Chapter 6

Result and Gamification in application

6.1 Introduction

This chapter evaluates game-based learning for outdoor learning with the proposed the framework from Chapters 4 and 5.In order to evaluate and assess our approach with the suitability for outdoor learning class from public school was sampled. We divided the evaluated framework into the two model between the Motivation and Fun model and the Learning outcome model (see Figure 6.1).

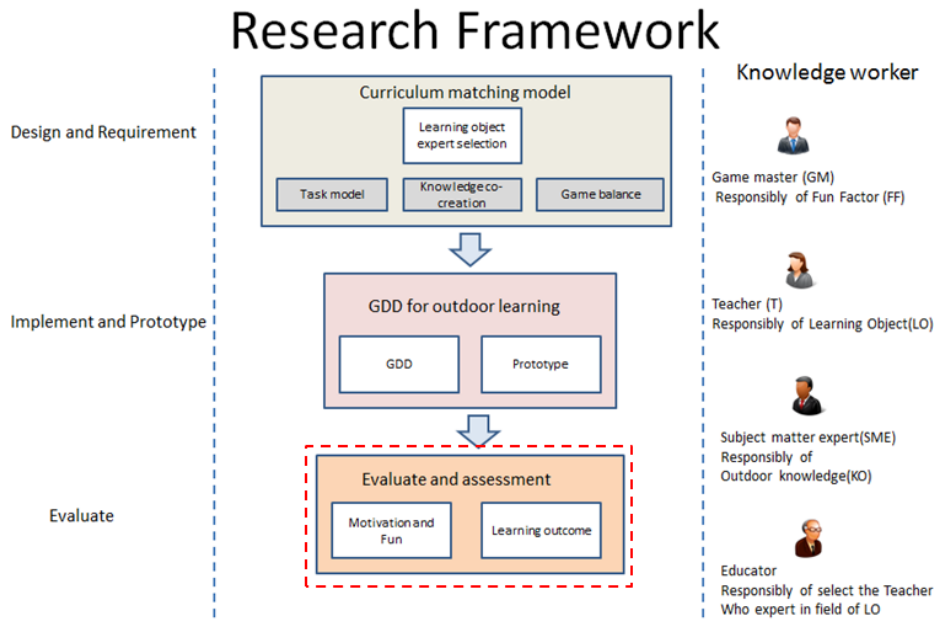


Figure 6.1 Research framework

6.2 Evaluation of Motivation and Fun

For Evaluation and Assessment model, we tested the model between Motivation and Fun. In term of Evaluating Fun, according to Johan Huizinga, fun is "an absolutely primary category of life, familiar to everybody at a glance right down to the animal

level". However, it is not the standard of methodology to measure the Fun state in person. Thus, in terms of Physiology the flow theory was purposed closely, the fun states with have a standard of measurement to test the flow, also known as the zone, is the mental state of operation in which a student performs an activity is fully immersed in a feeling of energized focus, full involvement, and enjoyment in the process of the activity. For that reason, we decided to test our fun factor by concept of flow theory as mentioned in chapter 1.

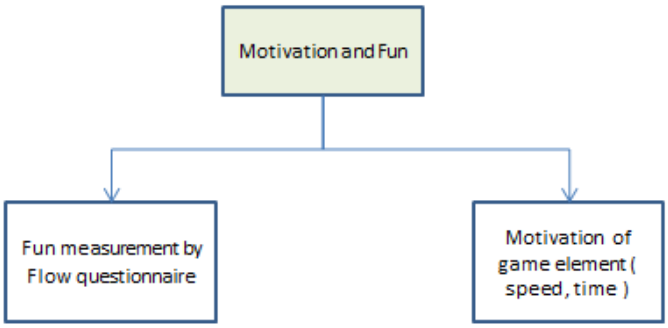


Figure 6.2 Evaluate and assessment model

For the part of measuring the motivation, it would enable a goal-directed behavior and is evident through action. However, behavior is not merely the outcome of motivation; researchers often use behavior to infer motivation and capture the strength of motivation by the extent one's actions are consistent with a focal goal. Thus, we measure the motivation by time, speed and action outcomes for each parameter related to the game element as (see Figure 6.2).

6.2.1 Evaluation of fun with flow measurement

In order to evaluate the Game based learning for outdoor learning, it was proposed that our conceptual framework with fun factor, we measured the fun factor by flow theory of play experience analysis was tested and studied for its psychometric properties. Since playability was very important from the theory of model of flow in game based learning, a dependable and valid measure of play was undeniable for further research. Unfortunately, Science has not yet produced such research. Thus, this was demonstrated and was conducted with the function of creating a new measure to confirm the experience of play (Thompson, 2007).

6.2.2 Method

6.2.2.1 Participants

A sample size of 59 participants was required from a secondary school in Chiang Mai. Thus, the sample size can give the principal both component analysis and structural equation modeling were planned for analysis. Fifty-nine students at least were selected at random to answer the questionnaire of flow experience with dispositional flow scale (DFS). This was done to test our model.

6.2.2.2 The design experiment

Participants were tested in terms of engaging the three games over on a field trip to Chiang Mai zoo. The between-subjects independent variable of "game" constituted the primary manipulation of the experiment. The game of Game based learning for outdoor activities was employed was tested on the flow experience of the Dispositional flow scale. Participants were asked to play the game from 10.00 am – 12.00 am. Each student brief on how to play the game 15 minutes before. This was between 9.30 am – 9.45 am.

