxonomy (Experiment One, Two and Three)

2. To identify the relationship between gamification and soft skills development, engagement, and satisfaction (Experiment Two and Three)

3. To identify the relationship between engagement and learning achievement, and soft skills development (Experiment Two and Three)

4. To evaluate Product Life Cycle (PLC) game, based on the responses given by the participants of all the experiments

1.5 Scope of the Study

This study covers selected undergraduate students of Thammasat and Mahidol Universities in Thailand. The developed educational card game was tested with small class sizes \( n < 40 \). The applicability of large class sizes was not considered in this study. To test the effects of gamification, only one lesson (PLC) was selected from the undergraduate curriculum.

1.6 Limitations of the Study

Every research conducted has limitations of its own, because of resource limitations, time considerations, and many more.

1) The selected sample of experiment one consisted of less number of students. Quasi experimental research design was used for experiment one, because it was the class which the instructor was assigned to teach, even though the number of students registered for the course was less.
2) Duration for pre-test and post-test were 16 minutes each, and the number of questions (16) may not have been sufficient to measure learning achievement. More accurate findings could have been obtained, if the duration of the game is increased, and more number of questions used to test the students’ knowledge.

3) Pre-test and Post-test were conducted on the same day, which may have an effect on post-test scores and the participants were exhausted to do the same test two times on the same day.

4) The PLC game is used to test the effects of gamification. However, results may not be generalized as there are many underlying factors (game design, delivery pattern, and evaluation) that determines the effectiveness of gamification.

5) Learning style of individual students may have an effect on their engagement, satisfaction, and learning achievement, which was not intentionally captured in this study.

6) This study was mainly based on Thai university students and generalizations should be made with care.

1.7 Methodology

The undergraduate students of Thammasat and Mahidol universities were selected for this study. Quasi experimental, and one group pre-test post-test designs were used as research designs. Three experiments were conducted to measure achievement in learning and soft skills development. Other sources of data collection were observations and individual interviews with undergraduate students. Chapter three explains methodology in detail.
1.8 Definitions of Terms

1. Gamification
Practice of activities more like games in order to increase the interest of the participants.

2. Active Learning
Anything that involves students in doing things and thinking about the things they are doing.

3. Undergraduate Students
Final year and second year undergraduate students who are attached to the School of Management Technology, Sirindhorn International Institute of Technology (SIIT), Thammasat University, Thailand, and second year students of the Department of Public Health, Mahidol University.

4. Educational Games
Games which are designed to help people to learn about certain subjects, concepts, or assist them in learning a skill as they play.

5. Product Life Cycle (PLC)
PLC is an important concept of business and marketing. A new product goes through a sequence of stages from introduction, growth, maturity and decline. This is known as the PLC and it is associated with the changes in the marketing environment.

6. PLC (Product Life Cycle) Game
The PLC game is mainly a card game which includes product cards, feature and strategy cards, happening and action cards, matching cards, and a puzzle. It was expected to teach the features and marketing mix strategies relating to PLC stages through this game. Furthermore, soft skills such as, interpersonal communication, decision making, critical thinking, time management, and leadership qualities are expected to be enhanced.
7. Marketing Mix Strategies
Marketing mix is the collection of controllable marketing tools namely, product, price, place, and promotion (commonly known as 4Ps). Effective marketing strategies combines 4Ps of the marketing mix. A plan of marketing actions/ decisions taken to achieve company goals can be stated as marketing strategies.

8. Engagement
The time and effort that students devote to educationally-purposeful activities, or students’ interactions with their learning activities.

9. Learning Achievement
Assessment of knowledge, skills, and attitudes/values students have gained.

10. Soft Skills
Skills that are needed for a successful career. Interpersonal communication, decision making, critical thinking, leadership, and time management were considered as soft skills in this study.

1.9 Chapter Organization
This thesis comprises of five chapters. This chapter (Introduction) presented the background and motivation, problem statement, significance of the study, objectives of the study, limitations, and definitions of terms. Chapter two explains relevant literature related to the study along with a conceptual framework followed by hypotheses. Chapter three addresses the research methodology in detail, and chapter four will discuss analysis of data and research findings. Chapter five will summarize the research study, with conclusions and recommendations.
Chapter 2
Literature Review

2.1 Introduction
This chapter explains a detailed analysis on the research studies carried out previously on gamification and active learning. It is important to understand the viewpoints of earlier studies to get a thorough understanding of the research area and ensure that the research covers all required areas in the formation of a comprehensive view. This chapter begins by explaining the issues in the 21st century higher education. Then it explains active learning and gamification in detail. Previous research studies relating to the main concepts are explained throughout this chapter. Finally, the relationships between various concepts are explained with the support of literature.

2.2 Issues in the 21st Century Higher Education
Higher education of the 21st century has many challenges. The world is rapidly changing, and educators have an important responsibility to prepare students for the society successfully. Quality of teaching and learning may be a persistent problem in higher educational institutions today. Students of generation Y or the digital natives are highly evolving in the society. Technology is considered as a way of life for them (Günüş & Kuzu, 2014). Teaching for them is a challenging task for some faculty members. Other challenges are traditional methods of teaching, unable to keep up with rapidly changing world, lack of understanding about the nature of the learners, misalignment of curriculum according to the needs of the changing world, lack of professional development of faculty members on pedagogical knowledge issues (Coetzee-Van Rooy, 2002), such as student learning styles, teaching strategies, and instructional styles. Old ways of teaching and learning are unable to keep up with the rapidly changing world today. Sharma (2017) stated that learning and innovation skills separate students who are prepared for 21st century work environments from the others. To prepare students for the future, communication, collaboration, critical thinking and creativity are important.
2.2.1 Learners of 21st Century

Blair (2012), stated that the learners of 21st century are highly rational and they want quick access to new knowledge. They need teachers to incorporate technology in the classroom. Though the students of the 21st century are highly capable on technical skills, high attachment to the mobile devices may distract them from the classroom. A disengaged student is a big problem for an institution. They may be likely to dropout and may spread negative opinions towards the institution as well (Shore, 2016). Active and collaborative learning is a better strategy in order to keep interest of students, while engaging them more on classroom activities.

2.3 Learning and Teaching

Students learn with the aid of many techniques such as, seeing, listening to, logical reasoning, memorizing, or building mathematical models. Various teaching methods can be seen, such as the lecture method, demonstrations and the like. Some of those methods focus on memory, and others mainly focus on understanding. As a result of the mismatch between common learning styles and traditional teaching methods boredom, poor performance on class tests, loss of attention, and drop-outs can be seen (Felder & Silverman, 1988).

2.3.1 Learning Styles

The learning process can be improved by understanding student learning style (Bernard, Chang, Popescu, & Graf, 2017). Students have different learning styles and therefore, teachers need to use various techniques incorporated into the teaching and learning environment (Franklin, Peat, & Lewis, 2003). Grasha (1996) identified six learning styles by student behavior.
Independent learners like to work independently, and a little instruction from the instructor is necessary. Students with a high absence rate belong to the style of Avoidant. Students who depend heavily on the instructor and their friends to complete learning tasks can be called Dependent learning style. Collaborative learning style refers to the learning style of students who enjoy group work. These students like tasks including group discussions and projects. Collaborative learners will share ideas and knowledge and learn. The lecture following the talk in a small group is most suitable for them. Participatory learning style refers to the learning style of students who wish to respond carefully to the requirements of the course and meet the requirements of the course on time. Classroom discussions will help most of all groups. Competitive learners expect the attention of instructor and a high grade. The purpose of these students is to demonstrate superior performance in the class over others. Competitive learners consider competition seriously and more powerful in class discussions. Amir, Jelas, and Rahman (2011) concluded that collaborative and competitive learning styles among students are prevalent. In addition, Yazici (2017) investigated the relationship between academic achievement and learning style. It was found that the academic achievement was low of the students of independent, dependent and cooperative learning styles. A moderate academic achievement could be found with students who belong participant style, and it was negative in avoidant style students. However, in the study conducted by Hamidah and Sarina (as cited in Yazici, 2017), significant relationship was not found between the cooperative learning style and the academic achievement.

2.3.2 Teaching Methods

Since the establishment of universities, lecture method has been considered the main method of education (Brockliss, 1996). Lectures are not an effective approach to stimulating students' interests. Students do not pay attention for 10 to 20 minutes continuously in the lecture (Weimer, 2014). It was found that lectures, reading comprehension, audio-visual presentation, demonstration (called passive learning methods) will help keep knowledge 5%, 10%, 20%, 30% respectively. However, by conducting group discussion, learning by doing, and teaching others (called active
learning methods), the average knowledge retention rate will be 50%, 75%, 90% respectively (Masters, 2013). This can be shown in Figure 2.1.

![Learning Pyramid](image)

**Figure 2.1. Learning Pyramid**

### 2.4 Knowledge Retention

Knowledge retention is important for successful learning and development (Chinn, 2017). Active learning has a positive influence on student knowledge retention (Pérez-Sabater, Montero-Fleta, Pérez-Sabater, Rising, & De Valencia, 2011). Student attention may be lost by their passive behavior in the classroom, which leads to reduction in knowledge retention (Auwal, 2013). Semb and Ellis (1994), concluded that students with high abilities learn and remember more than low-ability students. Knowledge retention can be measured by paper and pencil test as mentioned by Halpin and Halpin (1982). Forgetting happens despite of the skills, teaching aids, age, or background of the learner. There is a tendency to forget newly acquired knowledge and skills, though the teachers take a lot of effort to help students to acquire those. Therefore, periodic review is necessary to preserve knowledge in long-term (Lindsey, Shroyer, Pashler, & Mozer, 2014).
2.4.1 Forgetting Curve

The forgetting curve was developed by psychologist Herman Ebbinghaus in 1980. It illustrates the decreasing ability for the brain to retain information over period, when there is no attempt to retain. According to the curve, newly learned information is forgotten during the first few days (Figure 2.2).

![Ebbinghaus Forgetting Curve](https://www.inkling.com/blog/2015/08/why-google-changed-the-forgetting-curve/)

Figure 2.2. Forgetting Curve

Active involvement of the learner is one of the methods to combat the forgetting curve (Engineering, 2017).

2.5 Importance of Active Learning

Active Learning (AL) has become the buzz word in higher education today. Chickering and Gamson (1987) mentioned about seven principles which can help to improve undergraduate education. Use of AL techniques is one of the most important principal. The choice of AL strategy may affect by many considerations such as, objectives, student ability, teaching skills and preferences (of teachers), and class size. However, the goal of every teacher is to select strategies which promote active engagement in learning.
AL is a learner-centered approach that encourages student involvement in the learning process. Students become active participants rather than being passive listeners. As stated by Bean (2011), speaking, listening, reading, and reflecting are the basic elements of AL. There are several points to limit the use of ALS in the classroom. Course content may not be able to cover within a given period of time, shortening lecture duration, inability to apply for large classes, lack of resources, student resistance (towards a new approach) are some of them. However, there are many advantages of AL. It develops communication, increase motivation, enhance important concepts and skills, and it helps to build self-esteem. Critical thinking, as well as students self-directed learning can be improved as a result of Active Learning techniques (Van Amburgh, Devlin, Kirwin, & Qualters, 2007). By applying ALS, teachers can maintain student concentration over a long period of time. ALS also raises students’ interest in the subject (Felder & Silverman, 1988).

The theory behind AL is constructivism. It emphasizes that learners build their own understanding. “Learning is a process of making meaning. Learners replace or adapt their existing knowledge and understanding (based on their prior knowledge) with deeper and more skilled levels of understanding. Skilled teaching is therefore active, providing learning environments, opportunities, interactions, tasks and instruction that foster deep learning”. Learning occurs basically through social interaction with people. (a teacher or a learner’s peers) according to the theory of social constructivism (Cambridge, 2015).

Teacher is the facilitator of learning, in the constructivist classroom. His main focus is to guide students to develop their own understanding. Then the students will be able to generate new ideas and integrate those into their growing knowledge and skill. The student in the learner-centered classroom is an active learner. The teacher act as a facilitator and provides opportunities, (such as active involvement, problem solving, collaboration) with others. According to Gray (1997) the, features of the constructivist classroom are, students active involvement, democratic classroom environment, student-centered activities, and the teacher facilitated learning process. Students are working collaboratively in groups (exchange of ideas and emphasis on
communication skills can be seen) in the constructivist classroom. Those cooperative approaches cannot be seen in the instructivist classroom. Students are instructed by the teacher and work individually in such classrooms.

2.5.1 Cooperative and Collaborative Learning

Cooperative learning and collaborative learning are two variations of AL. Cooperative learning consists of assigning students into groups (with defined roles for each student) and a task to be accomplished by the group. It helps students work together in small groups to facilitate other group members learning while facilitating self-learning (Giraud, 1997). Benefits of cooperative learning are increased student understanding, and positive student attitudes. The use of cooperative learning method should lead to better learning and retention of students (Abu & Flowers, 1997). Keyser (2000) mentioned that cooperative learning is one approach to AL and cooperative learning is always AL; but all AL methods are not cooperative.

In collaborative learning, groups of learners work together either to solve a problem or to complete a task (Laal & Ghodsi, 2012). Higher achievement, supportive /committed relationships, good psychological health, social competence, and self-esteem are some of the advantages of collaborative learning. Higher achievement power, supportive and dedicated relationships, superior psychological health, social ability, self-esteem are part of the benefits of collaborative learning (Gunasagaran & Kamaruddin, 2006). Gokhale (1995), concluded that collaborative learning helps to develop critical thinking through discussion, idea clarification, and evaluating others' ideas.
2.5.2 Importance of Group Learning

R.-S. Chen and Hsiang (2007) mentioned that leaning is a social behavior and it happens only in the group interactions. Group learning is a widely discussed topic today. Some of the advantages of group learning are, individuals learn from each other, helps to clarify doubts about the concepts learned, and helps to develop skills which are required by the industry (Fernández-Breis, Castellanos-Nieves, & Valencia-García, 2009). Emke, Butler, and Larsen (2016), have done a study incorporating team based learning into pre-clinical pediatrics curriculum. According to their conclusion, over a short period of time, large gains in knowledge were possible. However, those did not persist. Therefore, further research is needed to identify the impact of team based learning on long term knowledge retention.

2.6 Debriefing

Debriefing, is a process which involves active participation of learners. It is guided by a facilitator or instructor, and the main goal is to recognize and fill the gaps in knowledge and skills (Raemer et al., 2011). Three modes of facilitation were suggested by Heron (1989) in adult learning. Those are the facilitator directs the learning process (hierarchical mode), The facilitator shares his or her power (cooperative mode), and the facilitator give autonomy to the group (autonomous mode). These three modes can be used in the debriefing process though the second mode is popular. Franklin et al. (2003) stated that debriefing after the game is more important. Gaw (1979), introduced six phases of debriefing (Experience, share, interpret, generalize, apply, and process).

Thiagarajan (1992) introduced the phases of debriefing in question formats. Those are, how do you feel? what happened? do you agree? what would you do?, and how can you improve the activity? Furthermore, to emphasize different phases, debriefing games (d-games) were introduced. some of such d-games were mood check, live likert group grope, envelope game, take five twenty questions. Those games have been successfully used with various groups of participants by various facilitators to debrief many variety of activities. Sawyer, Eppich, Brett-Fleegler, Grant, and Cheng (2016), introduced two time frames of which the debriefing could occur. Those are post-event
debriefing (after the completion of the event, guided by a facilitator or by learners themselves) or within-event debriefing (during the event; guided by the facilitator). The most commonly used method of debriefing was Facilitator-guided post-event debriefing.

2.7 Active Learning Strategies

There are many AL strategies which can be used for university education. The selection of the appropriate ALS depends on the discipline. The following describes some of the ALSs, commonly used in university education.

- **Role Playing**
  This is an effective AL strategy which has advantages, such as it arouses student interest as well as engagement. Students can connect course content to their lives and develop critical thinking skills too. Role playing is a heavily used ALS in social sciences. However, it is presumed that role playing is not very well known in engineering education.

- **Case study Method**
  Case study method has been used for business and law courses for many years, and now it is used by many disciplines. Students are able to solve problems using knowledge, concepts, and skills using this method (McKeachie & Svinicki, 2013).

- **Project-Based Learning (PBL)**
  PBL was seen in the business environment in the early 1990s (Selvakumar & Rajaram, 2015). Application of knowledge can be tested by project work. Time and resource management, and task and role differentiations are important in this. PBL focuses on the application of previously gathered knowledge. It may be carried out as individuals or small groups (Mills & Treagust, 2003). In group projects, group members have an opportunity to explore the assigned topics and share it with other groups.
• Clickers
Clickers provide an exciting new method to actively engage students in the process of learning. Research studies show that a measurable increase in student learning can be seen by using clickers. Through this device, a large number of students can send their individual response to an instructor’s computer. However, the necessity of special hardware (such as clickers) is decreasing with the introduction of teaching platforms like Moodle and other mobile applications. Using clickers, an instructor can assess students’ prior knowledge of subjects and check their understanding of new concepts during lectures. Instructors are able to understand the knowledge of students easily (McKeachie & Svinicki, 2013). Further, a real-time assessment and feedback can be given, which enhances the quality of the teaching-learning process.

• Discussions
Discussions are mostly used in small classes. However, this strategy can be used in classes of all sizes. Lecturing differs from teaching by discussion, because the end result of discussion is not known. It provides challenges and opportunities for the instructor and the students (McKeachie & Svinicki, 2013).

• Presentations
Presentations help students to improve their speaking, reading, writing, and listening skills. Good presenters can express their ideas very clearly. This skill is needed inside as well as outside of the class room. Instructors can assign a certain task for their students. The students can express their views through presentations (individuals/groups) for the given task. The audience can actively engage in the presentation by raising questions at the end (of the presentation). Most of the discussions are followed by presentations.

• Games
Educational games provide an encouraging and stimulating environment for students while providing them with feedback to promote learning (Bodnar, Anastasio, Enszer, & Burkey, 2016). By incorporating games into the curricula, students become active...
participants, rather than passive listeners. Key features of a game are curiosity, challenge, personal control, and fantasy. However, game design and implementation is time consuming. It is said to be a challenging task to align a game towards achieving learning objectives within specified lecture hours.