Game Player able to:

- Start game
- Walk around the location based
- Answer questions
- Collect Scores
- Find Monsters
- Click Monsters

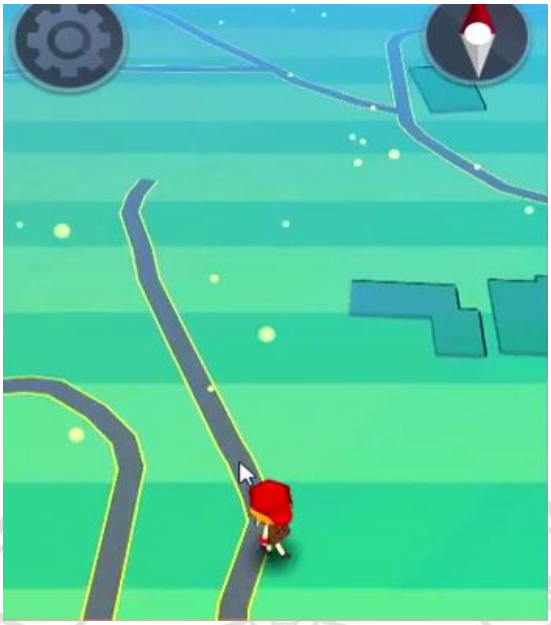


Figure 6.3 our game based learning for outdoor learning

6.2.2.3 Measure

For the past 10 years, the Dispositional Flow Scale (DFS) has been converted and translated into different languages, and it has also been applied in different cultural contexts, almost exclusively with samples from the sports sections and study section**.**The dispositional flow scale have two versions of the game. There is a full version with 36 items and short version with 9 items. Our sample group was primarily students between 12-15 ages that did not have good English skill. Thus, we translated the dispositional flow scale into a Thai version and selected the short version of DFS.

Dispositional Flow Scale (DFS)

Merging of Action and Awareness •I perform automatically, without actively deciding how to proceed. •I do things spontaneously and automatically. •Things just seem to happen automatically. •I make the correct actions or decisions without having to think about it.	**Challenge/Skill Balance** •I feel competent enough to meet the high demands of the situation. •I am challenged, but I believe that my skills will allow me to meet that challenge. •I feel just the right amount of challenge. •The challenge and my skills are at an equally high level.	**Sense of Control** •I feel like I can control what I am doing. •I feel as though I have everything under control. •I feel in total control of my thought processes. •I feel in total control of my body.
Clear Goals I know what I want to achieve. I clearly know what I want to do. My goals are clearly defined. I have a strong sense of what I want to accomplish.	**Autotelic Experience** The experience is extremely rewarding. I love the feeling of performing the activity and want to capture it again. The experience leaves me feeling great. I really enjoy the experience.	**Concentration on Task** I have total concentration. It is no effort to keep my mind on what is happening. My attention is focused entirely on what I am doing. I have no difficulty concentrating.
Loss of Self Consciousness I am not concerned with how I present myself. I am not worried about what others might be thinking of me. I am not concerned with how others might be evaluating me.	**Transformation of Time** It feels like time goes by quickly. Time seems to alter (i.e., to either slow down or speed up). I lose my normal awareness of time. The way time passes seems to be different from normal.	**Unambiguous Feedback** I am aware of how well I am performing. It is really clear to me how my performance is going. I have a good sense about how well I am doing.

Figure 6.4 Original Disposition flow scale (DFS) with short version

6.2.2.4 Procedure

After completing the game, all participants completed the Dispositional Flow Scale (DFS) as part of a package of assessments, which also included Big Nine measurements of Merging action and awareness, clear goals, loss of self-consciousness, challenge and skill balance, autotelic experience, transformation of time, sense of control, concentration of task at hand and unambiguous Feedback. For each statement in the DFS, participants provided a rating in terms of how “engaging” it was for them to have such an experience in the gameplay after they had finished. This was rated on a 5-point Lickert scale where a 5 meant it was very engage

6.2.2.5 Result

As the results show in Table 6.1, the self-report qualitative survey of students in the experiments, indicate that the overall score of the close-ended questions of students was higher than the average total DFS = 0.561,as the measurement of flow scale (DFS) that was still in flow state. However in detail, the item of loss of self-consciousness was a bit lower (0.451) than the other scores, due to be tiredness from playing the game for two hours. And other score, sense of control also most of the same value of loss of self-consciousness. According to Jackson and Eklund, the flow state

promotes activities more where a person's concentration and skills are crucial towards the final outcome. On the other hand of our studies, the original game lacked the level feature so students were unable to receive feedback on their progress. Therefore, they could not manage their skills and the difficulty levels. Furthermore, immediate feedback was missing from the game features, each so student had no visible feedback on their achievements which commented that such immediate feedback is a successful key factor for an effective achievement system.

Table 6.1 experiement with Dispositional Flow Scale (DFS)

Total DFS	0.561
Merging Action and Awareness	0.623
Clear Goals	0.640
Loss of Self Consciousness	0.451
Challenge/Skill Balance	0.531
Autotelic Experience	0.602
Transformation of Time	0.51
Sense of Control	0.45
Concentration on Task	0.61
Unambiguous Feedback	0.637

6.3 The evaluation of motivation

6.3.1 The study of Awarding Cooperation and leaderboard

The original action-awareness factor to contribute flow experience was replaced by playability factor. Playability in an education game background is approached as being only one factor among others that could effects student's learning experience. This factor was introduce by Forlizzi and Battarbee who have argued that user experience should be considered also from physical, sensual, cognitive, emotional, and aesthetic perspectives. The playability factor is proposed to replace Csikszentmihalyi's action-awareness merging dimension from original factor clear goals, challenge feedback, sense of control, which is ambiguous in the game based learning context. This

was clearly well effective because according to original flow, all factor inducing activities become instinctive and automatic, which is not fascinating from a learning objective. In our research focus on, game elements setting environment of gamification can improve quality of education game of flow dimension.

6.3.1.1 Participants

The participants were 96 students, aged between 10 and 12, recruited from various secondary schools around Chiang Mai province, Thailand. There were 48 students in each of the two groups: “Gamified” and “Non-Gamified” groups. The selected participants all had previous experience in online strategic games. It is necessary to note that some participants had prior knowledge on the Danida version of Game based learning for outdoor learning in the Eco challenge competition in 2013 but for this experiment we used the core version which is completely different as regards the game mechanics in order to make sure there is no significant difference of prior knowledge among the participants.

6.3.1.2 Design

An experimental design was used to address the hypotheses. Two groups were formed for the experiment in order to answer the research question:“Can a gamification environment for each game elements improve the performance of participants?” Participants were randomly assigned to two groups with different gamification environment settings set up in two rooms. 48 students had to play under the conditions set up for the “Gamified group” and the other 48 students were assigned to the “Non Gamified” group. The methodology is shown in Figure 2.

For each group, the game time was separated into four sessions beginning from 10.00 am to 15.00 pm with a lunch break between 12.00 pm and 13.00 pm. We arranged the physical environment of game elements in each session. We began with an initial session, since participants never played the core version of Game based learning for outdoor learning before, so the purpose of this session was to help participants get familiar with and learn the mechanics of the game. The second session aimed to measure the effects of cooperative learning on performance. The results were compared to the ones of the previous session in order to see how well the participants

managed to exchange knowledge. The third session focused on the leaderboard. The purpose was to show the participants' ranks in the whole group both upward and downward. This research session was designed to study the effects of leaderboard as a game element. The performance of such participants who saw the leaderboard and were able to see their performance relative to others was compared with those having no information about the leaderboard. The final session studied the effect of real awarding badges. It is widely accepted among researchers that awarding badges contribute to better performance. In our case study the participants with the top five scores were provided five real badges.

6.3.1.3 Procedure

The experiment was conducted in a "Gamified" and "Non-Gamified" environment. All participants took part individually in all the four phases of the experiment and each part took one hour.

· Initial session

Both "Gamified" and "Non-Gamified" groups were administered to determine the participant's' skills and make them be familiar with Game based learning for outdoor learning. Each participant was given a personal computer to learn the game mechanics.

· Cooperative session

This session was held immediately after the individual participants completed the initial session. The students in the "Gamified" group were asked to pair up to use one personal computer together. They were allowed to cooperate and discuss with each other in pairs about how to win the game but were not allowed to cooperate with other pairs. The time limit was one hour, which was determined according to the results of the cooperative session.

·Leader board session

This session started after the participants had a lunch break for one hour. Here, participants in the "Gamified" group were provided an access to the

leaderboard in two ways: through their personal computer via web browser and on a big screen in front of their room. For the “Non-Gamified” group no conditions have been changed, participants were asked to act the same way like in the previous session. The time limit was one hour, which was determined according to the effect of leaderboard and no leaderboard environment settings.

· Awarding badges session

This session was held immediately, after the participants completed the Leaderboard session. In the Awarding badges session, participants of the “Gamified” group were informed that those with the top five scores at the end of session receive real badges while the “Non-Gamified” group was told to continue to try their best to reach the highest score. Again, the time limit was set to one hour. The final session was determined to study the behavioral and performance effect of badges.

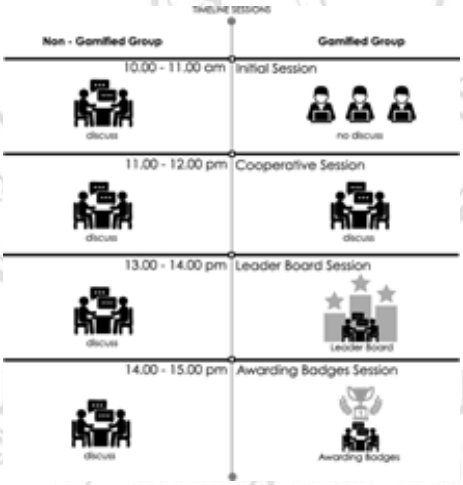


Figure 6.5 The overview of methodology

6.3.1.4 Measurement

As part of the measurement, the present study investigated the direct relationship between the gamification environment and the performance outcome. Therefore, there is no reliable way to infer which standard measurement should be used to mediate the effects of behavior outcome. As Hamari et al. (2014) note, a large portion of the studies on gamification and related studies in general seems to directly find the

relationship between the affordances of the system and behavioral changes but our research tried to directly measure the actual use in terms of numerical indicators, instead of self-reports. We measured the effects of gamification from two aspects of performance. First, performance of learning by ABT (Average of basin score per time unit).This score of the hydrology model-based game can determine how well the user understands the connectivity and importance of water resources, energy, and food and fund resource. Second, speed of responses, based on the APT (Average of playable round per time unit). This indicator was used to understand player behavior as regards performance speed by identifying the number of completed game rounds per time unit. Note that we used five minutes as a time unit for both ABT and APT follow equation 1, 2 to calculate.

$$ABT_t = \frac{1}{n}\sum_{i=1}^{n} BS_{i,t}$$

Where is participants, is Basin score at participant ***i*** at the time ***t***.