2.8 Review of Past Research Studies on ALSs

In Active Learning (AL), students are involved more directly in the learning process. AL has been used as an *umbrella* term for any method that involve students directly in their learning (Loveland, 2014). It makes classes more enjoyable for both students and instructors. Maintaining student attention throughout for 50-minute class is a difficult task for Instructors. Even though the instructors ask questions, the students may not respond or may not keep proper eye contact and then their attention may decrease gradually. Instructors can change the classroom environment by incorporating ALSs. It is a good opportunity for the students to discuss and argue on certain matters. They will pay their attention to the rest of the lecture (Felder, Woods, Stice, & Rugarcia, 2000). Researchers have indicated that AL improves student performance in Science, Engineering, and Mathematics disciplines (Freeman et al., 2014). To make the learning process more interesting and effective, methods such as flipped classroom, peer instruction methods, and think-pair-share can be introduced (Anitha & Rao, 2014). S. R. Hall, Waitz, Brodeur, Soderholm, and Nasr (2002) explained the process of adapting AL in a traditional lecture-based engineering class. The selected course (Unified Engineering), covers five sub-disciplines. Concept tests, in-class demonstrations, turn-to your partner discussions, cold calling, reading quizzes (at the beginning of the lecture), and muddiest-point-in the lecture cards were considered as ALSs. Student feedback was positive, when compared to traditional lecture-based method.

Yadav, Subedi, Lundeberg, and Bunting (2011), conducted a study using undergraduate students who were specialized in electrical engineering. The impact of problem-based learning (PrBL) on their conceptual understanding and their perceptions of learning was compared to a traditional lecture. Student learning enhanced more, when compared to the traditional lecture.
Schofield and Honoré (2009), stated that generation Y value active participation, networking, and interaction. Lecture based instructions are not valued by them, and they do not want lecture based information. They do not place more value on reading and listening, but they enjoy trial and error (Mangold, 2007).

2.9 Gamification

The term *Gamification* initiated in the digital media industry (Deterding, Dixon, Khaled, & Nacke, 2011). It is a new technology which combines parts of game play in non-game situations (Prince, 2013). Many researchers have the same view about gamification. But, Muntean (2011) stated that, creating a game itself cannot be considered as gamification. Furthermore, education should be more fun an engaging without bringing down its credibility. Gamification motivates students to study because of the positive feedback they get, and it works as a study booster. Another commonly agreed viewpoint is, points, badges and leaderboards are considered as elements of gamification. However, Gee, Shaffer, Squire, and Halverson (2005), mentioned about a contradictory viewpoint. They mentioned that people are not interested in obtaining points for playing games. They play game to socialize with others and to overcome challenges. As per their view point, the most engaging element of games are challenge, continuous feedback and high level of interaction. Iosup and Epema (2014) mentioned that gamification can be used to teach technically challenging course modules.

2.10 Game Development

Commercial game design and development started in 1970s. When designing games, complex games can be used as a framework. Rules are incorporated with popular games. Some games (Tetris) have minimal rules or procedures. They are easy to play and motivates students. The duration of the game should be considered by Instructors prior to course delivery. If they face a problem developing games he/she can think about other alternatives, such as, role playing games, card/board games, and video games. Offering rewards for the winners can make learning a memorable experience (Armier Jr, Shepherd, & Skrabut, 2016).
However, the usage of innovative techniques (like games) by young teachers may discourage by more senior teachers in the institute. As Koh, Kin, Wadhwa, and Lim (2012), suggested that younger teachers may find it difficult to use innovative techniques, if learners are the more senior teachers in the school. Senior teachers may discourage the younger teachers; they may not learn much by laughing or having fun. Koh et al. (2012), mentioned that many teachers have a positive attitude towards educational games and it may lead to better outcomes too. Barriers to adopting games, such as time, costs, relevance, limited resources, reactions of parents and lack of school support were highlighted by Gaudart (1999).

2.11 Educational Games

Educational Games has been defined by Fitzgerald (1997) as “an instructional method requiring the learner to participate in a competitive activity with preset rules” Pfeiffer and Jones (1985), described games as a “type of experiential learning where the learner engages in some activity, looks back at the activity critically, abstracts some useful insight from the analysis and puts the results to work”. Allery (2004), stated that many games are different from other educational strategies because of its competitive nature and the use of pre-determined settings (constrained by rules and methods).

Educational games provide an encouraging and stimulating atmosphere for students. They provide feedback to promote learning as well. Key features of a game are challenge, curiosity, personal control, and fantasy. However, game design and implementation need a significant amount of time.

Previous research shows that educational games have the ability to attract students towards learning and motivate them to participate in a more interactive environment. Reese and Wells (2007) stated that many people including teachers and students have a positive view about the use of games as a learning strategy in the classroom. Games can be used to develop many skills in a language class. But as for the views of Gaudart (1999), many teachers think that only elementary school learners enjoy games. Furthermore, some teachers think that the desire to play games is lost when the learner
reaches puberty. According to the experiences of Gaudart (1999), adults enjoy games more than children (sometimes). As stated by Hromek and Roffey (2009), games have a power to develop social and emotional learning in young people.

Some instructors may think that even though games are entertaining, those are not providing an educational benefit (Bennett, Wood, & Rogers, 1997). Students may think that games are too easy for a serious activity like learning, or not suitable for adult learners. Garris, Ahlers, and Driskell (2002) suggested that well-designed games can be used as valuable learning tools. Games motivate students to engage in decision-making processes (Gaudart, 1999). Premkumar and Bonnycastle (2006) mentioned about the use of games in a medical training. Halleck, Moder, and Damron (2002) mentioned about a positive motivational influence of a simulation used in a language classroom. Games and simulations not only motivate students, but also give an opportunity for experiential learning as well. Garris et al. (2002) discussed about a model called ‘game cycle’. Learning is facilitated by the learners’ repeated interactions with the gaming environment as mentioned in the model. According to an examination and student survey carried out by Keech, Avery, and Lirely (2011), it was found that knowledge retention can be increased by utilizing the games developed by students.

### 2.11.1 Educational Card Games

Su, Cheng, and Lin (2014), Stated that out of many game types, card game is more beneficial for enhancing student learning. Face-to-face interaction between player can be seen and card games can be played anywhere. Cards are easy to produce, integration of game rules with the instructional content is easy, and peer collaboration has many advantages for learning.

Much literature could be found relating to computer/video games in education. But the use of educational card/board games seems rare in the literature. Hamada, Hiji, and Kaneko (2014), discussed about software development board game (developed in 2009), to teach skills needed to manage human resources, cash and process management. Card games have been used in medical education frequently (especially
to teach biological concepts, physiological concepts), and language education. Rajashekar and Bellad (2016), mentioned about a card game to teach concepts of physiology. They have stated that an educational card game is an effective supplementary educational tool which improves students’ ability to analyze and retain knowledge for a long time. Su et al. (2014), introduced a card game to teach, human immunology. According to them, developing a suitable instruction method was a challenging issue. Schneider et al. (2012) stated that card game, which is a useful aid in teaching, plays a vital role in the teaching-learning process. They developed a card game to improve medical students’ knowledge about the white blood cell. Gaudart (1999), has done a research on the usage of games for English teaching and concluded that games allow learners to utilize the language completely that they have learned, by engaging in the communication process throughout the game. Franklin et al. (2003), stated that originally developed card games should be modernized in order to visually appealing to the students of 21st century.

Teachers can use simulations and games in second or foreign language education. New structures of language can be experimented, and the learners can practice what they have already learned by using both methods. When the learners practice, progress can be seen and it will motivate them towards learning (Gaudart, 1999).

2.12 Engagement and Learning

In the educational psychology, engagement has become a widely spoken topic. Benefits, such as increased motivation and achievement can be seen when students are engaged in the learning process as stated by Stocklmayer (2013). Pekrun and his colleagues described the relationship between emotion and engagement in the Control-Value Theory of Achievement Emotions (Pekrun, Götz, Titz, & Perry, 2002). As explained in the theory, academic emotions can change in two dimensions, such as, valence (positive or negative) and activation (activating or deactivating). Positive emotions, (such as, enjoyment and hope) can make engagement more effective. Disengagement caused by negative emotion (boredom and hopelessness).
Engagement and involvement have been used interchangeably by some of the researchers. Student Involvement Theory explains, “the greater the student’s involvement in college, the greater will be the amount of learning and personal development”. Astin (1999), defined student involvement as “quantity and quality of the physical and physiological energy that students invest in college experience”. Frequent interaction with faculty, spend significant time with other students and on campus, involvement with extracurricular activities are some of the features of a highly involved student. Furthermore, the theory emphasizes active engagement of the student in the process of learning, and motivates educators to focus on student’s activities. The theory is mainly focused on behavioral mechanisms which facilitates student development than on outcomes. Effective student-faculty contacts, active/collaborative learning and environment of the institution may cause high levels of student engagement. Those are related to student learning and development, and satisfaction. “High levels of student engagement are necessary for and contribute to collegiate success” (Carini, Kuh, & Klein, 2006). Student learning can be enhanced by high involvement and collaboration with peers (Korobova, 2012). Interaction with peers directly Effects on academic achievement of the student. Astin (1999), stated that “the student’s peer group is the most important influential source on growth and development during the undergraduate years”. According to the views of Günlü and Kuzu (2014) students’ interest towards faculty members, in or out class interaction with students, teaching of the courses entertainingly, active participation of students, lecturing techniques, feedback provision are some of the factors affecting class engagement.

In this study engagement refers to academic engagement or the student engagement in academic work which may include reading, writing, discussions, and group work and emotional engagement. Newmann (1992) defined, active involvement, attention, and commitment as engagement. Student participation in the academically meaningful activities was considered as engagement by many researchers. However, Even in the same learning process, the degree of engagement may different among students.
2.12.1 Components of Student Engagement

According to the views of Gunuc and Kuzu (2015), the main components of student engagement are shown in Figure 2.3.

![Figure 2.3. Components of Student Engagement](image)

This study mainly concerns about class engagement. It covers students’ cognitive, emotional and behavioral reactions to in-class educational activities. Students approaches to learning and the way they understand their own learning can be described as cognitive engagement. Positive emotions (interest and happiness in the class) belong to emotional engagement. However, when there are negative emotions (boredom, anxiety), emotional disengagement occurs. Behavioral engagement includes student’s active engagement in academic or other activities, ask questions, and pay attention (Gunuc & Kuzu, 2015).
2.13 Student Engagement, Learning, and Academic Success

Student’s engagement in learning is important to guarantee good academic results. High engagement is an important factor for better absorption of knowledge. To increase the students’ understanding on the learning process, they involve with specific activities in the university. Student engagement is highly associated with the blended learning (Mohd, Hussein, Aluwi, & Omar, 2016). It is assumed that engagement and learning are causally related. However, “some highly engaged students learn almost nothing”. This may be due to poorly designed classes or incompetent instructions (Mohd et al., 2016). Carini et al. (2006) found that student engagement is positively linked to critical thinking and grades and the relationship between engagement and academic performance is not robust. Sun and Wu (2016) stated about flipped classroom’s positive impact on learning achievement because flipped classroom gives more opportunity for collaboration. Praise student performance, proper use of humor, engage students outside the classroom, encourage them to talk, ask questions about their feelings, and follow up on topics raised by them, are some of the factors which help to promote student learning according to Gorham (1988).

According to the literature, direct relationship could be seen between student involvement and academic success. Parikh (2008) investigated the relationship between student engagement and academic performance considering international undergraduate students. GPA was used to measure academic performance. Results revealed that international students who has low campus involvement had higher than average GPAs. High level of academic achievement could be seen with highly engaged students and that was low with the students of low engagement according to guNuc (2014). Many different views could be found about the relationship between engagement and learning.
2.14 Gamification and Engagement

Kankanhalli, Taher, Cavusoglu, and Kim (2012) stated that fun is an aspect which is included in gamification. Because of fun people like to play games which evoke engagement. Furthermore, they stated about the motives for which people engaged in gamified applications. Those are intrinsic motivation (the pleasure generated by the activity (enjoyment gained by playing a game) rather than an extrinsic motivation (external reward; an activity is performed to get a reward). According to the results of the study conducted by Looyestyn et al. (2017), gamification can be effectively used in increasing involvement of online programs. But further studies are needed to completely examine gamification effects and its impact on engagement. Pesare, Roselli, Corriero, and Rossano (2016) presented two serious games which used gamification dimensions. Their aim was to sustain engagement and motivation in learning in the field of medicine.

2.15 Learner Satisfaction and Learning

The term satisfaction has been researched thoroughly in many studies. Learning satisfaction includes the individual’s “feelings and attitudes towards the education process and the perceived level of fulfillment connected to the individual’s desire to learn, caused by the learning motivation” (Chang & Chang, 2012). Harvey, Locke, and Morey (2002) described learning satisfaction as the happiness derived from students’ implications in specific activities (which are suggested by the curriculum design). They emphasized that individuals have different learning needs, and based on different learning activities they get different levels of learning satisfaction (Chang & Chang, 2012). Lo (2010) conducted a research to measure how factors of satisfaction affect perceived learning. It was found that high level of student satisfaction may enhance student learning. In this study, three satisfaction factors were identified as predictors of perceived student learning. Those are performance of the instructor, own commitment of the student towards learning, and the course policies. Topala and Tomozii (2014), suggested six indicators of learning satisfaction, namely individual characteristics, peer relationships, teacher and activities, learning facilities and material conditions, outcomes of the learning process and the learning environment. As cited by Chang and
Chang (2012), Huang (2002) used six factors as measurements of satisfaction namely, teacher’s teaching, result of learning, class materials, interpersonal relationship, administration, and learning environment. Furthermore, Wei (2003) has introduced four factors to explain learning satisfaction such as course content, teacher and teaching, learning environment, and administrative services. Chen (1997) has stated that, class materials, teacher’s teaching, student-teacher interaction, learning results, peer relationship and support as major factors of learning satisfaction. Recent researches considered student satisfaction is related to teamwork, team performance and collaborative learning (Topala & Tomozii, 2014).

2.16 Soft Skills Development

Many employees in the workforce today are lacking important soft skills. Fresh graduates may think that they are equipped with the skills that make them ready for the workplace. However, that assumption may not be true with related to skills (Anthony & Garner, 2016). Furthermore, educators those who wish to incorporate soft skills in to their courses have to face many challenges. “New activities geared toward teaching soft skills may sacrifice content for lectures, which is an important challenge”. Furthermore, “the end product of educating students on soft skills is often elusive and difficult to document” (Robles, 2012). Increasingly, business schools recognize that hard skills are not enough for workplace success. Therefore, they are trying to teach soft skills because they recognize them as vitally important for higher level management and leadership positions (Anthony & Garner, 2016).

2.17 Past Research Models in Learning Achievement

Learning Achievement can be defined as a particular knowledge, skill or behavior that a student is expected to demonstrate after a period of study (Ketchatturat & Phanpruek, 2014). Researchers have introduced different models for learning achievement, considering different variables. Figure 2.4 illustrates the model developed by Carroll on academic achievement.
(1) Carroll’s Model of School Learning

According to the model depicted in Figure 2.4, academic achievement is expressed in terms of time. Carroll (1989) have stated that this model could be used to solve current issues in education.

(2) Walberg's Model of Educational Productivity

Student aptitudes, instruction and environment affect learning. Positive environment and good instruction affect aptitudes according to Figure 2.5. Furthermore, aptitudes correlate with learning. Therefore, it is needed to include aptitudes in theories of educational productivity according to the views of Fraser, Walberg, Welch, and Hattie (1987).
(3) Leithwood and Mascall Model

Leithwood and Mascall (2008) have done a study to estimate the impact of collective leadership (CL) on other variables as depicted in Figure 2.6. As for the findings, CL explained a significant proportion of variation in student achievement.

Figure 2.5. Walberg's (1981) Model of Educational Productivity

Figure 2.6. Leithwood and Mascall Model of Student Achievement
There are many other models developed by various researchers in the literature to assess student achievement/academic achievement or learning. In this study, a new framework is proposed to measure learning through engaging in gamification. Section 2.18 describes the proposed conceptual framework of the study.

2.18 Conceptual Framework

“A Conceptual Framework is described as a set of broad ideas and principles taken from relevant fields of enquiry and used to structure a subsequent presentation” (Reichel & Ramey, 1987). Based on the literature presented in the above sections, the conceptual framework is developed as shown in Figure 2.7.

In this framework, *gamification* refers to “practice of activities more like games, in order to increase the interest of the participants”. Product Life Cycle (PLC) game was developed and used as an innovative teaching tool. According to Wortley (2016) primary purpose of using gamification elements is to trigger attention and engagement. He mentioned about elements of gamification, such as rules, rewards, penalties, competition, achievement, failure, learning, skills, and feedback. Teachers can use these elements in the class room to enhance the teaching process. The PLC game was developed considering rules, competition, achievement, points, learning, and feedback as well. However, Nadolny, Alaswad, Culver, and Wang (2017), stated that game mechanics vary, depending on the level of students. According to their survey results, in the middle school, challenge, competition, and feedback were important in middle
level. However, assessments, points and rewards were important for high school and college levels. Furthermore, they suggested that use of badges, non-academic rewards, and competition may not be effective as other strategies, even though those are popular game mechanics.

According to the Figure 2.7, gamification was considered as the independent variable, and learning achievement and soft skills development were considered as dependent variables. It is expected that, because of the gamification, students may engage more with game activities, and then it may have an impact on their learning achievement and soft skills development. In this framework, cognitive domain (knowledge and the development of intellectual skills) of learning was considered. Therefore, the students were expected to obtain the lower order knowledge levels (remember, understand), as well as higher order levels, such as apply, and analyze. Furthermore, it is assumed that gamification may have a favorable impact on student satisfaction.