$$APT_t = \frac{1}{n}\sum_{i=1}^{n} PR_{i,t}$$

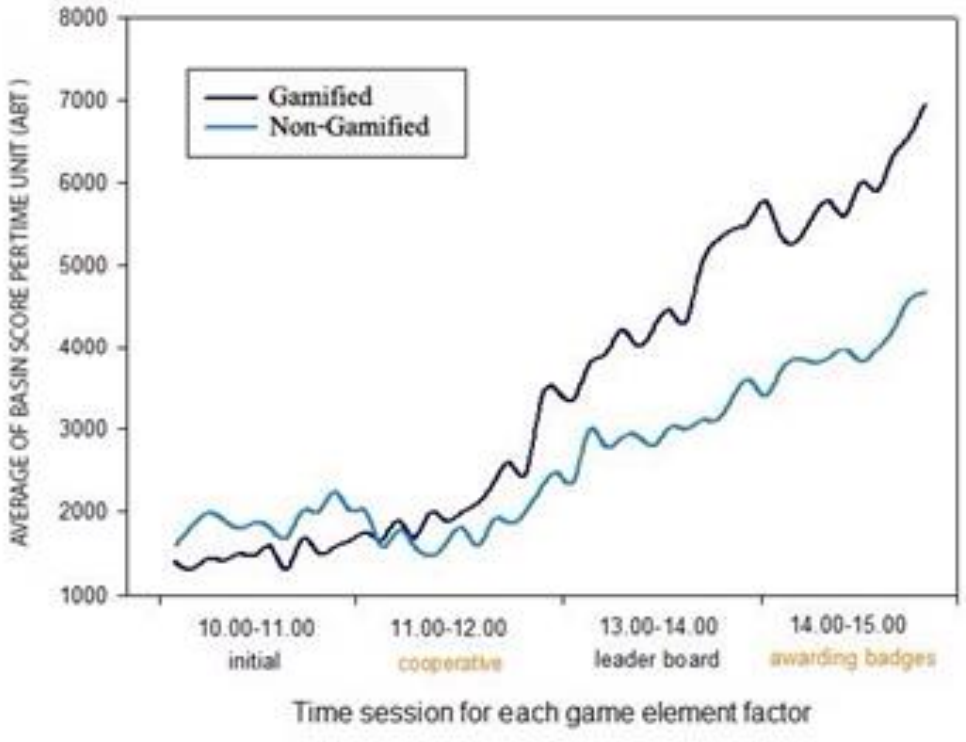
Where is participants, is Playable round at participant ***i*** at the time ***t***.

We analyzed the effect of the gamification environment on the performance by the Basin score of Game based learning for outdoor learning. To do so, participants completed several rounds in the game. In this experiment, there was no time limit given for students to complete each session. The Basin score in Game based learning for outdoor learning shows the overall performance of the player taking five separate factors into account: population, food, eco system, funds and energy. For each factor the game logic calculates the score based on how well the participant manages to organize the people and their environment on the simulated map. All points are then summed to calculate the final score showed at the end of the game. As matter of fact, there is a tendency of shortening game round length due to the fact that participants become more and more familiar with the game during the play. Therefore, it is important to take the factor of habituation into account in the investigation of the effects of gamification.

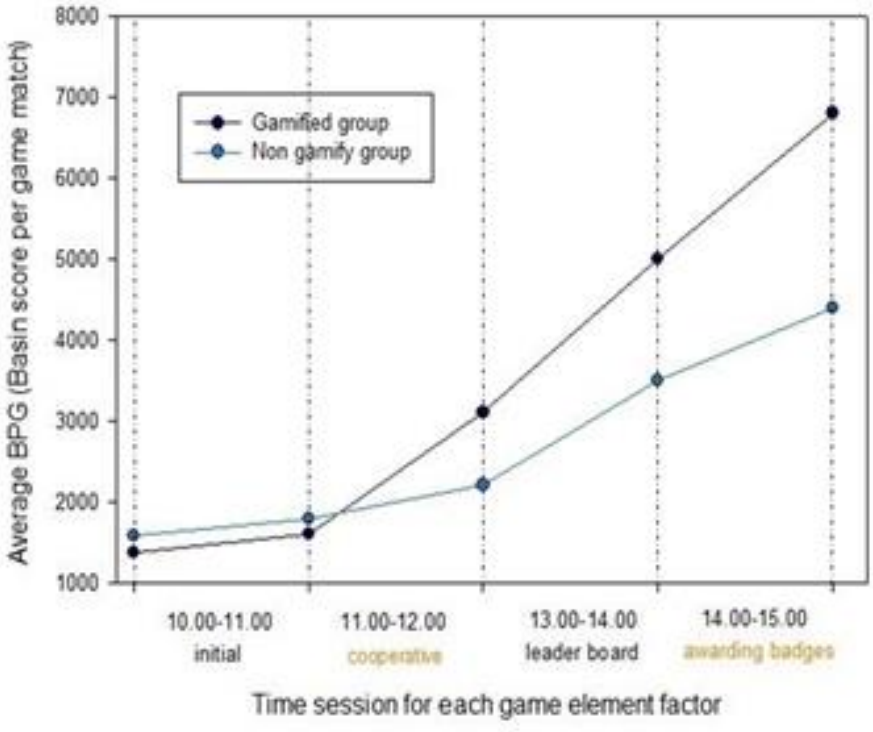
6.3.1.5 Results

Graph 1 and table 1 present the properties of ABT and angle difference for both experiment groups. In all response the basin score analyses the common statistic of the natural log of time for each session including each game element. The graph was calculated by the average of the participant groups for each session. In general, the average score of the Gamified Group first exceeded the score of the Non-Gamified group in the leader board session (score = 1,000) and the difference of the scores continued to increase (score = 2,000) in the awarding badges session. Finally, by the end of the experiment the average Basin score of the "Gamified" group has exceeded the score of the "Non-Gamified" group by more than 55%.As well as the normalize slope of basin score (table 1) present the normalize slope of ABT for each session the line of slope calculate from start point of begin in each session to end point of each session as show in graph 1 (right).Overall the slope of Gamified group also showed higher than Non Gamified group especially in leader board session (degree change = 49).

Finally, both graph 1 and table of ABT show significant of whole game element of Gamified session.



(a)



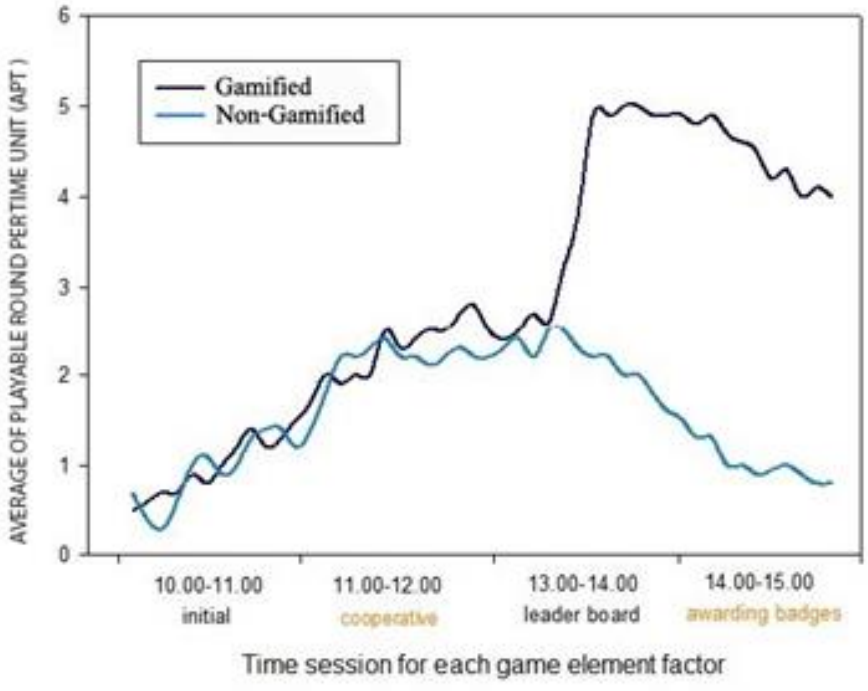
(b)

Graph 6.1 average (a) and Normalize (b) slope of basin scores per time unit (ABT) of Gamified and Non-Gamified Group

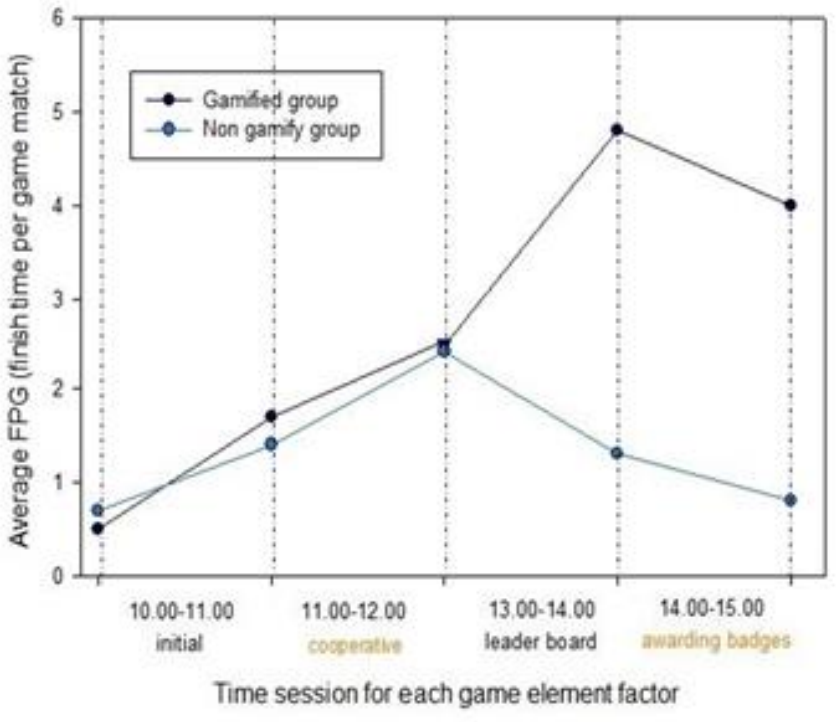
Table 6.2 Angle difference (graph 1 right) of ABT for each game element

Average of basin score per time unit (ABT)		
Session	Gamified group (degree)	Non Gamified group (degree)
Initial	+5	+5
Cooperative	**+32**	+10
Leader board	**+49**	+29
Awarding badges	**+38**	+20

Data analysis of Graph 2 and table 2 show a significant difference in the averages of playable round per time unit. Similarly to the previous graph, the initial and the cooperative sessions do not show much difference in APTs however in the leader board session the Gamified Group show a significantly, more than two times higher APT than the Non Gamified Group (APT = 5.1 and 2.5 respectively). In the awarding badges session both groups' APTs begin to similarly drop. For the normalized slope, the angle difference of Gamified group of Leader board shows a significant difference (degree change = 48).For Graph 2 and table 2 of ABT also show significant on leaderboard but not for cooperative and awarding badges.