2.19 Hypotheses Development

Hypothesis is an educated guess about a problem’s solution and it has been defined by Uma (1992) as a “logically conjectured relationship between two or more variables expressed in the form of testable statements”. Malhotra (2007) stated that “hypothesis is an unproven statement or proposition about a factor or phenomenon that is of interest to the researcher”. Research hypothesis derived from the conceptual framework (Figure 2.7) are as follows.

Gamification and games have become a popular trend in education. Therefore, more attention has been given for gamification in education conferences all over the world (Pike, 2015). Gamification indirectly leads to learning according to the views of M. Hall (2014). As for the findings of Buckley and Doyle (2016), gamified learning has a positive impact on learning. Iosup and Epema (2014) found that gamification is correlated with an increase in the students’ passing percentage.

H1: Gamification affects Learning Achievement
Sousa and Rocha (2017), mentioned that soft skills as personal attributes which enhance interactions between individuals, career prospects, and job performance. Dochie, Herman, and Epure (2017) stated that Learning Soft skills is a challenging task in the present education system. Games provide different contexts and scenarios for learners and both technical skills as well as soft skills can be enhanced by games. Furthermore, students can easily obtain the skills and apply them in a classroom setting by playing games.

H2: Gamification Correlates with Soft Skills Development

Student engagement refers as the active involvement or attention, interest, and passion they show when take part in the learning process. da Rocha Seixas, Gomes, and de Melo Filho (2016); Reeve (2012), investigated that gamification has positive effects on student engagement. M. Hall (2014) stated that engagement directly affected by gamification. Incorporation of game elements can enhance student engagement and motivation according to many research studies.

H3: Gamification Correlates with Engagement

Student engagement plays a vital role in improved learning. Importance of student engagement leads to a positive effect on learning outcomes (Poondej & Lerdpornkulrat, 2016). Furthermore, lack of student engagement may result in difficulties in effective learning.

H4: Engagement Correlates with Learning Achievement

Subramaniam (2013), mentioned that soft skills can be acquired by engaging with the subjects learning experience. Chamorro- Premuzic, Arteche, Bremner, Greven, and Furnham (2010) stated that soft skills are associated with the degree of engagement.

H5: Engagement Correlates with Soft Skills Development
By incorporating game elements to lessons, student satisfaction towards the lesson or game can be increased. As for the findings of an experiment conducted by Tsai, Cheng, Yeh, and Lin (2017), game based learning approach increased the student interest and satisfaction.

H6: Gamification Correlates with Satisfaction

2.20 Chapter Summary

This chapter presented the literature related to the study and it started by discussing the issues in the 21st century higher education and special emphasis was given for Active Learning (AL) in university education. The next section explained the importance of AL, past research studies on AL with special reference to the educational games as an AL strategy. Next, it discussed the concepts related to the development of the conceptual framework, and the final section of the chapter presented the literature related to hypothesis development.
Chapter 3  
Methodology  

3.1 Introduction  
This chapter begins with an overview of the experiments conducted. Then the methodology adapted for the study in detail, to conduct the study is described. It provides the information on the sample population, research tools used, and data analysis techniques as well. The main purpose of this study was to identify the impact of gamification on students learning achievement and soft skills development.  

3.2 Overview of Experiments  
Three experiments were conducted on three different days. Participants of all the experiments, signed a consent form prior to treatments. Overview of the experiments can be shown by Figure 3.1.  

![Figure 3.1. Overview of Experiments](image)

Figure 3.1. Overview of Experiments
### Table 3.1. Sample Profile

<table>
<thead>
<tr>
<th>University</th>
<th>Experiment One</th>
<th>Experiment Two</th>
<th>Experiment Three</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thammasat</td>
<td>Mahidol</td>
<td>Thammasat</td>
</tr>
<tr>
<td>No. of students</td>
<td>Control group</td>
<td>Experimental</td>
<td>38 (M 2, F 36)</td>
</tr>
<tr>
<td></td>
<td>13 (M 7, F 6)</td>
<td>group</td>
<td>9 or 10 students</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16 (M 7, F 9)</td>
<td>per team</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 students per</td>
<td>7 or 8 students</td>
</tr>
<tr>
<td></td>
<td></td>
<td>team (4 teams)</td>
<td>per team</td>
</tr>
<tr>
<td>Degree &amp;</td>
<td>Engineering</td>
<td>Public Health</td>
<td>EM</td>
</tr>
<tr>
<td>(Medium of</td>
<td>Management (EM)</td>
<td>(Thai)</td>
<td>(English)</td>
</tr>
<tr>
<td>instruction of</td>
<td>(English)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the degree)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre/post test</td>
<td>Done</td>
<td>Done</td>
<td>Done</td>
</tr>
<tr>
<td>Questionnaire</td>
<td>Done (for experimental group only)</td>
<td>Done</td>
<td>Done</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Done</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Retention test</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.3 Experiment One

The purpose of this experiment was to determine whether there are any differences between lecture method and gamification with regard to students' learning achievement and soft skills development. Quasi experimental design was used for experiment one with the objective of examining the cause of a certain phenomenon. Participants were not selected randomly. The reason behind the selection of such a design is, it is the class, the lecturer was assigned to teach, and students were selected for experimental and control groups based on their Grade Point Average (GPA) of the previous semester. The sample size of each group of experiment one was (n<20). Experiment one was conducted as the pilot study. The process of the experiment can be shown using Figures 3.2 (a) and (b).

![Figure 3.2(a) Steps of Experiment One - Experimental Group (Game)](image1)

![Figure 3.2(b) Steps of Experiment One - Control Group (Lecture)](image2)
Table 3.2. Composition of the Population - Experiment One

<table>
<thead>
<tr>
<th>Department (Degree programme)</th>
<th>No. of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE (Civil Engineering)</td>
<td>6</td>
</tr>
<tr>
<td>EM (Engineering Management)</td>
<td>29</td>
</tr>
<tr>
<td>ME (Mechanical Engineering)</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>45</strong></td>
</tr>
</tbody>
</table>

Twenty-nine students who belong to the EM degree program were considered as participants of the experiment One.

### 3.3.1 Sample Characteristics

The sample consisted of fourth year undergraduate students of the School of Management Technology (MT), Sirindhorn International Institute of Technology (SIIT), Thammasat University, Thailand, who are reading for BSc. (Engineering Management) degree program. They follow ITS 442 - Entrepreneurship for IT Business Development course (Free elective course). The medium of instruction of their degree programme is English.

Initial survey was done to identify currently used active learning strategies and their attitudes towards educational games as an ALS. Audience analysis or analysis of potential players is very important factor for gamification design. Instructors should be able to identify student motivation, cultural norms, and previous knowledge regarding topics of interest. Students attitude towards cooperation and competition are the other important factors to be considered. Obtaining information about players may help instructors to design games which maintain attention, and interest. Based on the stage of the game development process, the required information may vary. Through questionnaires, information such as students’ previous knowledge, their motivation and interests can be obtained (before developing the game). Student feedback is important after developing the game. Information on direct observation and the feedback of the students helped to modify game elements for future use.
3.3.2 Sampling

The selected group of students were sub-divided in to two main groups. Sample selection was done based on quasi experiment design. All the students (29) were ranked according to the descending order of their GPA of the previous semester. The process can be shown in Table 3.3.

Table 3.3. Sampling

<table>
<thead>
<tr>
<th>Student 1</th>
<th>GPA 3.79</th>
<th>Lots were drawn by selecting each pair of students. Based on the lots, one student was randomly selected to experimental group and the other student was selected to control group.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 2</td>
<td></td>
<td>The above process repeated up to the last student.</td>
</tr>
<tr>
<td>Student 29</td>
<td>GPA 2.5</td>
<td></td>
</tr>
</tbody>
</table>

After assigning all the students, the sub-group composition can be stated as follows:
For experimental group 16 students (exposed to a one-hour card game relating to PLC)
For control group 13 students (exposed to a one-hour lecture on PLC)

Further, experimental group was divided into four teams, which consisted of four students each. Those four students were randomly selected by drawing lots (in advance) and team details were informed, before starting the game.

Pre-test (Appendix A) was conducted to assess prior knowledge level of both groups of students before the game is played and before they attend the lecture (To test whether they have the same knowledge level before lecture session and game session). The group of students who belong to the control group studied the lesson through lecture method. A card game to teach the lesson Product Life Cycle (PLC) was played with the students of the other (experimental) group. Points were given for the experimental group (for each team) for the game activities. Point allocation for game sessions and the rubric for brainstorming session can be found in Appendix F.
A post-test was conducted to assess the knowledge gained during both sessions (lecturing and gaming). The test scores were used to assess the learning achievement through the lecture and game. Comparisons were done within the group and between groups.

An overview of the methodology of experiment one can be illustrated by Figure 3.3.

Finally, the game evaluation, soft skills development, student engagement, and satisfaction were measured by giving questionnaires for the students of experimental group (The questionnaires were distributed, and the students were asked to submit on the next day). The reason for distribution of questionnaire on a ‘take home’ basis is to obtain their honest opinions towards the new approach. They can take their time and leisurely attempt it at home). But, except one student, all of the others returned the completed questionnaires after the session on the same day. The objective of distributing questionnaire was, the researcher wanted to know whether students are happy about the new approach and whether they have learned from the new tool, whether they have engaged in the activities well, and to get an idea about improvement of their soft skills.
Knowledge retention test was done to identify which method is more suitable in retaining knowledge. The same pre/post-test questionnaire was given after one month of the treatments, for both groups. Furthermore, personal interviews with the game participants were conducted to get student opinions in detail about the game session and to find out the impact of soft skills development as a result of doing game activities and to get their feedback about the game.

3.3.3 Lecture Method

Participants of the control group (13 students) were given 16 minutes to do a pre-test before they were exposed to a one-hour lecture on PLC (Lecture was done using a PowerPoint slide presentation). An activity was given for five minutes to think and write before starting the lecture, as an ice breaker. Post-test was given after the lecture (Appendix A).

3.4 Experiment Two

Sample size of experiment one was smaller, and participants had a prior knowledge about PLC. Therefore, experiment two was conducted as a follow-up measure (to confirm further the impact of game on learning achievement) considering randomly selected participants. This experiment used one group pre-test post-test design. Participants were given a pre-test, after that exposed to a treatment (game) then a post-test was given measure the effects of the treatment. The effects of the treatment can be obtained by measuring the difference between the post-test and the pre-test results (Uma, 1992).

3.4.1 Sample Characteristics

The sample consisted of thirty-eight, second year undergraduate students of the Department of Public Health, Mahidol University, Thailand, who are reading for the degree program of this group of students was Thai language. They did not have prior knowledge about marketing or business-related subjects.
3.4.2 Method

Selected sample was randomly divided into four teams. Each team consisted of nine or ten members. All the teams were exposed to game session only. Participants were given pre-test before starting the game. Because of the language barrier, all the questions given in pre-test were translated to their native language (Thai). There were twelve Multiple Choice Questions (MCQs) in the pre-test and they were asked to do the test individually, within twelve minutes. There was one MCQ, which was attempted by all team members collectively (All teams got a different question to discuss and select the most suitable answer). Duration for the discussion question was four minutes for each team.

After completing pre-test, the researcher introduced game sessions. After that students played the PLC card game. Four graduate students of Mahidol University supported as Teaching Assistants (TAs). Game participants could clarify their doubts about the game (in their native language) from the TAs. TAs were provided with a file with game sessions, and evaluation in detail, to get an overall idea about each game session.

After the game session, the post-test was done to measure their learning achievement. Same set of questions were given for them and the duration was the same as pre-test. Questionnaires were distributed to measure their soft skills development, engagement, and satisfaction towards the new learning experience. Debriefing could not be done due to time constraints. Points were given and winning team was decided, but the researcher could not meet the students to discuss their results in detail. An overview of the methodology of experiment two can be illustrated by Figure 3.4.
3.5 Experiment Three

Some participants of experiment two found it somewhat difficult to play the game successfully, even though an introduction related to PLC lesson and game done bilingually (Thai and English). In order to overcome that limitation, experiment three was conducted considering the same number of participants (38) at Thammasat University. One group pre-test post-test design was used as the research design.

3.5.1 Sample Characteristics

The sample consisted of thirty-eight, second year undergraduate students of the School of Management Technology (MT), SIIT, Thammasat University, Thailand, who are reading for BSc. (Engineering Management) degree program. The medium of instruction of this group of students was English. They did not have prior knowledge in marketing. They studied GTS 231 – Law and technology as a free elective course module and the educational game was played, though the subject area addressed by the game was unfamiliar for them.

3.5.2 Method

Selected sample was divided in to four teams, randomly. Each team consisted of seven or eight participants. They were given a pre-test before starting the game. There were 16 Multiple Choice Questions (MCQs) in the pre-test and the participants were asked to complete it (circle correct answers) within 16 minutes.

After completing this task, the researcher did an introduction about the lesson Product Life Cycle (PLC) and the game sessions were conducted using PowerPoint slides. After that the participants played the PLC card game.

Post-test was done to measure their learning achievement after the game session. Questionnaires were given them in order to evaluate PLC game, to measure soft skills development, engagement and satisfaction of the new learning experience. Points were given for each team and the winning team was selected. An overview of the methodology of experiment three can be illustrated by Figure 3.5.
3.6 Research Tools

Two main research tools were used in this study. Those are; one experimental tool and four data collection tools, as shown in Figure 3.6.

3.6.1 Experimental Tool - Product Life Cycle (PLC) Game

(1) Tool Development

This game is mainly a card game to teach “Product Life Cycle” concept in the area of Marketing/Business. Before developing the card game, the researcher referred several reading materials (journal articles, books and the web resources) related to gamification, student engagement in academic activities, active learning, student perceptions towards
card games, and learning. After that, by looking at the undergraduate catalog of fourth year students, the subject area was selected. The selected students of experiment one followed the course module ITS 442 - Entrepreneurship for IT Business Development. Product life cycle strategies were one area which should be covered under this particular course module. Finally, the researcher selected the PLC concept, to develop a card game. Cards were developed based on PLC explanation given in the book *Marketing Management* by Kotler and Keller (2012).

(2) Validity and Reliability

Face and content validity of the instrument (PLC Game), was tested by an expert in the marketing field. To increase reliability, the researcher conducted three experiments, instead of one to confirm learning achievement and soft skills development.

(3) Introduction – PLC Game

Main purpose of this experiment was to use an innovative teaching tool to facilitate students’ knowledge and understanding of Product Life Cycle. Product Life Cycle is an important concept in Marketing (Rahman, 2017). PLC game is a card game with five major sessions. Students were expected to learn the PLC concept, by playing the game. This was done on a team basis, four students per team was necessary to play the game successfully within the limited time period. The total planned duration was 1 hour and 20 minutes (including game instructions session by the instructor and the debriefing session) for this game and it was expected that lower level thinking (such as, remembering and understanding), as well as higher order thinking (such as, ability to apply the concepts, and analysis), would be enhanced after playing the game. Furthermore, the game participants may tend to think critically, and their understanding of the subject matter, decision-making ability and, interpersonal communication were expected to be improved. Appendix - F shows the game score criteria. The following sections describe the game in detail.

Classroom Arrangement

Four big tables (for four teams), surrounded by four chairs (each table) – four participants sat (face to face) around each table. Name of the team and team members’ names were displayed on each table. Team member allocation was informed before starting the game session.
Equipment needed (per team)

1) Game rules manual
2) One A4 Sheet
3) PLC image (this is an image of the Product Life Cycle)
4) 4 boards representing each stage of the PLC*
5) 6 sets of cards
   (product cards, feature cards, strategy cards, happening cards, action cards, matching cards)
6) Crossword puzzle*

* group name should be indicated on each board and puzzle
(all of these items should be placed on the tables of each group before starting the game)

Table 3.4. Sessions of the PLC Game

<table>
<thead>
<tr>
<th></th>
<th>Pre-test</th>
<th>16 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
<td>5 minutes</td>
</tr>
<tr>
<td>2</td>
<td>First Session - Brainstorming</td>
<td>5 minutes</td>
</tr>
<tr>
<td>3</td>
<td>Second Session - Feature &amp; Strategy</td>
<td>30 minutes</td>
</tr>
<tr>
<td>4</td>
<td>Third Session- Happenings &amp; Actions</td>
<td>8 minutes</td>
</tr>
<tr>
<td>5</td>
<td>Fourth Session- Matching Cards</td>
<td>15 minutes</td>
</tr>
<tr>
<td>6</td>
<td>Fifth Session - Crossword Puzzle</td>
<td>5 minutes</td>
</tr>
<tr>
<td></td>
<td>Post-test</td>
<td>16 minutes</td>
</tr>
<tr>
<td></td>
<td>Debriefing</td>
<td>10 minutes</td>
</tr>
</tbody>
</table>

Sessions in detail are as follows.

(i) **Introduction to brief the Game** (5 minutes)

The researcher introduced herself, and the total experimental process, including objectives, one week before playing the game and obtained the written consent of the students to participate in all the game related activities. Therefore, a brief introduction to the game (including the objectives of the game and the lesson briefing) was done by the researcher on the day of the experiment. PLC lesson introduction and the game instructions
were done using PowerPoint slides and a small movie clip. Printed copies of game instructions were distributed among the teams for their easy reference.

(ii) **Brainstorming Session** (5 minutes)

Cuseo (1997) stated that brainstorming tasks are ideal for group work because multiple ideas and different viewpoints can be gathered by it. The main purpose of this session was to bridge relationships among team members while collecting many opinions.

Participants were asked to get the A4 paper (already there on each table). They were given a question on new product idea generation (“How do companies develop new product ideas?”). All the teams got the same question and they were asked to discuss and write their answers on the given A4 sheet. Points were given for correct answers. The objectives of this session were to build participants team spirit, interpersonal communication, thinking, and leadership as well. See Appendix F(1) for writing rubric.

(iii) **Feature and Strategy Card Session** (30 minutes)

This is the most important session in this game. Participants were informed to take PLC image, 4 boards, product cards, feature cards and strategy cards.

a) They were asked to look at the image of PLC (Figure 3.7) and to understand it.