(a)



(b)

Graph 6.2 Average (a) and Normalized slope (b) of playable round per time unit (APT) of Gamified and Non-Gamified group

Table 6.3 Angle change (graph 2 right) of APT for each game element

Average of playable round per time unit (APT)		
Session	Gamified group (degree)	Non Gamified group (degree)
Initial	+30	+19
Cooperative	+21	+26
Leader board	+48	-28
Awarding badges	-21	-15

6.3.2 The study of motivation of social, leveling and virtual Badge

6.3.2.1 Design

An experiment design II was used to study the game elements of Leveling, trophies and social factor. Participants were asked to assemble a group from the same school and randomly each school group was assigned to two groups with different gamification environment settings set up in four rooms. The participants in group A were seated in rooms 1 and 2 and the other group was seated in rooms 3 and 4. Students in both groups had to play under the conditions set up but in different periods (sessions) and in different gamification environment of various game elements in order to compare the results of both groups.

6.3.2.2 Participants and Procedure

For each group, the game time was separated into four sessions beginning from 10.00 am to 15.00 pm with a lunch break between 12.00 pm and 13.00 pm. We arranged the physical gamification environment of game elements in each session. We began with a Level session that was designed to study the effects of the game element ‘Level’ .The level had been increased after each round until the play was

finished. The participants were able to see their ranks in both groups in order to compare them with those having no information about the levels. In addition, the purpose of this session was to help participants get familiar with and learn the mechanics of the game, since participants never played the core version of Game based learning for outdoor learning before. The second session aimed to study the effect of 'Trophies Achieved' as a game element in order to see if the element 'Trophies Achieved' can motivate the participants. There were four special prizes for the participants who gained highest score, highest average score, highest amount of rounds played and highest number of collected trophies. The third session focused on 'Social war'. The purpose was to study the effect of 'Social war' and also to see the teamwork and cooperation of students from the same school in a challenging, competition situation. In our eco-challenge, the school earning the highest total score was regarded as the winner. In each session we used game elements in order to carry out our experiment in either group A or B.The final session purposed to show all the students in both groups all the information from the previous sessions. With this application of the gamification environment we could study the effects of each game element on the participants' performance and we could make a comparison with the other group having no gamification elements assigned to. In addition, the students were able to see their performance relative to others in each session by a web browser which showed the results in the format of ranks.

Figure 6.6 Overview methodology of design II

6.3.2.3 Measurement

As regards measurement, the present study investigated the direct relationship between the gamification environment and the performance outcome. Therefore, there is no reliable way to determine which standard measurement to be used to get a picture about the effects of behavior and outcome. As Hamari et al. (2014) noted a large portion of the studies on gamification and related studies in general seem to directly find the relationship between the affordances of the system and behavioral changes [8]. In our research, however tried to directly measure the actual use in terms of numerical indicators and self-reports. We measured the effects of gamification from two aspects of the performance. First, we used "Actions Per Minute" or "Active Per Minute" commonly abbreviated as APM, a term which was used for the first time in the real-time strategy field of electronic sports referring to the total number of actions that a player can perform in a minute. The performance speed was stimulated from session to session.

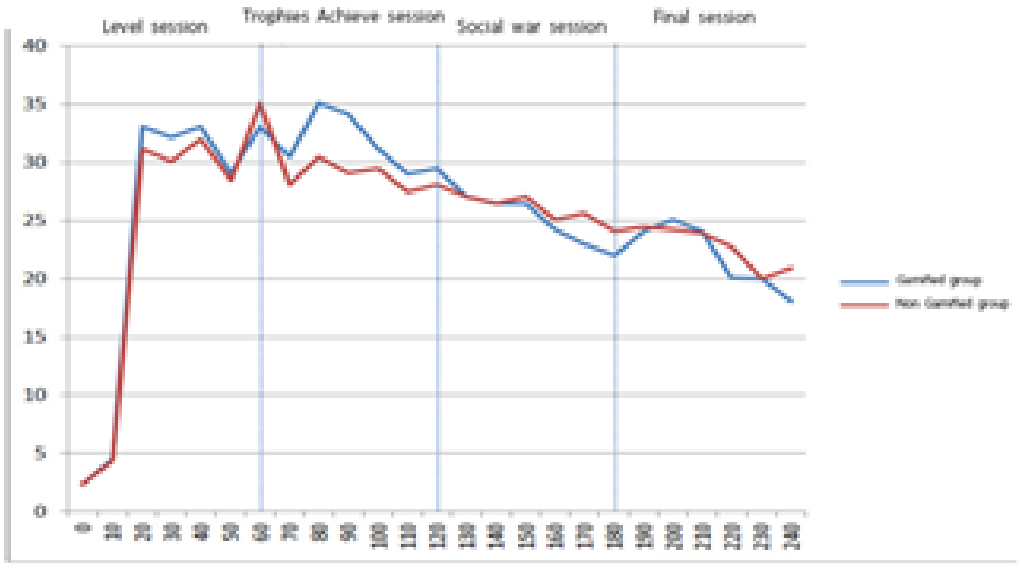
The self-report qualitative survey was collected from 15 students from the control (non-gamified) and 15 students from the experiment (gamified) groups. The aim of this survey was to obtain information on the attitude towards and perspectives of the serious game method from students of both control and experiment groups. We

implemented the semi-structure questionnaire which consisted of 2 parts, the first containing close-ended questions about the attitude towards the game applying such categories as enjoyment, challenge, preference, difficulty, and willingness to use the system in the near future. A five-point Likert-type scale, ranking from 1 (strongly disagree) to 5 (strongly agree) has been applied. The second tool was an open-ended questionnaire which allows students to express their attitude towards serious games without being influenced or interrupted by the researcher.

All points were then summed to calculate the final score showed at the end of the game. As a matter of fact, there is a tendency of shortening game round lengths due to the fact that participants become more and more familiar with the game during the play. Therefore, it is important to take the factor of habituation into account in the investigation of the effects of gamification.

6.3.2.4 Result

Graph 4 presents the properties of average APM as we mentioned before. In all responses the APM refers to the common statistic of the natural log time for each session including each game element. The graph was calculated by the average of the participant groups for each session. In general, the average score of the Gamified Group first exceeded the score of the Non-Gamified group in the Level Session (APM = 33.2) and the difference of the scores continued to increase (APM = 35.1) in the Trophies Achieved Session. Finally, by the end of the experiment the average APM of the "Gamified" group has slightly higher than the score of the "Non-Gamified" group.



Graph 6.3 *Overview Average of APM for each sessions*

According to table 3, the results from self-report qualitative survey indicate that the overall score of the close-ended questions of students in the experiment groups was higher than of the control group, while the attitude reflected by the open-ended questionnaire was positive regarding both groups. The score of the experiment group was significantly higher ($p = 0.05$) than in the control group regarding enjoyment (experiment = 4.06, control = 3.3), preference (experiment = 4, control = 2.6), and willingness to use the system in the near future (experiment = 3.8, control = 2.4). One student from the experiment group explained that "The game was more enjoyable when a leaderboard was applied and a competition took place". Another student expressed that "the reward motivates me in completing the tasks". According to Halan, Cendan, and Lok (2010) creating social competition by incorporating leaderboard can promote engagement and participation [10]. In our study, students from the "gamified" group agreed that they feel more joy when they are able to compare their scores with others. Multiple-goals feature in games allow students to set their own goals for their own achievements which promotes enjoyment and engagement. Moreover, students in experiment or gamified group were intended to use this system with game elements in nearly future.

Table 6.4 The self-reports qualitative survey of student in experiment and control groups

Enjoyment.					
Group	***N***	$\bar{x}$	***S.D.***	***T***	***Sig.***
Experiment	15	4.07	.799	2.157	.040**
Control	15	3.33	1.047		

Challenge.					
Group	***N***	$\bar{x}$	***S.D.***	***T***	***Sig.***
Experiment	15	3.67	.816	.664	.512
Control	15	3.47	.834		

Enjoyment.					
Group	***N***	$\bar{x}$	***S.D.***	***T***	***Sig.***
Experiment	15	4.07	.799	2.157	.040**
Control	15	3.33	1.047		

Challenge.					
Group	***N***	$\bar{x}$	***S.D.***	***T***	***Sig.***
Experiment	15	3.67	.816	.664	.512
Control	15	3.47	.834		

6.3.2.5 Discussion

Although most students showed a positive attitude, we also found that the attitude towards challenge is the same in both groups (experiment = 3.6, control = 3.40). Moreover, students in both groups reported that the game was difficult for them (experiment = 4, control = 4.2). One student stated that “the game logic is too hard for me; I cannot completely understand the meaning of the game”. Another student pointed out that “I cannot select the level of the game which would be suitable for me”. According to Jackson and Eklund, the flow state promotes activities more where a person’s concentration and skills are crucial for the outcome. In our studies, on the other hand, the original game lacked the level feature so students were unable to receive feedback on their progress. Therefore, they could not manage their skills and the difficulty levels. Furthermore, immediate feedback was missing from the game features

so student had no visible feedback on their achievements which commented that such immediate feedback is a success key factor for an effective achievement system.

6.4 The measurement of knowledge assessment I

The flow experience factor contribute to the gameplay mechanics was proposed by the playability factor. Playability in an educational game background is approached as being the only factor that can only affect the student's learning experience. It was hoped that through the fun and enjoyment of the game, students could engage in an active learning process to review their game-based learning content knowledge even when they were not aware of an upcoming test. Therefore, the purpose of this study was to determine the effects of game-based learning and the anticipation of a test on secondary students' achievements and improve the quality of educational game in terms of flow dimension.

Participants

The participants tested were 45 students, aged between 13 and 16, and were selected from various secondary schools around Chiang Mai province, Thailand. They were split into three groups composing of 15 students. They were labeled: "Anxiety group", "Boredom group" and "Flow" groups. The selected participants all had previous experience in mobile games. It is important to note that some participants had prior knowledge on location based games such as pokemon go. For this experiment we used the Game-based learning for outdoor activities which is completely different in terms of the game mechanics in order to make sure there is no significant difference of prior knowledge among the participants.

Design

An experimental design was used to address the hypotheses. Three groups were formed for the experiment in order to answer the research question: "Can we apply the concept of flow theory to learning task activity?" Participants were randomly assigned into three groups with different Gamification environment settings set up in three rooms. 15 students had to play under the conditions set up for the "Flow group" and the

other 30 students were assigned to the “Anxiety” group and “boredom” group. The methodology is shown in Figure 2.