(One - two minutes were given)

![Product Life Cycle (PLC)](image-url)

Figure 3.7. Product Life Cycle Image
(b) Students were asked to take four boards which represent each stage of the PLC.

**Black** colour board represents introduction stage.

**Green** – growth stage

**Purple** – maturity stage

**Red** – decline stage

A sample board with the relevant product card of the “Introduction” stage is shown in Figure 3.8.

![Sample Board](image)

**Figure 3.8. Sample Board**

(c) Participants were asked to take product cards, feature cards, and strategy cards. They were supposed to think, discuss, and then place the cards in the relevant place on the relevant board (Figure 3.8).

Product cards – There were four product cards and ‘product’ on each card belongs to a different stage of the PLC (for example e-toothbrush is on the introduction stage of the PLC at this moment. Small description about the product is mentioned, on the back side of the card). Figure 3.9 shows a sample product card.
- Feature card – These cards explain one of the special feature relevant to each stage of the product lifecycle. For example, the following card shows a feature of the introductory stage. The participants were expected to think and discuss about this feature and place this card on the given place of the INTRODUCTION Board. There were 16 feature cards altogether.

Figure 3.9. Sample Product Card

Figure 3.10. Sample Feature Card
• Strategy cards - These cards explain one of the special strategy relevant to each stage of the product lifecycle. For example, the following strategy is mostly related to the introductory stage. Participants were asked to think and discuss about this strategy and place this card on the given place of the INTRODUCTION Board. There were 16 strategy cards altogether.

![Sample Strategy Card](image)

**Card No: 09**

*Offer a basic product (Produce basic version)*

Figure 3.11 Sample Strategy Card

Objectives of this session: To improve collaboration, thinking, decision making, and time management

Points were given for the correct selection of cards. One point was given for one correct card selection.

(iv) **Happening and Action Cards Session** (8 minutes)

Though it is said that newly introduced product go through all the stages methodically, in the PLC, marketers have to face sudden challenges in the market. Happening cards show unexpected happenings in the market and participants have to carefully discuss the scenario stated in each card and select the most suitable action, from action cards. There were four happening cards and twelve action cards. For each happening, there were three actions given (one action was mentioned in each card). The participants were required to select the
most suitable action. *Yellow smiley faces* were inserted with most suitable actions. *Green smiley faces* were inserted for the next possible option in order to create a fun.

Objectives: Improve thinking and to apply the knowledge and understanding gained from feature and strategy card session, improve decision making skills, and increase motivation while creating fun.

Participants could gain 5 points for the selection of the correct action. Winners of this session were selected based on the maximum points gained.

![Figure 3.12(a) Sample Happening Card](image)

![Figure 3.12 (b) Action Cards](image)
(v) **Matching Cards Session** (15 minutes)

Matching cards - Description of these cards were similar to the feature and strategy cards with slight changes.

Players were asked to pick a card from four cards, which shows the name of PLC stage. There were four cards and the four players, each player being asked to pick one card at the beginning of this session. Matching cards set (which includes the details almost same as
feature and strategy cards), were shuffled and the team leader was asked to distribute nine cards for each player. Each player should hold their own card set (like a fan), with the front side facing the player. Then the next player who sits on his/her right-hand side was asked to pick a card. If it belongs to his/her selected stage of the PLC, he/she can keep it on the top of the table (front side up). Players should carefully memorize the features and strategies learnt during the “feature and strategy stage”. If the second player thinks that it is not relevant for him/her, he/she can add it to his/her own card set and ask the next person to pick a card from his/her card set. These actions were repeatedly done until the time (15 minutes) is over. Players were not allowed to talk during this session. The team with the maximum number of correct cards was selected as winning team of this session. Four Clowns were included with the complete deck of cards, to create fun and interest. If the number of players were more than four in a team, only four players should be selected from the team members, for this round. A small video demonstration was shown before the session to understand the session clearly.

Objectives of this session: To have fun, memorize the features and strategies learnt in the previous round.

(vi) Crossword Puzzle (5 minutes)

Each team was asked to complete the puzzle collectively within the given time period. Those who came up with the maximum correct answers, was selected as the winning team. One point was given for one correct answer. Objectives of this session: Measure recalling ability, improve collaboration, and time management

One puzzle was provided for each team (Figure 3.14).
ACROSS
3. Shut down of ............ outlets can be seen at the declining stag of PLC. (unprofitable)
5. Advertising is reduced to retain loyal customers at this stage. (decline)
6. Sales are rapidly rising at this stage. (growth)
7. Sales volume peak at this stage of PLC. (maturity)
8. 4Ps are product, price, place and ..........(promotion)

DOWN
1. Profits are negative at this stage of PLC. (introduction)
2. Producer uses limited number of outlets to sell their products. (selective)
4. The marketing objective at the introduction stage is to create product .......... and trial.
    (awareness)

Figure 3.14. Crossword Puzzle

The last game session was the puzzle. Game score criteria is given in Appendix F.

(vii) Post-test (16 minutes)

After all the above sessions, students sat in a classroom setting again. Post-test, relating to PLC was distributed among them. Students were not allowed to talk with each other or look at others’ answers. Objectives were to assess students’ knowledge and understanding about the subject matter after playing the game.
(viii) Debriefing

Debriefing session was planned to be done by the instructor for 10 minutes. Objective was to brief all game sessions (with the learning objectives) and conclude the results briefly in order to let the students understand the subject matter well. However, debriefing was postponed due to the time constraint.

After completing all the sessions above, a questionnaire was distributed to evaluate the game, soft skills development and to measure engagement, and satisfaction (Appendix I).

3.6.2 Data Collection Tools

This study was a mixed method research which includes collecting, analyzing, and integrating quantitative (experiment), as well as qualitative (observations, interviews) methods. This type of research approach is used when the combination provides a better understanding of the research problem. As per the view of Boyd (2000), one of the important goals of a researcher is to design a study which has a strong internal and external validity and reliability. By decreasing investigator bias (Shih, 1998), validity and strength of the potential study can be increased. Furthermore, Denzin (1973) stated that using methods involving triangulation, investigator biases can be minimized, and validity and strength can be increased. Triangulation is the combination of two or more data sources, investigators, methodological approaches, or theoretical perspectives within the same study. In this study, the methodological triangulation was emphasized.

Data collecting tools which were used for the study are as follows.

(1) Pre-test and Post-test

Tool Development: Pre-test post-test designs are widely used in behavioral research and the main purpose is to compare groups after the treatment. In this study, the pre-test post-test papers consisted of sixteen Multiple Choice Questions. Each question consisted of four answer options and the duration was sixteen minutes for each test (Appendix A). Frederick J. Kelly is considered as the father of multiple choice test (Watters, 2015) and it has been a popular method of student assessment (Brown &
Abdulnabi, 2017; Cheung & Bucat, 2002). Four-option multiple choice is conventionally used by many researchers (Dehnad, Nasser, & Hosseini, 2014). Educators widely use Bloom’s Taxonomy of educational objectives to judge the depth and appropriateness of the coverage of course material (Bell & Fogler, 1995). In this study, Bloom’s revised taxonomy (Appendix B) was incorporated into MCQs, and questions were developed according to the first four domains of Blooms taxonomy. There were four questions aiming at each level as follows.

- remembering (Q1-Q4),
- understanding (Q5-Q8),
- applying (Q9-Q12), and
- analysing (Q13-Q16)

Participants were asked to circle the most suitable answer. Previous studies on MCQ development, especially journal articles including web references on Blooms taxonomy, and materials on Product Life Cycle concept were referred when developing the test.

**Validity and Reliability**

Test was validated by an expert in the marketing field. A test blueprint (sometimes called as table of specifications) was prepared when developing the test. (Appendix C). Test blueprint provides a listing of major content areas and the cognitive levels intended to be included in the test paper. It is a tool to increase content validity of an assessment (Patil, Gosavi, Bannur, & Ratnakar, 2015). Furthermore, Patil et al. stated that it should be an important part of assessment which helps in distribution of appropriate weightage and questions across topics. Multiple-choice test (MCT) is considered as one of the most important formats of testing students’ performance (Khairani & Shamsuddin, 2016). Test reliability was improved by preparing a test blue-print. Furthermore, KR 20 was used to measure internal consistency reliability (Appendix D) Effectiveness of pre-test and post-test was assessed by Item analysis (Appendix E).
(2) Questionnaire

Tool Development

The questionnaire consisted of different sections namely, the game evaluation section, and sections to measure soft skills development, student engagement, and satisfaction. The first part consisted of questions to gather personal information (name, student ID number, gender). Questions relating to PLC game evaluation were mentioned under second part of the questionnaire. Student perceptions of soft skills development, was measured using a likert scale given under the section three of the questionnaire. Fourth and fifth sections of the questionnaire included statements to measure the level of perceptions on engagement and satisfaction respectively. To measure engagement, and satisfaction towards the new learning experience, there were eight and nineteen items in the questionnaire. Five-point likert scales (5 = strongly agree, 4 = Agree, 3 = Neutral, 2 = Disagree, 1 = Strongly Disagree) were used to measure them.

The main benefit of using the likert scale is that, the respondent would have freedom to express their views using a range of alternatives. Also, the responses may be more focused and easy to use directly for analysis purposes. However, no standard could be seen regarding the number of points on rating scales, and different practices can be seen (Rossi, Wright, & Anderson, 2013). Researchers often use various formats of Likert-type rating scales with different numbers of alternative responses to collect data (X. Chen, Yu, & Yu, 2015). Likert scale items in this study, were adopted by a similar study conducted by Odenweller, Hsu, and DiCarlo (1998).

When developing the likert scale items, both positively and negatively keyed items were included and, the negatively keyed items were reverse-coded before conducting the reliability analysis. Psychometricians recommend reverse coding to avoid response biases associated with multi item scales which are worded in a single direction (Wong, Rindfleisch, & Burroughs, 2003).
Validity and Reliability

The face and content validity of the questionnaire were evaluated by two experts. The reliability of the questionnaire was tested by using Cronbach’s alpha. Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. It is considered to be a measure of scale reliability. The alpha values for soft skills development, engagement, and satisfaction were 0.87, 0.89 and 0.92 respectively, which shows a good internal consistency. The coefficient alpha is the most popular measure of reliability for a multiitem scale (Uma, 1992). The literature suggests that some scale lengths are preferable to maximize reliability and validity (Rossi et al., 2013).

(4) Observations

Tool Development: Observation is one of the most common data collection methods. Unstructured observation which involves studying the spontaneous behavior of participants in a natural surrounding is one of the best options to apply. Text books and journal articles were referred before planning what to observe. Participants body language specially including facial expressions, their interactions with team members and their behavior within the group were mainly observed. Observations guidelines were prepared in advance (Annex G (2)). During the game play, a video camera was setup to capture students’ emotions, and their motivation and interest towards the new approach.

Validity and Reliability: It is said that natural observations are less reliable as other variables cannot be controlled. Therefore, the repeatability of the study may be difficult for another researcher. There are some threats for the validity of observations such as, subjects do not behave in the way they normally behave, inadequacy of measuring instruments, and observer bias. Observational researchers assess the validity by checking the reliability of research techniques, by examining the amount of agreement between two observers of the same behavior, and triangulation. In triangulation, observational data can be compared with interview data. In this study, to increase validity and reliability, triangulation is used.
(5) Interviews

Tool development

Semi-structured interviews are being done with students who participated in experiment one. It is done based on their answers given in the questionnaire. The researcher expects in depth look into their answers, given in the questionnaire. Use of checklist (Lawrence, 1995) helps to cover all relevant areas of the interview (Appendix G (2)). Semi-structured interview, is a more flexible version of structured interview as “it allows depth to be achieved by providing the opportunity on the part of the interviewer to probe and expand the interviewee's responses” (Alshenqeeti, 2014). Interview guidelines were prepared by referring text books and journal articles.

Validity and Reliability

Dornyei (2007) stated that validity and reliability issues serve as guarantees of the results of the participants’ performances. To maintain the validity and reliability of interviewing, researchers should follow techniques (Alshenqeeti, 2014). Avoiding asking leading questions, taking notes rather than depending on tape recorders, conducting a pilot interview, asking interviewees a sum up and clarify the points they have made are some of them. Researcher can refer to the interview through audio recording (of an interview). The use of tape recorded interviews may help to eliminate interviewer bias (Bucher, Fritz, & Quarantelli, 1956). Therefore, in this study, all the interviews conducted, were voice recorded. Furthermore, when the voice recorder is used during the interview, major points highlighted by the respondents were noted.

3.7 Data Analysis

Descriptive statistics such as frequencies, percentages, mean, standard deviation and inferential statistics (t-test, and correlation) were used as main statistical tools.
3.8 Experimental Method

Experimental method can be summarized as follows.

**Experiment One – Experimental Group (Game Session) - (Thammasat University)**

(1) The Researcher introduced herself and the nature of experiment including objectives and all the other steps to the participants and obtained their written consent to participate in those activities one week before the experiment.

(2) On the day of the experiment, participants were asked to do the Pre-test. Duration of the Pre-test was 16 minutes. Participants were not allowed to talk with each other or look at others’ test papers, during the tests.

(3) After the Pre-test, the participants were assigned to four teams (four members in each team)

(4) The researcher introduced the game sessions using a PowerPoint presentation.

(5) Participants played the game sessions as stated in Table 3.4 (2-6).

(6) Participants were asked to go back their chairs to do the Post-test.

(7) After the test, questionnaires were distributed to evaluate game, soft skills development, engagement, and satisfaction.

(8) Debriefing was done through LINE messages.

(9) Winners of the game were announced in another day and presents were given for the winners.

**Experiment One – Control Group (Lecture Session) - (Thammasat University)**

(1) The researcher introduced herself and the nature of experiment including objectives and all the other steps to the participants and obtained their written consent to participate in those activities one week before the experiment.

(2) On the day of the experiment, participants were asked to do the Pre-test. Duration of the Pre-test was 16 minutes. Participants were not allowed to talk with each other or look at others’ test papers, during tests.

(3) The Researcher conducted a one-hour lecture session with the use of PowerPoint slides for the participants.

(4) Participants were asked to do the Post-test.
Experiment Two (Mahidol University)

(1) The researcher introduced herself and the nature of experiment including objectives and all the other steps to the participants and obtained their written consent to participate in those activities (The target group follow their degree program in Thai Language. Therefore, the terms included in the consent form was translated to Thai language by a facilitator before they sign the form).

(2) Participants were randomly selected and there were four teams with 9 -10 students per team. Therefore, four Teaching Assistants (TA’s) supported the researcher to conduct the experiment successfully. They were instructed with all the necessary information about the complete process of the experiment, in advance. They were provided with game marks allocation sheets and observation guidelines as well.

(3) Next, Pre-test papers were distributed for the participants. Those papers were translated to Thai language by a Thai Facilitator. Duration of the Pre-test was 12 minutes. One discussion question was given for each team to discuss and select the answer (duration 4 minutes).

(4) After the Pre-test, the participants were randomly assigned to four teams (9-10 members per team).

(5) Briefing about the PLC concept and the game instructions were given using English and Thai languages. The researcher introduced the game using a PowerPoint presentation.

(6) Participants played the game sessions as stated in Table 3.4 (2-4, and 6. Matching card session was omitted, because of the large number of students in a team)

(7) Participants were asked to do the Post-test.

(8) After the test, questionnaires were distributed to evaluate game, soft skills development, engagement, and satisfaction.

(9) The Researcher could not do debriefing due to the time constraint.

(10) Best leader was selected based on the observations made by the Researcher. Winners of the game were informed in another day.
**Experiment Three (Thammasat University)**

(1) The Researcher introduced herself and the nature of experiment including objectives and all the other steps to the participants and obtained their written consent to participate in those activities one week before the experiment.

(2) On the day of the experiment, participants were asked to do the pre-test. Duration of the Pre-test was 16 minutes. Participants were not allowed to talk with each other or look at others’ test papers, during tests.

(3) After the pre-test, the participants were randomly assigned to five teams (7-8 members in each team)

(4) The researcher introduced the lesson PLC in brief, and the game using a PowerPoint presentation.

(5) Participants played the game sessions as stated in Table 3.3 (2-4, and 6. Matching card session was omitted, due to the time constraint).

(6) Participants were asked to go back their chairs to do the Post-test.

(7) After the test, questionnaires were distributed to evaluate game, soft skills development, engagement and satisfaction.

(8) Winners of the game was informed on another day and presents were given for them.

**3.9 Chapter Summary**

The objective of this chapter was to present the methodology used for this study in detail. An overview of the experiment process followed by detailed explanations of each experiment was given at the beginning. The next section of the chapter explained about research tools used including experimental tool and four data collection tools. The last section explained the basic steps of the experimental method. The data analysis and the results of the study will be presented in the next chapter.
Chapter 4

Data Analysis and Findings

4.1 Introduction

This chapter presents the results of the data analysis and findings. Findings are mainly based on the game score, results of the Pre-test and Post-test, results of the questionnaire, observations, and personal interviews. Descriptive statistics; mean, and standard deviation and inferential statistics; paired samples t-test, and correlations were used for data analysis, depending on the different characteristics of the data being tested.

4.2 Findings

The presentation of findings organized according to the objectives mentioned under chapter one are as follows. Developed hypotheses were tested where relevant.

(1) Finding One presents the results of leaning achievement of gamification;
   - by comparing mean score between pre-test and post-test who participated in the lecture session and game session of Experiment One (4.2.1.1) (a) (b).
   - by comparing post-test mean scores between lecture session and game session of Experiment One (4.2.1.2).
   - by comparing knowledge retention test mean score between lecture session and game session of Experiment One (4.2.1.3)
   - by comparing mean score between pre-test and post-test of undergraduate students of Experiment Two and Three (4.2.1.4) (a) (b)
   - by analyzing the level of achievement according to Bloom’s Taxonomy of Experiment One, Two and Three (4.2.1.5) 1- (a) (b) 2, 3

(2) Finding Two assesses the relationships between gamification on soft skills development, engagement, and satisfaction of the participants of Experiment One (game session), Two and Three.
(3) Finding Three identifies the relationships between engagement and learning achievement and soft skills development of the participants of Experiment One (game session), Two and Three.

(4) Finding Four explains Product Life Cycle (PLC) game evaluation results by the participants of Experiment One (game session), Two and Three.

4. 2.1. Learning Achievement of Gamification

The above objective was divided in to five sub objectives to understand the effect of gamification on learning achievement under different conditions.

4.2.1.1. (a) Pre-test and Post-test Mean Score Comparison Experiment One - Lecture Session

To find out the whether the participants of the lecture session (control group) made any progress after the lecture, MCQ test was given them twice as pre-test and post-test. The results are shown in table 4.1. Descriptive statistics were used to analyze data of experiment one, because of non-random sampling.

Table 4.1. Pre-test and Post-test Mean Score Comparison of Experiment One - Lecture Session

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>13</td>
<td>10.15</td>
<td>2.44</td>
</tr>
<tr>
<td>Post-test</td>
<td>13</td>
<td>11.92</td>
<td>2.10</td>
</tr>
</tbody>
</table>

As shown in Table 4.1, Mean score has been increased (pre-test $M =10.15; SD = 2.44$) post-test $M =11.92, SD = 2.10$) after the lecture session.
**Finding 1.1 (a) Pre-test and Post-test Mean Score Comparison of Experiment One - Lecture Session**

From the data presented in Table 4.1, $M$ gained from Post-test is higher than that of Pre-test. This implies that the lecture session could increase the knowledge level of the participants.

**4.2.1.1. (b) Pre-test and Post-test Mean Score Comparison of Experiment One - Game Session**

To find out whether the participants of the Game Session (experimental group) made any progress after playing the game, MCQ test was given them twice as pre-test and post-test. The results are shown in table 4.2. Participants of the game session was an independent group of students and they did not participate in the lecture session.

<table>
<thead>
<tr>
<th></th>
<th>$n$</th>
<th>$M$</th>
<th>$SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>13</td>
<td>10.00</td>
<td>3.21</td>
</tr>
<tr>
<td>Post-test</td>
<td>13</td>
<td>11.31</td>
<td>2.49</td>
</tr>
</tbody>
</table>

There is a difference in the learning achievement (test scores) before and after the treatment (game session). The mean score value is higher after the treatment (game session) as shown in Table 4.2 (pre-test $M = 10.00$, post-test $M = 11.31$).

**Finding 1.1(b) Pre-test Post-test Mean Score Comparison of Experiment One - Game Session**

From the data presented in Table 4.2, Post-test $M$ is higher than that of Pre-test. This implies that the game session could increase the knowledge level of the participants.
4.2.1.2. Post-test Mean Score Comparison of Lecture Session and Game Session (Experiment One)

A mean score comparison was done between the two groups to find out which group of participants could achieve higher score. The results are shown in table 4.3.

Table 4.3. Post-test Mean Score Comparison of Experiment One - Lecture and Game Sessions

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>13</td>
<td>11.92</td>
<td>2.10</td>
</tr>
<tr>
<td>Game</td>
<td>13</td>
<td>11.31</td>
<td>2.49</td>
</tr>
</tbody>
</table>

There is a slight difference in the mean score between lecture session \((M = 11.92; \ SD = 2.10)\) and game session \((M = 11.31; \ SD = 2.29)\) after the treatment.

**Finding 1.2**: Post-test Mean Score Comparison of Lecture and Game Sessions (Experiment One)

From the data presented in Table 4.3, Post-test \(M\) is slightly higher in lecture session than that of game session. This implies that the students have almost the same knowledge level after the treatments.

4.2.1.3. Knowledge Retention Test Mean Score Comparison of Lecture Session and Game Session (Experiment One)

Descriptive statistics \((M, SD)\) were used to compare data between two treatments after the knowledge retention test.

Table 4.4. Knowledge Retention Test Mean Score Comparison of Experiment One – Lecture and Game Sessions

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>13</td>
<td>10.77</td>
<td>1.87</td>
</tr>
<tr>
<td>Game</td>
<td>13</td>
<td>11.15</td>
<td>2.76</td>
</tr>
</tbody>
</table>
There is a slight difference in the mean score between lecture group and game group after one month of the treatment. Slight increase in the knowledge retention level of participants of the game session could be seen according to the results.

**Finding 1.3: Knowledge Retention Test Mean Score Comparison of Lecture Session and Game Session (Experiment One)**

From the data presented in Table 4.4, Knowledge Retention $M$ is slightly higher in Game session than that of Lecture session. This implies that the students may have better knowledge retention after playing the PLC game than the lecture.

**4.2.1.4. (a) Pre-test and Post-test Mean Score Comparison of Experiment Two**

Thirty-eight undergraduate students who were reading for Public Health degree program of the Faculty of Public Health, Mahidol University, Salaya Campus attended the game session only. Those students were randomly selected to play the game. Inferential statistics were used to analyze the data. To compare pre/post test means, paired samples $t$-test was used. The paired-samples $t$-test is used when each individual in the sample is measured using the same test before and after a period of time (Piaw, 2013).

Hypothesis one was tested based on the data analysis of experiment two and three.

$H_{10}$: Gamification does not affect learning achievement

$H_{11}$: Gamification affects learning achievement

Figure 4.1 gives a clearer picture about the data sets of experiment two. Box plot is used to visually summarize and compare groups of data. The box plot uses the median, the approximate quartiles, and the lowest and highest data points to convey the level, spread, and symmetry of a distribution of data values. It can also be used to identify outlier data values easily.
Median score of post-test is higher than pre-test according to the Figure 4.1. Pre-test scores are positively skewed (median is closer to lower quartile). When mean > median, a distribution is considered as positively skewed. This happens when the data set constitutes high frequency of high valued scores. The post test scores are negatively skewed (median is closer to upper quartile). No outliers could be found with the data set. Table 4.5 (a) and (b) show the results of the paired sample $t$ test.
The paired-samples T-test shows that the research result is significant ($t = 4.36$, $df = 37$, $p < .05$). There is a significant difference in the learning achievement (test scores) before and after the treatment (game session). The mean score value is higher after the treatment (game session).

**Finding 1.4 (a): Pre-test Post-test Mean Scores Comparison of Experiment Two**

The post-test mean score has been increased after the treatment as shown in the table 4.5 (a). (pre-test $M = 6.34$; post-test $M = 7.53$). Therefore, the null hypothesis is rejected. This shows that the game session could increase the learning achievement of the participants of experiment two.

### 4.2.1.4 (b) Pre-test and Post-test Mean Score Comparison of Experiment Three

The boxplot shown in Figure 4.2. gives a clear picture about the median values of the two data sets. Both test scores are positively skewed in this group of students. One outlier could be identified and, it has been omitted when calculating paired sample t-test scores mentioned in Table 4.6 (a) and (b).
Figure 4.2. Box plot – Pre/post Test Scores of Experiment Three

Table 4.6. (a) Pre-test Post-test Mean Scores – Experiment Three

<table>
<thead>
<tr>
<th>Pair 1</th>
<th>Pre-test</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>37</td>
<td>7.57</td>
<td>1.99</td>
</tr>
<tr>
<td>37</td>
<td>12.35</td>
<td>1.98</td>
</tr>
</tbody>
</table>

Table 4.6. (b) Paired Sample Statistics – Experiment Three

<table>
<thead>
<tr>
<th>Pair 1</th>
<th>Pre-test</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>SD</td>
<td>t</td>
</tr>
<tr>
<td>4.78</td>
<td>2.51</td>
<td>11.56</td>
</tr>
</tbody>
</table>

The paired-samples t-test shows that the research result is significant ($t = 11.56$, $df = 36$, $p < .05$). There is a significant difference in the learning achievement (test scores) before and after the treatment (game session).
Finding 1.4 (b): Pre-test Post-test Mean Scores Comparison of Experiment Three

The mean score is higher after the treatment as shown in Table 4.6 (a) (pre-test $M = 7.57$, post-test $M = 12.35$). Therefore, the null hypothesis is rejected. The result shows that the game session could increase the knowledge level of participants of experiment three.

4.2.1.5. Levels of Achievement - Bloom’s Taxonomy

The purpose of this section is to analyze pre-test, post-test and knowledge retention test correct answers based on the selected levels of Bloom’s Taxonomy. To measure learning achievement, pre-tests and post-tests were conducted for the participants of experiment one, two and three. However, a knowledge retention test were administered for the participants of experiment one only. Bahrick, Bahrick, and Wittlinger (1975) have stated that an exam given immediately after the course is completed is a measure of original learning; an exam given some time after learning is completed is a measure of retention. The knowledge retention test was administered one month after the post-test. It is worthwhile to get an idea about percentages of correct answers for each test in all the experiments.
1(a). Correct Answer Percentage for the Selected Levels of Bloom’s Taxonomy Experiment One (Lecture Session) is shown in Figure 4.3.

![Graph showing pre-post-retention comparison](image)

Figure 4.3. Correct Answer Percentage - Experiment One (Lecture Session)

Correct answer percentage is high in post-test for many questions (Q1,2,3,6,7,11,12,16). However, almost all (100%) the participants have selected correct answers for Q5 and 12 of the knowledge retention test.

The questions asked in the MCQ tests, were designed based on the first four levels of the Bloom’s taxonomy. Q1-Q4 asked to test participants ability to ‘remember’. Their ‘understanding’ could be tested by the correct answer selection for Q5-Q8. ‘Application’ of the knowledge could be tested from Q9-Q12, and the last four questions (Q12-Q16) were developed to test the ‘analysis’ of the knowledge gained. Average number of correct answers for the above four categories in relating to participants of the experiment one of the lecture session can be summarized in Figure 4.4.
As shown in Figure 4.4, the majority of participants (85%) of experiment one (lecture session) could answer questions which were aiming to test the ‘understanding’ level of the Bloom’s taxonomy in post-test. By looking at the correct answer percentage of the pre-test, it was observed that they have marked questions which were designed to test the ‘analyzing’ of their knowledge. However, conclusions cannot be made related to pre-test results, because the participants may have marked correct answers by guessing. In the knowledge retention test, majority have successfully answered questions to test ‘analyzing’ ability of the students.

**Finding 1.5(a): Correct Answer Percentage and the Selected Levels of Bloom’s Taxonomy Experiment One (Lecture Session)**

The lecture session may have a positive impact on the development of ‘understanding’, ‘analyzing’ and ‘remembering’ levels of the Bloom’s Taxonomy (based on the post-test results). However, the participants of lecture session (experiment one) could successfully answer questions included to test ‘analysis’ than other levels in the taxonomy, in the knowledge retention test.
1(b). The same analysis were conducted to identify the nature of correct responses of the participants of the experiment one game session.

![Figure 4.5 Correct Answer Percentage - Experiment One (Game Session)](image)

Almost all the participants (100%) could successfully select answers for Q2 and Q16. Correct answer selection for the retention test was high for Q1, Q5, Q9, Q10 and 11. When compared the results with the participants of lecture session, the majority of game session could retain the knowledge.

Average number of correct answers for the above four categories in relating to participants of the experiment one of the game session could be summarized in Figure 4.6.
Finding 1.5 (b): Correct Answer Percentage and the Selected Levels of Bloom’s Taxonomy Experiment One (Game Session)

As depicted in the Figure 4.6, participants of game session of experiment one could answer questions relating to test, ‘understanding’, ‘analyzing’ and remembering’ levels successfully (based on the post-test). This finding is compatible with the finding of the lecture group. However, the participants could successfully answer questions included to test understanding and application levels, than other levels in the taxonomy in the knowledge retention test.

(2) Correct Answer Percentage and the Selected Levels of Bloom’s Taxonomy Experiment Two

Experiment two was conducted with undergraduate students of Mahidol university. They were reading for the bachelor’s degree in Thai medium. Only twelve questions were
developed for them considering the first three levels of the Bloom’s taxonomy. Correct answer responses made by them for each question can be shown by Figure 4.7.

![Correct Answer Percentage - Experiment Two](image)

**Figure 4.7. Correct Answer Percentage - Experiment Two**

Remarkably, the correct answer percentage was very low for Q4 in the post test. Almost all the participants could successfully select the answer for Q1.

The Figure 4.8 demonstrates the correct responses made relating to each level being tested.

![Impact of PLC Game on Learning Achievement](image)

**Figure 4.8. Correct Answer Percentage for Selected Levels of the Bloom’s Taxonomy - Experiment Two**
Finding 1.5 (c): Correct Answer Percentage for Selected Levels of the Bloom’s Taxonomy

- Experiment Two

PLC game may have helped the participants of experiment two to successfully answer questions, which were included to test ‘applying’ and ‘remembering’ abilities of the participants. They were comparatively unsuccessful in answering questions to test ‘understanding’ level.

(3) Correct Answer Percentage and the Selected Levels of Bloom’s Taxonomy

Experiment Three

Figure 4.9. shows the number of correct answer (%) of the participants of experiment Three for both pre-test and post-tests. Remarkable improvement could be seen in correct answer percentage of post-test for all the questions.

As shown in Figure 4.9, almost all the participants (100%) have marked correct answer for question number 2 and 16 during the post-test. The lowest percentage (16%) of the participants have marked correct answer for question number 11, during pre-test (before conducting the game session). But after the game session, 50% of the participants have given correct answers for question 11. Engagement with game may have a positive impact on their knowledge.
The Figure 4.10 illustrates the correct responses made relating to each level being tested in experiment Three.

![Impact of PLC game on learning achievement](image)

**Figure 4.10. Correct Answer Percentage for Selected Levels of the Bloom’s Taxonomy - Experiment Three**

As illustrated in Figure 4.10, the majority of participants of experiment three could answer questions developed to test ‘remembering’, ‘understanding’, and ‘analyzing’ levels of the Bloom’s taxonomy. The results are compatible with the result of experiment one.

**Finding 1.5. (d): Correct Answer Percentage for Selected Levels of the Bloom’s Taxonomy - Experiment Three**

The PLC game may have helped experiment three participants learning achievement by improving ‘remembering’, ‘understanding’ and ‘analyzing’ abilities.
4.2.2 Gamification and Soft Skills Development, Engagement, and Satisfaction

Game scores of individual students was considered as gamification in this study. Students perceptions towards interpersonal communication, decision making, critical thinking, time management, and leadership skills were considered (based on the responses given for the liker scale items) under soft skills development. Furthermore, engagement and satisfaction were measured using a likert scale. Correlation analysis was done to test the following hypothesis.

H20: Gamification does not correlate with soft skills development
H21: Gamification correlates with soft skills development
H30: Gamification does not correlate with engagement
H31: Gamification correlates with engagement
H60: Gamification does not correlate with satisfaction
H61: Gamification correlates with satisfaction

4.2.3 Engagement and Learning Achievement and Soft skills Development

H40: Engagement does not correlate with learning achievement
H41: Engagement correlates with learning achievement
H50: Engagement does not correlate with soft skills development
H51: Engagement correlates with soft skills development

Table 4.7. Bivariate Correlations – Experiment Three

<table>
<thead>
<tr>
<th>Measure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Game Score</td>
<td>1</td>
<td>.54**</td>
<td>.51**</td>
<td>.38*</td>
<td>.06</td>
</tr>
<tr>
<td>2. Engagement</td>
<td>1</td>
<td>.82**</td>
<td>.50**</td>
<td>-.05</td>
<td></td>
</tr>
<tr>
<td>3. Satisfaction</td>
<td>1</td>
<td>.66**</td>
<td></td>
<td>-.02</td>
<td></td>
</tr>
<tr>
<td>4. Soft Skills</td>
<td>1</td>
<td></td>
<td>-.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Post-test Score</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. Intercorrelations of Experiment Three Participants (n = 34) are presented above the diagonal. 1 = Game Score, 2 = Engagement, 3 = Satisfaction, 4 = Soft Skills, 5 = Post-test score  p < 0.05*, p < 0.01**

As shown in Table 4.7, there are significant positive correlations between gamification (game score) and soft skills (r = .38; p < 0.05), gamification and engagement
(r = .54; p < 0.05), gamification and satisfaction (r = .51; p < 0.05), engagement and soft skills development (r = .50; p < 0.05) in experiment three. Therefore, null hypotheses are rejected and there are relationships between gamification and the other selected variables (soft-skills, engagement, satisfaction), and engagement and soft skills development in experiment three.

Table 4.8. Bivariate Correlations – Experiment Two

<table>
<thead>
<tr>
<th>Measure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Game Score</td>
<td>1</td>
<td>.55**</td>
<td>.56**</td>
<td>.41**</td>
<td>.48**</td>
</tr>
<tr>
<td>2. Engagement</td>
<td>1</td>
<td></td>
<td>.84**</td>
<td>.64**</td>
<td>.56**</td>
</tr>
<tr>
<td>3. Satisfaction</td>
<td>1</td>
<td>.75**</td>
<td></td>
<td>.54**</td>
<td></td>
</tr>
<tr>
<td>4. Soft Skills</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>.25</td>
</tr>
<tr>
<td>5. Post-test Score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Note. Intercorrelations for Experiment Two participants (n = 38) are presented below the diagonal
1 = Game Score, 2 = Engagement, 3 = Satisfaction, 4 = Soft Skills, 5 = Post-test score
p < 0.05*, p < 0.01**

As shown in Table 4.8, there are significant positive correlations between gamification (game score) and soft skills (r = .41; p < .05), gamification and engagement (r = .55; p < 0.05), gamification and satisfaction (r = .56; p < 0.05), engagement and learning achievement (r = .56; p < 0.05, measured in terms of post-test score) engagement and soft skills development (r = .64; p < 0.05) in experiment two. Therefore, all the null hypotheses are rejected and there are relationships between gamification and the other selected variables, and engagement and soft skills development, and learning achievement in experiment two.
Table 4.9. Bivariate Correlations – Experiment One

<table>
<thead>
<tr>
<th>Measure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Game Score</td>
<td>1</td>
<td>.75**</td>
<td>.50</td>
<td>.74**</td>
<td>.67*</td>
</tr>
<tr>
<td>2. Engagement</td>
<td>1</td>
<td>.32</td>
<td>.58*</td>
<td>.65*</td>
<td></td>
</tr>
<tr>
<td>3. Satisfaction</td>
<td></td>
<td>.20</td>
<td>.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Soft Skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.76**</td>
</tr>
<tr>
<td>5. Post-test Score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Note. Intercorrelations of Experiment One Participants \( (n = 13) \). Means and standard deviations are shown in the Table. 1 = Game Score, 2 = Engagement, 3 = Satisfaction, 4 = Soft Skills, 5 = Post-test score

\( p < 0.05^*, p < 0.01^{**} \)

As shown in Table 4.9, there are significant positive correlations between gamification (game score) and soft skills \( (r = .74; p < 0.05) \), gamification and engagement \( (r = .75; p < 0.05) \), gamification and satisfaction \( (r = .50; p < 0.05) \), engagement and soft skills development \( (r = .58; p < 0.05) \), engagement and learning achievement \( (r = .65; p < 0.05 \text{ measured in terms of post-test score}) \), and engagement and soft skills development in experiment one. Therefore, all null hypotheses are rejected and there are significant positive relationships between gamification and the other selected variables, and engagement and soft skills development and learning achievement in experiment one.

**Finding 2: Gamification and Soft Skills Development, Engagement, and Satisfaction**

Significant positive correlations could be seen between gamification and other selected variables in all the experiments. All the null hypotheses are rejected.

**Finding 3: Engagement and Learning Achievement and Soft skills Development**

Significant positive correlations could be seen among the variables in Experiment one and two. All the null hypotheses were rejected relating to those two experiments. However, there was a negative correlation between engagement and learning achievement in Experiment three. Therefore, the null hypothesis relating to experiment three (Engagement does not correlate with learning achievement) is accepted.
Table 4.10 Summary of Findings of All Experiments (Mean, Correlation and Taxonomy Levels)

(1) Experiment One

<table>
<thead>
<tr>
<th>Control (Lecture) n = 13</th>
<th>Experimental (Game) n = 13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>10.15</td>
<td>2.44</td>
</tr>
<tr>
<td>10.00</td>
<td>3.21</td>
</tr>
</tbody>
</table>

Taxonomy levels: Remembering, Understanding, Analyzing levels for both control and experimental group

Correlations: G - Soft .74   G – Eng. .75   G – Sat .50,   Eng – LA .65,   Eng. - Soft .58

(2) Experiment Two – Paired Sample Statistics (n = 38)

| $M$ | $SD$ | $t$ | $Df$ | $p$ |
| 1.18 | 1.67 | 4. | 2.10 | 0.00 |

Taxonomy levels: Applying, Remembering

Correlations: G - Soft .41   G - Eng. .55   G - Sat .56   Eng - LA .56,   Eng. - Soft .64

(3) Experiment Three – Paired Sample Statistics (n = 37)

| $M$ | $SD$ | $t$ | $df$ | $p$ |
| 4.78 | 2.51 | 11.56 | 36 | 0.00 |

Taxonomy levels: Remembering, Understanding, Analyzing

Correlations: G - Soft .38,   G - Eng .54,   G - Sat .51  
Eng - LA -.05,   Eng. - Soft .50

Note. G = Gamification, Soft = Soft Skills, Eng.= Engagement, Sat.= Satisfaction, LA = Learning Achievement
A summary of hypothesis testing is given in Table 4.11.

Table 4.11 Summary of Hypothesis Testing

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Experiment Two</th>
<th>Experiment Three</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1 Gamification affects Learning Achievement</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>H2 Gamification correlates with Soft Skills Development</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>H3 Gamification correlates with Engagement</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>H4 Engagement correlates with Learning Achievement</td>
<td>√</td>
<td>✗</td>
</tr>
<tr>
<td>H5 Engagement correlates with Soft Skills Development</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>H6 Gamification correlates with Satisfaction</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>

*Note.* √ = supported, ✗ = not supported

4.2.4 Product Life Cycle (PLC) game evaluation results

The following section explains the findings obtained from questionnaire survey and the other qualitative data collection methods (interviews and observations).

4.2.4.1 Game Evaluation by the respondents of Experiment One

Majority of the students who participated in the game session of experiment one liked to learn a lesson by playing an educational game (92.3%). Almost all of them agreed that the number of participants were enough to play the PLC game. There were four members in each team. The most interesting game session, and most difficult session were matching cards, and feature and strategy session respectively. Feature and strategy session was the most important part of the game. Participants were expected to learn, features and marketing mix strategies related to each stage of the Product Life Cycle by engaging with this activity. Crossword puzzle was correctly done by all the teams.

All the participants were agreed about time allocation for pre/post tests and all the other sessions of the game. Seventy one (71%) of the participants opinion towards the nature of MCQs in pre/post tests were ‘neutral’. The rest of them have an idea of either ‘difficult’ or ‘easy’.
Based on the analysis of likert scale items, participants have a perception that the PLC game has a positive impact on their critical thinking ($M = 4.35$), decision making ($M = 4.28$), and interpersonal communication ($M = 4.14$). Further, they believe that the game encouraged interaction among team members, and it helped to establish better relationships among them and it helped to recall the concepts of the lesson PLC. According to the satisfaction questionnaire, PLC game seems to be an enjoyable game ($M = 4.53$).

(2) Interviews

When conducting interviews with the participants of experiment one, a convenient location for them was selected. Majority (80%) of them faced the interview inside the library. The rest (20%) of the participants, faced the interview inside a classroom.

The participants of the interview stated that they have already studied the lesson Product Life Cycle (PLC), when they were in their third year (one year before), and therefore they could recall the concepts they learned during pre-test. Some other views were “during knowledge retention test, I felt that I have learnt something from the game”, “I could confirm some answers which I selected for pre-test for sure after the game”; “I communicated a lot with others”; “my decision may be OK for 60%.”; “Everyone was rely on my view”; “If I never learn marketing class before; I could have learned a lot, but because of game session, I could remind the concepts”; “I read all LINE messages” . “Some students think that reading LINE massages is not a part of their grading”, “I prefer table top games like PLC, because then I can communicate more with others”. “game cards should be more descriptive”, “briefing is needed after completing each game session”, “the game was effective, and it helped to recall the lesson we studied last year”, “face to face is fun; but I like digital games much”, “without a background understanding I may not be able to do this game”. “ I could share my knowledge with friends during the game”, “when using board or card games we can help each other”, “More content can be learned from lectures; coverage is limited in games; game in the lecture (half half) is better; put the game in the correct time, when students get bored”, “I played leader role and my communication improved; I want other people believe in my view; we have to analyze a lot; to analyze the situation, we have to think”. 
Another interviewee stated that the team members were not his friends and he could have contributed more, if the others were his own friends. The purpose of the brainstorming session was mainly to build or enhance the relationships among team members because they were assigned to the respective groups by the instructor. However, by analyzing the statement of that student, it is clear that the main purpose of the brainstorming session was missing. The main purpose of debriefing (which was planned to conduct after post-test on the same day) in this study was to discuss the nature of experiment, its objectives, summary of the lesson learnt through the activities and to get their feedback.

The debriefing session for the participants of experiment one, was done through LINE messages after the game, on the following day. However, participants were not satisfied with debriefing. It can be visible through their opinion (“I didn’t read the debriefing by LINE. Those massages were sent to the whole group. If those were sent individually, I will read”, “The quantity of the messages was too much”; “I read group LINE massages, if I feel that something is important for me. Otherwise I don’t care, I saw the LINE massages, I skipped those”)

Patton (1990) stated that people in interview will tell things that are not intended to tell. This could be proved by the opinions of interviewees. Those are; “I could not express my ideas; my team leader was dominating”, “I did not do pre/post-test and did not participate well in game activities because I was not in a good mood on that day; I was hungry and wanted to finish all the activities soon and go; but I thought and selected the answers for retention test because on that day my mood was good, but normally I don’t like reading long paragraphs; one year ago, during ‘Marketing’ lecture, I didn’t listen to the lecturer properly, because I played with my phone during the lecture; I know some other students who marked questionnaire (satisfaction, engagement) without properly reading them”.

Interviewees (90%) agree that they could improve their interpersonal communication skills, decision making, and critical thinking after playing the game. Team leader’s behavior affects other members behavior. There were collaborative leaders as well as dominating leaders in the experiment one, according to the views of the interviewees.
(3) Attitude Survey

Participants of experiment one had a chance to engage in a series of games during the last semester of their final year including the PLC game under the course module ITS 442. A questionnaire survey was done to identify their attitudes towards various Active Learning Strategies (ALSs) on the very first day of the lecture series (ITS 442). According to the initial survey, case study method was rated as the most popular ALS. Many students preferred to play video games using smart phones than card/board games. By the end of the semester almost similar survey was carried out in order to find whether there are changes in their attitudes. Remarkably, their preferences have been changed towards card/board games.

4.2.4.2 Game Evaluation by the respondents of Experiment Two

Fifty percent of the students who participated in the experiment two liked to learn a lesson by playing an educational game. Remarkably, the rest of the students had either ‘neutral’ idea (42%) or ‘disagree’ (8%) about learning a lesson by playing a game. This implies that the respondents are not familiar with educational games or English language may acted as a barrier for proper understanding of the game (the medium of instruction of their degree program was Thai language). The number of participants for the experiment two was 9 or 10 members. According to their opinion (29%), the number of participants was too much to do the game activities properly. The most interesting session of the learning activity was ‘puzzle’ session (37%). Majority of the respondents (34%) stated that ‘pre-test’ was the most difficult learning activity. Twenty-nine percent of them think that feature and strategy as the most difficult session. Majority (more than 80%) stated that time allocation for pre/post tests were enough. However, for brainstorming and puzzle sessions, time allocation seems to be inadequate for some of the respondents (24%). Both of these activities were group activities and the time allocation should be sufficient if all the team members collaboratively involved in those activities. Remarkably, 45% respondents have stated ‘neutral’ and 47% stated ‘difficult’ for the MCQs in the pre/post tests. The reason behind this may be the nature of the subject area being tested by doing this game. The group have not done any marketing or business-related subjects before. Respondents have a perception that the PLC game has a positive impact on their critical thinking (\(M = 3.74\)),
decision making \((M = 3.53)\), and interpersonal communication \((M = 3.53)\). The mean values are slightly lower than the values of experiment one and Three. Furthermore, the respondents feel that the team members were supportive \((M = 3.84)\), and playing PLC game helped them to establish better relationships among themselves \((M = 3.55)\). However, based on their responses, the game helped them to recall the concepts of the lesson. This is a contradictory viewpoint, which can’t be believe because the respondents did not have a prior knowledge about PLC lesson at all. They think that they could learn the lesson PLC by playing this game \((M = 3.82)\). The respondents believe that learning through card games is effective than learning through other common methods, such as case study method, role playing, discussions and presentations \((M = 3.55)\). However, it can be concluded that the respondents may have gain at least some idea about PLC, by playing this game.

4.2.4.3 Game Evaluation by the respondents of Experiment Three

When analyzing the questionnaire data of experiment three, two questionnaires were omitted due to the mismatch between positively and negatively worded items. Majority of the students \((83\%)\) who participated in experiment three like to learn a lesson by playing an educational game. The rest of them have a ‘neutral’ opinion. Among the respondents, \(86\%\) has indicated that the number of participants were enough to play the PLC game. Only \(14\%\) of the respondents have indicated that the number was too much to play the PLC game. However, the number of participants for experiment three was either 7or 8 members in each team.

The most interesting game session, and most difficult session of the overall learning activity was brainstorming session, and pre-test respectively. The most difficult game session was feature and strategy \((28\%)\) for them. From the respondents, \(75\%\) have stated that duration given for pre-test was sufficient. However, \(31\%\) have indicated that the duration was more than enough to do the post-test. The reason may be, the familiarity with the test \(\text{\footnotesize (Same set of questions given for both tests)}\). Over \(90\%\) of the respondents, agreed about the duration given for brainstorming and feature and strategy sessions of the game. Thirty one percent of the respondents have stated that the duration was more than enough to do the puzzle. The puzzle may have been a ‘too easy’ activity for them. Fifty Three percent of the participants opinion towards the nature of MCQs in pre/post tests were
‘difficult’. The rest of them had an idea of ‘neutral’. Based on the analysis of likert scale items, participants have a perception that the PLC game has a positive impact on their critical thinking ($M = 4.25$), interpersonal communication ($M = 4.22$), and decision making ($M = 4.17$). Furthermore, they believe that the game helped to recall the concepts of the lesson PLC, and encouraged interaction among team members. However, the respondents did not have any experience related to the lesson PLC, and their opinion could not be believed. According to the satisfaction questionnaire, the respondents believe that learning through card games was effective than learning through lectures ($M = 4.29$), and also it was effective than other common methods of active learning, such as case study method, role playing, discussions and presentations ($M = 4.24$).

4.2.4.4 Observations

Observations were carried out for all the experiments, according to the criteria given in Appendix G (1). The researcher played the role of an observer for all the experiments. Engagement and the interactions of participants of experiment one was higher than that of other two experiments.

Table 4.12 Summary of the Game Evaluation Results of Experiment One

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you like to learn a lesson by playing a game?</td>
<td>Yes (92%)</td>
</tr>
<tr>
<td>What is your opinion about the number members in a team? (4 members)</td>
<td>Enough</td>
</tr>
<tr>
<td>What was the most interesting game session?</td>
<td>Matching cards</td>
</tr>
<tr>
<td>What was the most difficult game session?</td>
<td>Feature and Strategy</td>
</tr>
<tr>
<td>Time allocation for each session</td>
<td>Enough (100%)</td>
</tr>
<tr>
<td>Nature of MCQs in pre-test and post-test</td>
<td>Neutral (71%)</td>
</tr>
<tr>
<td>Opinion on soft skills development</td>
<td>Critical Thinking (CT), Decision Making (DM), Interpersonal Communication (IC) may be improved</td>
</tr>
</tbody>
</table>

90
Table 4.13 Summary of the Game Evaluation Results of Experiment Two

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you like to learn a lesson by playing a game?</td>
<td>Yes (50%)</td>
</tr>
<tr>
<td>What is your opinion about the number of members in a team? (9/10 members)</td>
<td>Too much</td>
</tr>
<tr>
<td>What was the most interesting game session?</td>
<td>Puzzle</td>
</tr>
<tr>
<td>What was the most difficult game session?</td>
<td>Feature and Strategy</td>
</tr>
<tr>
<td>Time allocation for each session</td>
<td>Additional time needed for brainstorming and puzzle</td>
</tr>
<tr>
<td>Nature of MCQs in pre-test and post-test</td>
<td>Neutral or difficult</td>
</tr>
<tr>
<td>Opinion on soft skills development</td>
<td>CT, IC, DM may be improved</td>
</tr>
</tbody>
</table>

Table 4.14 Summary of the Game Evaluation Results of Experiment Three

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you like to learn a lesson by playing a game?</td>
<td>Yes (83%)</td>
</tr>
<tr>
<td>What was your opinion about the number of members in a team? (7/8 participants)</td>
<td>Enough (86%)</td>
</tr>
<tr>
<td></td>
<td>Too much (14%)</td>
</tr>
<tr>
<td>What was the most interesting game session?</td>
<td>Brainstorming</td>
</tr>
<tr>
<td>What was the most difficult game session?</td>
<td>Feature and strategy</td>
</tr>
<tr>
<td>Time allocation for each session</td>
<td>Duration was more than enough for the puzzle (31%)</td>
</tr>
<tr>
<td>Nature of MCQs in pre-test and post-test</td>
<td>Difficult /neutral</td>
</tr>
<tr>
<td>Opinion on soft skills development</td>
<td>CT, IC, DM may be improved</td>
</tr>
</tbody>
</table>
4.2.4.5 Triangulation

Triangulation (combination of the methodologies in the study of the same phenomena) was used when conducting experiments in this study with the hope of increasing the validity. Miles and Huberman (1994) stated that validity of the findings is enhanced when using more than one instrument measuring the same thing. Several kinds of methods, or data can be used for triangulation, including both quantitative and qualitative approaches (Patton, 1990). In this study, observations, and interviews were used in addition to questionnaire data to get opinions about the treatment.

4.3 Chapter Summary

The purpose of this chapter was to analyze data and to present the findings of the study. Findings were stated according to the order of objectives. The next chapter will discuss the findings, and conclude the study by highlighting recommendations and suggestions for further research.
Chapter 5

Discussion, Conclusions and Recommendations

5.1 Introduction

This chapter discusses the findings of the experiments described in the previous chapter. First, it starts by summarizing the purpose followed by a discussion of the findings relating to each objective in the study. The latter part of this chapter explains conclusions, and recommendations for further research.

5.2 Discussion

The main purpose of this study was to identify the effects of gamification on learning achievement and soft skills development. Findings suggests that gamification can be used as an Active Learning Strategy especially for university students. Major findings of the study can be discussed as follows.

5.2.1 Discussion One: Learning Achievement of Gamification

To measure learning achievement of the participants of experiment one Mean scores of pre-test and post-tests were compared within groups and between groups. Control group pre-test $M = 10.15, SD = 2.44$; Post-Test $M = 11.92, SD = 2.10$; Knowledge Retention Test $M = 10.77, SD = 1.87$. Experimental group Pre-test $M = 10.00, SD = 3.21$, Post-test $M = 11.31, SD = 2.49$; Knowledge Retention Test $M = 11.15, SD = 2.76$. Figure 5.1. summarizes learning achievement results of experiment one.
By comparing all these tests marks, it can be concluded that gamification has an impact on learning achievement. It may lead to better knowledge retention than lecture method.

The knowledge retention test score was slightly high in experimental group in experiment one (control group $M = 10.77$, $SD = 1.87$; experimental group $M = 11.15$, $SD = 2.76$). Smith (2017), stated time as an important element when measuring learning. Researchers should design their studies to examine effects over time rather than relying on one-time measurements taken closely after completing gamified curriculum. Randel, Morris, Wetzel, and Whitehill (1992) stated that the use of entertaining games to review materials increase the knowledge retention. The result of this study is contradictory with the findings of Rondon, Sassi, and de Andrade (2013). Their study concluded that the traditional lecture still seems to be more effective in improving short and long-term knowledge retention of the students.
For control group, the lecture was conducted in an attractive manner with the aid of PowerPoint slides. Though the lecture method becoming unpopular among academics, a well-planned lecture series may be the best teaching method for many subjects and many students specially in transferring conceptual and systematic knowledge (Charlton, 2006). However, students may easily become distracted during the class while sitting in a lecture. Student attention may shift in many ways such as day dreaming, or using mobile devices during the lecture (Christine Harrington, 2017). The quality of the delivery of lecture and the game might have affected the findings of experiment one (post-test), which was not quantified. Though immediate learning performance could be seen in lecture method, in the long run, interactive learning strategies like games may be more beneficial in enhancing learning than lecture method.

In experiment two, the paired-samples t-test shows that the research result is significant \( (M = 1.18, t = 4.36, df = 37, p < .05) \). There was a significant difference in the learning achievement (test scores) before and after the treatment (game session) of the participants of experiment two.

A similar analysis was conducted to compare mean scores of the participants of experiment three. The paired-samples t-test shows that the research result was significant \( (M = 4.78, t = 11.56, df = 36, p < .05) \). There was a significant difference in the learning achievement (test scores) before and after the treatment (game session). This shows that PLC game session could increase the knowledge level related to the PLC concept. The results of experiment two and three are compatible with the results of the study conducted by Rastegarpour and Marashi (2012). A teacher-made card game could improve student’s learning according to their findings.

Armstrong and Landers (2017), stated that adding game elements to a course may increase student engagement with course material, and then improves academic performance. Consistent with most other literature, this study shows that there is an increase in students’ test scores when treated with game-based learning activities. As for the views of Hamari et al. (2016), challenge in the game is a significant predictor of learning outcomes. Jui-Mei, Chun-Ming, Hwang, and Yueh-Chiao (2011), concluded that
computer game-based learning can improve the learning achievements and attitudes of students. However, according to the data analysis of a study conducted by Loveland (2014), activity based teaching method did not lead to higher student comprehension or procedural ability.

Lecture method as well as game method seem to be equally important in learning achievement. Lecture method may be a good strategy for short-term memory recall. However, gamification may help students to retain knowledge more than the lecture method. Similar study done by Ibrahim and Al-Shara (2007), concluded that interactions during class among students and between faculty and students increases their achievement in the class and retention.

This study incorporated Bloom’s Taxonomy for Multiple Choice Questions (Pre-test, Post-test) with the hope of increasing student learning after answering questions of each level successfully. The findings of this study show that the participants could answer more questions which were developed to test remembering, understanding, and applying levels of the taxonomy. This result is compatible with the result of a study conducted by Kim, Patel, Uchizono, and Beck (2012). However, they concluded that a well-developed MCQ which incorporates different learning domains of the taxonomy is a possible method to assess critical thinking skills. The participants of experiment two were comparatively unsuccessful in answering questions developed to test understanding level of the taxonomy. It could have been attributed to the medium of instruction of their degree program, which was in Thai language. They may have found it difficult to properly understand the game materials which may also lead to less engagement and satisfaction.

5.2.2 Discussion Two: Gamification, Soft skills Development, Engagement, and Satisfaction

According to the correlation analysis results, significant positive relationships between gamification and soft skills development, gamification and engagement, and gamification and satisfaction could be found in all experiments (Table 4.7, 4.8, 4.9). The correlation coefficients are moderate/weak in experiment two and three. However, strong correlations
could be found in experiment one between gamification and soft skills development \((r = .74, p = .05)\) and gamification and engagement \((r = .75, p = .05)\). As for the responses of the interviewees (of experiment one), the PLC game helped them to develop soft skills, such as critical thinking, decision making, and interpersonal communication. Some researchers have indicated the importance of soft skills for job performance. Soft skills are personal characteristics that strengthen an individual’s interactions, career potentials and job performance. Games are like a pipeline for soft skills learning and development (Sousa & Rocha, 2017). Therefore, if students can improve their soft skills within the classroom itself, it may help them to perform well with good people’s skills needed for the 21st century. Janßen, Valter, Borowski, Vossen, and Jeschke (2016), stated about the importance of soft skills development in higher education. They have suggested that, to promote students’ employability in later career, soft skills have become more important in higher education. Furthermore, they have introduced, simulation based learning, to develop soft skills. Anthony and Garner (2016) studied about various pedagogical methods for soft skills development in a business students class. Amazingly, guest speech on soft skills had received maximum ratings. Renaud and Wagoner (2011) stated that students can use games to engage in complex tasks and instructors can use educational games to improve problem-solving skills and help students to understand the lessons. Raut (2014), stated that board games are an important medium of education for teaching communication, collaboration, and problem solving. Pöllänen and Vartiainen (2011), also agreed that board games help to teach communication, collaboration, and problem solving in an engaging way. It is needed to design proper interactive learning environments to obtain usable knowledge, talents and to develop social skills (Kriz, 2009).

As for the results of this study, weak/moderate correlations could be seen between gamification and soft skills development in experiment two and three. However, large number of team members of experiment two (9-10 members) and three (7-8 members) may have been a barrier for them to properly engage with the game and to interact with others. Less engagement of some participants in experiment two and three could be observed personally by the researcher during game sessions. Based on the questionnaire data, some of the respondents of experiment two and three have indicated that the number of team members was too much to properly engage with the game. However, there were four-
member teams in experiment one (game session) and all the respondents (100%) agreed that four-member team was ideal to play the game successfully. Students’ engagement with game activities could be witnessed properly, during game sessions. Hanus and Fox (2015) mentioned that satisfaction, enjoyment, and engagement with class material as some of the benefits of gamification.

Participants of experiment two have indicated that they are moderately satisfied with the game. They follow their degree program (Public Health) in Thai medium and the game materials were prepared in English. Language may have been a barrier for them to understand the game properly, though the game introduction was translated to Thai language, just before starting the game. Therefore, the selected students of experiment two may have been lacking the interest towards the tested subject area through the game. They have never learnt business related subject before. The PLC game may be more applicable and interesting for undergraduate students who are following business related subjects.

The participants of experiment three were from Law and Technology course module. Those students may also have a lack of interest towards the selected discipline (marketing) for the game. The results could have been better if proper audience was selected to play the game.

The result (moderate satisfaction) is compatible with the results of the longitudinal study conducted by Hanus and Fox (2015). According to their study students of the gamified course had less satisfaction. However, great amount of satisfaction towards game based learning was found according to the survey results of Nadolny et al. (2017).

5.2.3 Discussion Three: Engagement, Learning Achievement and Soft skills Development

Significant correlations could be found between engagement and learning achievement and also between engagement and soft skills development of the participants of experiment one and two (Table 4.9, 4.8). In experiment one, there were four members per team and, it seems a good opportunity for them to interact with others easily and engage
with the game. Alarmingly, there is no positive correlation between engagement and learning achievement in experiment three. There may be other factors affecting student engagement in the activity which may indirectly affect student learning such as the negative attitudes towards the activity, Psychological/physiological state of the student, support of the team members, atmosphere of the classroom and many more.

Lee (2014) conducted a study and justified that student engagement at school as an important predictor of academic performance. Jung, Choi, Lim, and Leem (2002), stated that social interaction and peer collaboration are vital in enhancing learning. According to the view of Iosup and Epema (2014), gamification can help students to increase passing rates, and participation and then high student satisfaction. As for the results of the study conducted by Hamari et al. (2016), game engagement had a positive impact on learning, and also challenge of the game had a positive impact on learning both directly and through the increased engagement. Ibrahim and Al-Shara (2007) stated that by increasing student-student interaction (through interactive teaching methods) and student-faculty interaction, achievement in the class can be increased. Gamification proposes to use “game thinking” and to increase user engagement and stimulate their active participation, thereby enhancing outcomes. However, Armstrong and Landers (2017), stated a contradicting viewpoint. They have stated that behaviors and attitudes mediate this relationship.

5.2.4 Discussion Four: PLC Game Evaluation

Based on the post-test results, responses stated on the questionnaire and from the interview evaluations, the PLC game has helped the participants to learn the PLC concept. Experiment one consisted of four members. There are many viewpoints regarding the group size by many researchers. Cumaranatunge (2002) stated that, though there are no fixed rules regarding size, groups of 3, 4 or 5 are advisable, and many teachers suggest 4 as the optimum size. Sydney school of Education (2017) mentioned that the group size is an important consideration, when planning an assessment task and the ideal group size is 4 to 5 students. Then the contributions of group members will be meaningful and collective.
decision making will be easier. Furthermore, if the group size is too large, students may have problems with coordination and management, fair workload distribution and establishing working relationships with one another. According to the ideas of Cuseo (1997), face-to-face interaction is high and close proximity can be seen, in smaller groups (3-4 students). Then the personal responsibility to team mates will also be high. However, some researchers have concluded that the group productivity increases as group size increases, and other researchers concluded that group productivity decreases as group size decreases (Bertucci, Conte, Johnson, & Johnson, 2010). Kooloos et al. (2011) stated that optimal size of collaborative learning is not fixed. However, according to Kooloo’s study, students of 5-member group could score high perceived participation.

For this study, teams consisting of 4 members were ideal to play the PLC game (depending on the nature). The team members could fairly distribute the game activities among themselves. Some distractions could be observed among 9-10 and 7-8 member teams. Some participants mentioned that if they could select their team members they could have done the game successfully. The researcher did not allow students to select their team members, due to the nature of the experiment. Garfield (1993), stated that instructor may allow students to self-select groups. However, as for the recommendations of Cuseo (1997), instructors should carefully choose the groups for activities involving critical thinking.

A short video demonstration was played when introducing the matching cards session. Moreno and Mayer (2007) stated that by incorporating a video to explain the game, the students will understand the game rules properly and will be able to play the game more efficiently. Then it minimizes the potential problems students may have while playing the game.

All the teams could answer the crossword puzzle satisfactorily. Crossword puzzles have been using as a teaching technique in disciplines such as communication, health and psychology, which may result in improved retention of facts and association of concepts and improved level of confidence (Franklin et al., 2003).
Debriefing session was planned to conduct at the end of all game sessions. Howitt and Cramer (2014) stated that debriefing occurs after the completion of the experiment, which provide information about the nature of the experiment. Furthermore, they have mentioned that debriefing may be delayed if there are many stages of the experiment and debriefing after the initial stages may affect the results of the latter stages. In this study also, debriefing affects post-test and it was delayed considering the nature of the experiment, nature of the student behavior, and the time constraint. Finally, it was done through LINE messages for experiment one students only, though it was not effective.

Observations have been considered as the fundamental base in social and behavioral sciences (Adler, 1994). Data obtained through observations are more reliable and free from respondent bias (Uma, 1992). By appointing individual observers for each team more accurate data can be gathered. However, the “Hawthorne Effect” (people may change their behavior due to the attention they are receiving from researchers) of direct observation may be unavoidable. Campbell, Maxey, and Watson (1995) stated that the potential impact of the Hawthorne effect as one of the difficulties in observation studies. In this study, participants’ behavior and engagement towards gamification (PLC Game), was favorable in all the experiments. However, it may have been due to the Hawthorne effect. The researcher could identify participative leaders through observations.

In this study, interviews were conducted with the volunteers of experiment one. The main purpose of an interview is to explore experiences, views, believes and motivations of individuals on issues. Interviews are believed to provide a deeper understanding of social phenomena. This method is more suitable when detailed opinions are required from individual participants (Gill, Stewart, Treasure, & Chadwick, 2008). In an interview the interviewer and the interviewee play two roles; actor and observer, or speaker and listener (Farr, 1982). Semi-structured interview is the more flexible version of structured interview “as it allows depth to be achieved by providing the opportunity on the part of the interviewer to probe and expand the interviewee's responses”. Interviews are conducted at changing locations, which might have influenced the interview. Collected information during interviews should be free of bias as possible. Bias may be inaccuracies or errors of the data collected. Biases may occur from interviewee, interviewer or situation.
Interviewees can bias the data when they do not express their true opinions. They may provide information that they think the interviewer expects of them or like to hear. Misinterpretation or distortion of gathered information by interviewers is another problem. Therefore, trust and rapport with interviewees are important (Uma, 1992). A good interview is a base for open opinions, feelings, knowledge, and experience for both the interviewer and interviewee (Patton, 1990). In this study, based on the personal interview results, it was found that the PLC game can be used as an active learning strategy. As for the interview responses the PLC game seems a good game and further modifications are not needed to be done.

5.3 Conclusions

The PLC game can be used to increase student engagement in the lesson with small groups of students. Participants may be able to learn Product Life Cycle concept, while developing soft skills such as, critical thinking, decision making, and interpersonal communication. Participants of a small group setting (Experiment 1) were highly engaged with the game, greatly impressed, and their motivation towards game-based learning increased after their exposure to the game though it is not visible from the data analysis. However, Nadolny et al. (2017) concluded that grade level as an important factor when planning game based learning because students have different motivations based on grade level. The selected grade level for PLC game was undergraduate level, and the game can be implemented as an active learning strategy for university education.

Gamification is an innovative teaching strategy and a better solution for student disengagement with classroom activities. High usage of mobile devices during lectures and other common ALSs (case study, group discussions etc.) could be avoided by incorporating educational card/board (tangible) games to the university curriculum. During PLC game sessions, the participants did not have any free time to use mobile devices. They had a target to achieve in each game session.

By incorporating small teams (with maximum four members) to play classroom games, the 21st century skills (specially, critical thinking, decision making, interpersonal
communication, time management, and leadership) may be improved. More engaging games are needed to develop such skills. Engagement seems to be a mediator between gamification and learning achievement and gamification and soft skills development. Learning achievement and soft skills development may be improved because of High engagement with game may favorably affect learning achievement and soft skills development.

Educational game developers can develop card/board games which can be played during lecture time. Furthermore, they must consider factors such as expected learning outcomes, learning styles, and attitudes of the students as well. There may be some students in the classroom, who show high rate of absenteeism and are not keen on participating in classroom activities. Gamification may be one of the best solutions to change their attitudes. However, some students may have a negative attitude towards educational card/board games. According to the views of Tobias, Fletcher, and Wind (2014), researchers and game designers mention that educational games are not much entertaining compared to those designed only for entertainment. Therefore, gathering of attitudinal data on educational games may be important.

There are some students who like to learn lessons by lecture method rather than playing games. The key points that can be transferred to the students may be limited when using games within the stipulated time (when compared to lectures). Small games can be incorporated to lectures, in order to make lectures more effective. Lectures can be more effective if instructors can use interactive lectures (Heather Macdonald, 2017). The lecture can be divided in to segments of active learning methods, such as demonstrations, activities or discussions. All students should be able to participate in those methods. Weltman and Whiteside (2010) also stated the importance of using short periods of active learning throughout the lecture. They suggested to stop the lecture every 10-15 minutes for a short time. This break can be effectively used for small activities such as group discussions, work on a problem or to understand the material. Incorporation of innovative AL strategies, such as small games may be a good alternative for the effective use of lecture break rather than focusing more on traditional approaches. A well-managed educational game can be used as a successful ALS, despite other barriers.
5.4 Recommendations and Suggestions for Further Research

Based on the findings and conclusions of the study, the following recommendations were made for further research.

1. All the experiments were done selecting undergraduate students from Management and Health disciplines. However, it might be of interest to investigate whether there is any significant difference if the students of another disciplines are used.

2. The number of members in a team should be carefully planned, based on the nature of the game. Then students can properly engage with all the activities and free riders can be avoided.

3. Although the present findings support the effectiveness of gamification on students’ learning achievement and their knowledge retention, the samples of each experiment were restricted to a limited number of participants ($n<40$). Therefore, future studies should consider more participants to generate more evidence on the effects of gamification on learning achievement and soft skills development. Furthermore, it is suggested to conduct knowledge retention test at least after six months or one year to properly evaluate the knowledge retention.

4. This study was limited to two universities in Thailand. Undergraduate students of different countries might have been exposed to different teaching and learning practices. Therefore, it might be of interest to study whether there will be a significant difference if this study could be done in other countries as well.

5. This study did not consider individual participants learning style. The results may vary if it is conducted using students who belong to the same learning style. The results might have been better if the students were segregated based on their learning styles.

6. Understanding students’ learning styles is important to improve the effectiveness of learning (Amir et al., 2011). Students who belong to ‘avoidant’ style show high
rate of absenteeism and are not keen on participating in classroom activities. Game based learning may be one of the best solutions to change their attitudes. Winners of the game can be awarded more points for their assessments (of the related subjects), in order to increase their enthusiasm and to motivate others towards the gaming culture.

7. Pre-test and post-tests were conducted on the same day for all the experiments due to time constraints. For better results, those tests should be conducted on two different days. Participants seemed to be exhausted doing the same test on the same day. If they are exhausted the ultimate impact may be less satisfactory with the new learning experience.

8. It is recommended to get the support of Teaching Assistants when conducting game sessions specially for large classes.

9. Educational game development is a time-consuming activity. Games can be designed during the curriculum development stage itself. As a result, the instructors will not be discouraged though the game development is a time-consuming activity.

10. As the study suggests that educational games is an effective way of teaching when compared to traditional teaching approaches, it is logical to make game contributions a part of assessments of the respective course modules. Thereby instructors can make the students more engaged as they will be rewarded by assessment marks.

11. However, lack of support from higher authorities may prevent instructors from using the games in the classroom. Universities should understand the value of game based learning and give faculty members more exposure to games by organizing gaming sessions, workshops, and conferences.
5.5 Chapter Summary

This chapter discussed the interpretations of the results obtained from the data analysis and recommendations were provided based on the findings of the study. Further, it concluded the entire study by exploring pathways for future studies while explaining the recommendations of the completed study.
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Appendices
Appendix A
Pre/Post Test

Name: 
Student ID Number: 
Gender: 
Degree Program: 
Duration: 16 Minutes

Please circle the most suitable answer for each of the following questions.

1. There are five stages of the Product Life Cycle (PLC). Which of the following is not a generally accepted stage?
   (a) Introduction 
   (b) Plateau 
   (c) Maturity 
   (d) Decline

2. In which stage of the PLC do sales volume peak?
   (a) Maturity 
   (b) Product development 
   (c) Growth 
   (d) Decline

3. In which stage of the PLC, profits are lowest and highest respectively?
   (a) Introduction and growth 
   (b) Introduction and maturity 
   (c) Introduction and decline 
   (d) Decline and growth

4. In which stage of the PLC, the advertising and promotion are aimed at retaining existing customers and persuading customers to switch from competitor products?
   (a) Introduction 
   (b) Maturity 
   (c) Growth 
   (d) Decline

5. ................. stage is a period of slowdown in sales growth because the product has achieved acceptance by most potential buyers.
   (a) Product development 
   (b) Introduction 
   (c) Growth 
   (d) Maturity
6. Increased competition leads to price decrease. Increasing public awareness, sales volume increase significantly, are the characteristics of ............... stage of the product life cycle.
   (a) Maturity
   (b) Decline
   (c) Growth
   (d) None of the above

7. When a new product is introduced to the market, a company can use either ........A.... or ...B....... strategy depending on the situation. If the company is the first entrant to the market, it may use ........A....... to recover product development and advertising costs. ........A..... means introducing a product at a high price, because no one else offers it. ...B....... is the practice of offering a lower price for a new product or service during its initial offering.

   A and B are,
   (a) A is skimming pricing and B is penetration pricing
   (b) A is penetration pricing and B is skimming pricing
   (c) A is economy pricing and B is premium pricing
   (d) A is psychological pricing and B is skimming pricing

8. Every product goes through each stage of the PLC for;
   (a) 1 year
   (b) 2 years
   (c) 5 years
   (d) It is not fixed

9. Which of the following do help to extend the life cycle of a product?
   (a) Stop selling the product
   (b) Sell the product to another company
   (c) Re-package the product
   (d) Spend less on advertising

10. Which industry will have a shorter PLC?
    (a) Banking
    (b) Retail products
    (c) Technology
    (d) All will have the same PLC

11. An example for a product in the maturity stage is,
    (a) DVD players
    (b) Laptops
    (c) Manual typewriters
    (d) Google smart watch
12. Which of the following is **NOT** an example of a sales promotion?
   (a) A small toy given with kid’s “Happy Meal” at McDonalds
   (b) A display of new book arrivals at a bookstore
   (c) “Buy one get one free” offers by Pizza Hut
   (d) Free samples of a new brand of cheese given at Tesco Lotus

13. Select the **WRONG** statement from the following statements.
   (a) Products will come to the decline stage because of technical advances, innovation or changing customer tastes.
   (b) Introduction stage of the PLC focuses on maximizing market share.
   (c) Some clothing fashions last for a short period and come to the decline stage of the PLC very quickly.
   (d) Length of the PLC varies based on industry, product and, market factors.

14. Mr. Wiraporn is a Business Consultant for a large company. He needs to review the performance of “Aroi” cake shop as a part of his job. When “Aroi” was established, it was the only cake shop in the area and has been in business for nearly three years. The cake shop experienced high sales in the first two years in business. During those two years, Mr. Wiraporn noticed sales growth of the shop increased from 10% to over 70%. Soon after the rapid sales growth, during third year, the shop started to experience nearly a zero sales growth. Mr. Wiraporn found that a newly opened shop, which is located nearby, was offering discounts on cakes. But many customers still prefer the taste of “Aroi” cakes.

Mr. Wiraporn realized that “Aroi” cake shop is now in the ……………… stage of the Product Life Cycle.
   (a) Introduction
   (b) Decline
   (c) Maturity
   (d) Growth
15. You and Me (Pvt) Ltd. introduced a new mosquito coil called, “Mosquit” last year. They promoted the product with the tag line “chemicals zero” which is made using an extract of a plant. Despite high product price, sales have started to increase for consecutive 6 months.

Select the **CORRECT** statement from the following.
(a) “Mosquit” has reached to the growth stage of the Product Life Cycle (PLC).
(b) Marketing objective of the Mosquit’s current stage of the PLC is to, defend market share.
(c) Management has to think about selective distribution at this stage.
(d) Product modifications should be done at this stage.

16. TU Food & Beverage (Pvt.) Ltd is experiencing the following with regard to one of their products called TU Coke.
- Sales of TU Coke are gradually decreasing.
- Customers interest towards artificial beverages is decreasing.
- The company still has a set of loyal customers.
- Management decided to shut down unprofitable TU Coke outlets.

Meanwhile, The company introduced a spicy donut specially for teenagers. It is a product which they love to eat, and sales are increasing rapidly. TU Coke goes well with this donut. Those who buy donuts, like to buy a TU Coke as well.

Management has four options as follows.
Option 1 - Relaunch the product TU-Coke (C) along with TU Donuts (D).
Option 2 - Launch an advertising campaign emphasizing “C & D go together”
Option 3 - Shutdown the TU-coke business and start selling TU-donuts.
Option 4 - Sell TU- Coke business to another company.

What is/are the best option/options?
(a) All four options are suitable.
(b) Option 1 & 2 are suitable, but 3 & 4 are not suitable.
(c) Option 3 is most suitable, because there is an increasing demand for donuts.
(d) Option 4 is most suitable, because TU Coke has reached to the declining stage.
Bloom’s Revised Taxonomy

Bloom’s taxonomy identifies three domains of learning (cognitive, affective, and psychomotor). The cognitive domain is the primary focus of classroom education. As shown in the Figure, cognitive domain is hierarchically classified as remembering, understanding, applying, analyzing, evaluating, creating.
Appendix C
Test Blueprint for Product Life Cycle Knowledge Assessment
(Pre-test and Post-test Assessment)

<table>
<thead>
<tr>
<th>Objective</th>
<th>Learning Outcome</th>
<th>Bloom’s Taxonomy classification</th>
<th>No. of test items</th>
<th>Point value</th>
<th>Weight %</th>
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<td>To assess memory recall</td>
<td>Remembering</td>
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<td>4</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>To measure understanding of the concepts</td>
<td>Understanding</td>
<td>4</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>To measure the application of knowledge and understanding</td>
<td>Applying</td>
<td>4</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>To measure decision making ability on a given scenario</td>
<td>Analyzing</td>
<td>4</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td></td>
<td><strong>16</strong></td>
<td><strong>16</strong></td>
<td><strong>100</strong></td>
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</table>

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Appendix D

Pre-test Post-test Internal Consistency

(1) KR 20 Calculation

\[ r_{KR20} = \frac{k}{\sum p(1-p) + \sum q(1-q)} \]

- \( r \) is the Kuder-Richardson formula 20
- \( k \) is the total number of test items
- \( \sum \) indicates sum
- \( p \) is the proportion of test takers who pass an item
- \( q \) is the proportion of test takers who fail an item
- \( \sigma \) is the variation of the entire test

(Source Dr. KA Korb, University of Jos)

\[ = 0.65 \]

KR 20 is a measure of index of internal consistency test reliability and generally ranges from 0.0 to 1.0. Higher values represent a more internally consistent instrument.
Appendix E

Item Analysis (Experiment One)

<table>
<thead>
<tr>
<th>Q</th>
<th>P</th>
<th>ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>0.9</td>
<td>-0.2</td>
</tr>
<tr>
<td>Q2</td>
<td>1.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Q3</td>
<td>0.7</td>
<td>-0.2</td>
</tr>
<tr>
<td>Q4</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Q5</td>
<td>0.9</td>
<td>0.2</td>
</tr>
<tr>
<td>Q6</td>
<td>0.8</td>
<td>0.0</td>
</tr>
<tr>
<td>Q7</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>Q8</td>
<td>0.8</td>
<td>0.5</td>
</tr>
<tr>
<td>Q9</td>
<td>0.6</td>
<td>0.8</td>
</tr>
<tr>
<td>Q10</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Q11</td>
<td>0.8</td>
<td>0.2</td>
</tr>
<tr>
<td>Q12</td>
<td>0.9</td>
<td>0.2</td>
</tr>
<tr>
<td>Q13</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Q14</td>
<td>0.8</td>
<td>0.5</td>
</tr>
<tr>
<td>Q15</td>
<td>0.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Q16</td>
<td>1.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

The most frequently used item analysis statistics is the item difficulty index (P value). It is a measure of the proportion of examinees who answered the item correctly. It can range between 0.0 and 1.0. (higher value indicates that a greater proportion of examinees responded to the item correctly, and it is an easy item)

The item discrimination index (ID) is a measure of how well an item is able to distinguish between examinees who are knowledgeable and those who are not. The possible range of the discrimination index is -1.0 to 1.0.
Appendix F
Game Score Criteria

(1) Rubric for writing – for brainstorming session
(short answers based on discussion)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>If all 10 correct</td>
<td>8</td>
</tr>
<tr>
<td>For 9 acceptable answers</td>
<td>7</td>
</tr>
<tr>
<td>For 8 acceptable answers</td>
<td>6</td>
</tr>
<tr>
<td>For 7 acceptable answers</td>
<td>5</td>
</tr>
<tr>
<td>For 6 acceptable answers</td>
<td>4</td>
</tr>
<tr>
<td>For 5 acceptable answers</td>
<td>3</td>
</tr>
<tr>
<td>For 4 acceptable answers</td>
<td>2</td>
</tr>
<tr>
<td>For 3 acceptable answers</td>
<td>1</td>
</tr>
<tr>
<td>Less than 3</td>
<td>0</td>
</tr>
</tbody>
</table>

(2) Game points allocation

<table>
<thead>
<tr>
<th>Session</th>
<th>Maximum Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brainstorming</td>
<td>8</td>
</tr>
<tr>
<td>Feature &amp; Strategy</td>
<td>32</td>
</tr>
<tr>
<td>Happenings &amp; Actions</td>
<td>20</td>
</tr>
<tr>
<td>Matching cards</td>
<td>32</td>
</tr>
<tr>
<td>Crossword puzzle</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
Appendix G
Guidelines for Observations and Interviews

(1) Guideline for Observations

| Group: ................. | Date: ................. |
| Time: .................. |

<table>
<thead>
<tr>
<th>Participants’ Behavior</th>
<th>Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Did they engage in game related activities?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>-If yes, percentage of engagement:</td>
<td></td>
</tr>
<tr>
<td>Less than 25%</td>
<td></td>
</tr>
<tr>
<td>25% - 50%</td>
<td></td>
</tr>
<tr>
<td>More than 50%</td>
<td></td>
</tr>
<tr>
<td>50% - 75%</td>
<td></td>
</tr>
<tr>
<td>More than 75%</td>
<td></td>
</tr>
<tr>
<td>2. During activities, did participants help each other to understand the materials?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>3. Did any confusions arise during the game activities?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>4. During activities, did they have enough time to complete the assigned task?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>5. Did they use mobile phones during the activities?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>6. Any other observations or further clarifications on the above matters</td>
<td></td>
</tr>
</tbody>
</table>

(2) Guidelines for Interviews

1. How did you select answers for Pre-test?
2. What are your suggestions for the improvement of PLC game?
3. Do you think that you could develop soft skills by participating in the game? Can you tell some examples?
4. What is your opinion towards board/card games and digital games?
5. What are your views on debriefing through Line messages?
## Appendix H

### Lesson Plans

### (1) Lecture Session

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Introduction</strong>&lt;br&gt;The researcher introduced herself and the nature of the experiment one week before (the experiment) and the written consent was obtained from the participants (10 minutes).</td>
</tr>
<tr>
<td>2.</td>
<td><strong>Learning Objective – To teach the Product Life Cycle (PLC) concept</strong>&lt;br&gt;Teach features and strategies of each stage of the PLC</td>
</tr>
<tr>
<td>3.</td>
<td><strong>Before starting the lecture, a question was given for the students to think and write answers as an ice-breaker (5 minutes).</strong>&lt;br&gt;(Question - How do companies develop new product ideas?)</td>
</tr>
<tr>
<td>4.</td>
<td><strong>After discussing the icebreaker, the Lecture was conducted using PowerPoint slides (60 minutes).</strong></td>
</tr>
</tbody>
</table>

### (2) Game Session

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Introduction</strong>&lt;br&gt;The researcher introduced herself and the nature of the experiment one week before (the experiment) and the written consent was obtained from the participants (10 minutes).</td>
</tr>
<tr>
<td>2.</td>
<td><strong>Learning Objective – Self learning of the Product Life Cycle (PLC) concept, identify features and strategies of each stage of the PLC, through the PLC game.</strong></td>
</tr>
<tr>
<td>3.</td>
<td><strong>Introduction of the PLC game – The lesson PLC briefing and the introduction to the game sessions were done using a PowerPoint presentation and a small movie clip (5 minutes).</strong></td>
</tr>
</tbody>
</table>
4. **Brainstorming Session** (5 minutes)  
Objectives - To build team spirit, improve interpersonal communication, critical thinking, and leadership  
Before playing the game, a question was given for the participants to think, discuss, and write the answers on the given A4 sheet.  
(The question - How do companies develop new product ideas?)

5. **Feature and Strategy Card Session** (30 minutes)  
Objective - To improve collaboration, thinking, decision making, and time management. Refer the following section for more details.  
3.6.1. (3) (iii), page 49

6. **Happening and Action Cards Session** (8 minutes)  
Objectives - Improve thinking and to apply the knowledge and understanding gained from feature and strategy card session, improve decision making skills, and increase motivation while creating fun. Refer the following section for more details.  
3.6.1. (3) (iv), page 52

7. **Matching Cards Session** (15 minutes)  
Objectives - To have fun, Memorize the features and strategies learnt in the previous round. Refer the following section for more details.  
3.6.1. (3) (v), page 54

8. **Crossword Puzzle** (5 minutes)  
Objective - Measure recalling ability, improve collaboration, and time management. Refer the following section for more details.  
3.6.1. (3) (vi), page 55
Appendix I
Questionnaire

Part 1 - Demographic information

Student Name - ……………………………

Student ID Number - ……………………………

Please state your Gender (Please circle): M   F

Part 11- Evaluation – Game

Please mark your choice on the following scale.

(1) Do you like to learn a lesson by playing a game?

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

(2) What is your opinion about the number of participants in a team?

(a) not enough  (b) enough  (c) too much

(3) What is the most INTERESTING session of this learning activity? Please rank if you have more than one choice.

(a) brainstorming  
(b) feature & strategy cards round  
(c) happening and action cards round  
(d) matching cards round  
(e) crossword puzzle  
(f) post test

(4) What is the most DIFFICULT session in this learning activity? Please rank if you have more than one choice.

(a) brainstorming  
(b) feature & strategy cards round  
(c) happening and action cards round  
(d) matching cards round  
(e) crossword puzzle  
(f) post test

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(5) Please mark your opinion on “Time allocation for each activity”.

<table>
<thead>
<tr>
<th></th>
<th>More than enough</th>
<th>Enough</th>
<th>Not Enough</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Pre-test</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>(b) Brainstorming</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>(c) Feature and Strategy</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>(d) Happenings and Actions</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>(e) Matching cards</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>(f) Crossword Puzzle</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>(g) Post-test</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

(6) Multiple choice questions given in the Pre/post tests are,

(a) Very difficult □
(b) Difficult □
(c) Not difficult (can manage) □
(d) Easy □
(e) Very easy □

(7) What do you like most about this game? ...........................................................................................................

(8) What do you like least about this game? ...........................................................................................................

(9) Please state your suggestions for further improvement of this game.
..........................................................................................................................................................
..........................................................................................................................................................
..........................................................................................................................................................
**Part 111- Perceptions on Soft Skills Development**

What do you think about the following? Do you think that you can improve the following skills through this learning activity? State your level of agreement.

<table>
<thead>
<tr>
<th>Skills</th>
<th>Strongly Agree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Interpersonal communication</td>
<td>5 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td>(b) Decision making</td>
<td>5 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td>(c) Critical thinking</td>
<td>5 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td>(d) Time management</td>
<td>5 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td>(e) Leadership skills</td>
<td>5 4 3 2 1</td>
<td></td>
</tr>
</tbody>
</table>

**Part 1V – Perceptions of Engagement**

SA = Strongly Agree  SD = Strongly Disagree

<table>
<thead>
<tr>
<th>Items</th>
<th>SA</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The game encouraged student interaction.</td>
<td>5 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td>2. The game promoted discussion of the key topics of the lesson.</td>
<td>5 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td>3. The game helped to recall the concepts of the lesson.</td>
<td>5 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td>4. I put a lot of effort into this game.</td>
<td>5 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td>5. My group members were supportive.</td>
<td>5 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td>6. I DID NOT TRY HARD to do well in this game.</td>
<td>5 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td>7. I could not do the game well.</td>
<td>5 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td>8. Playing the game helped me to establish better relationships with my team members.</td>
<td>5 4 3 2 1</td>
<td></td>
</tr>
</tbody>
</table>
### Part V – Perceptions of Satisfaction

<table>
<thead>
<tr>
<th>Items</th>
<th>SA</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The purpose of the game was well explained</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>2. Instructions of the game were easy to understand</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>3. Cards were nicely designed</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>4. The description on the card was easy to understand</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>5. The total time allocation was appropriate to play the game</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>6. Classroom was well arranged to play the game</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>7. I like the game a lot</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>8. I enjoyed the game a lot</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>9. The game was fun to play</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>10. The game was boring</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>11. I am satisfied with my contribution towards this game</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>12. I could learn the lesson Product Life Cycle (PLC) by playing this game</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>13. After playing this game, an interest created in my mind about the lesson PLC</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>14. The content of the lesson was clear after playing the game</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>15. Playing the game WAS NOT a time-wasting activity</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>16. My overall satisfaction was high towards this game</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>17. I would like to recommend the game to my colleagues.</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>18. Learning through card games is effective than learning through lectures</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>19. Learning through card games is effective than learning through other common methods, such as case study method, role playing, discussions and presentations.</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

Thank you for your corporation!!!

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