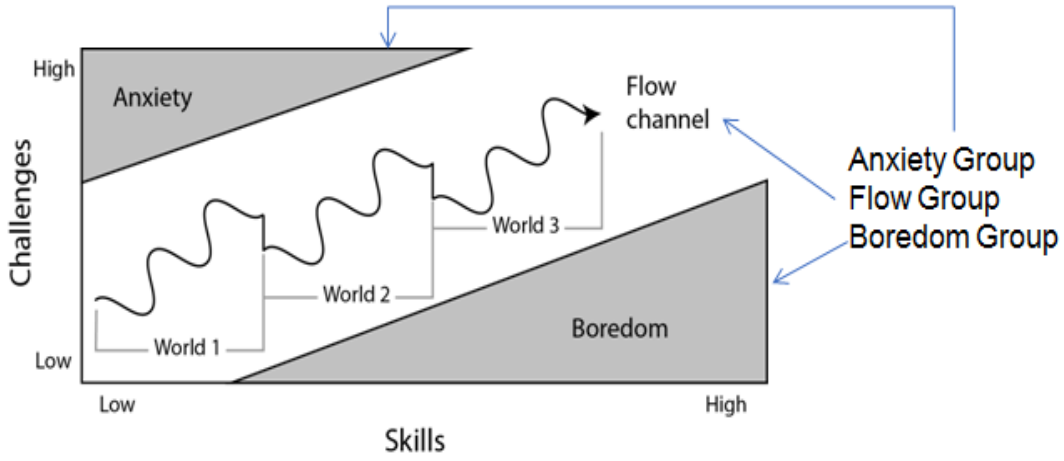


Figure 6.7 the research methodology for applied concept to flow theory

For each group, the game time was separated into four sessions beginning from 10.00 am to 12.00 pm with a lunch break between 12.00 pm and 13.00 pm. We arranged the location for physical environment in Chiang Mai zoo. We began with an initial session. This was done so who had participants never played the Game-based activity for outdoor learning before, so the purpose of this session was assist participants and to get familiar with and learn the mechanics of the game. The second session aimed to measure their learning performance. The results were compared with the other two groups between “Flow group” and “Non flow group” in order to see the difference between the participants measure again teach other by their learning performance. In this session, we let two groups play at the same time since this Game-based learning for outdoor activities is playing individually. The final session studied was to review the answer to keep statistics from the group and then review the student's performance. It is widely accepted among researchers that awarding badges contribute to better overall performance.

Procedure

The experiment was conducted using an “Anxiety group”, “Boredom group” and “Flow groups” environment. All participants took part individually in all of the three phases of the experiment.

· Initial session

“Anxiety group”, “Boredom group” and “Flow” groups were administered to determine the participant's’ skills and make them be better familiar with Game based learning for outdoor activities. Each participant was given a personal mobile to learn the game mechanics.

· Gameplay session

This session was held immediately after the individual participants completed the initial session. The students in the “Gamified” group were asked to pair up and use one personal computer together. They were allowed to cooperate and discuss with each other about how to win the game but were not allowed to communicate and work with other pairs. The time limit was one hour, which was determined according to the results of the cooperative session.

· Final session

This session started after the gameplay after the students had a lunch break for one hour. Here, participants in the “Flow” group were provided an access to the questionnaire: through their personal computer via the web browser.

Measurement with knowledge tests during game play

Knowledge tests were conducted on the educational material using four multiple choice questionnaire when students played Game-based learning for outdoor learning during second session. Referring to the knowledge on the benefits of subject of science, the participants were given a questionnaire with four general choices and eight scores. For each group, we collected the three data for the measure the statistics. First the activities during playing the game. This data included time during walking and playing game. Secondly, the total time of learning the data had counted when students started to

read the information and appears on the screen before knowledge test. Finally the total time of assessment showed data counting when student finished reading and started answering the questions.

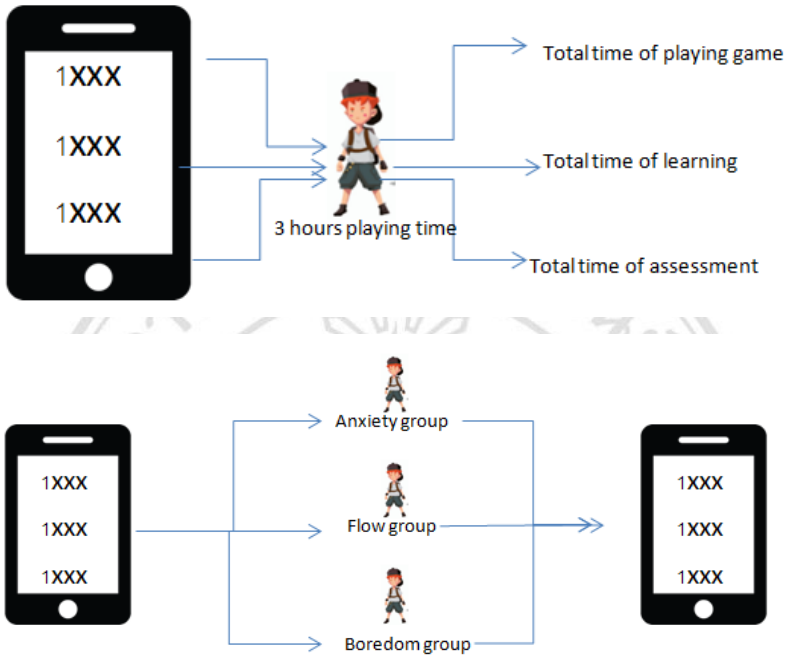
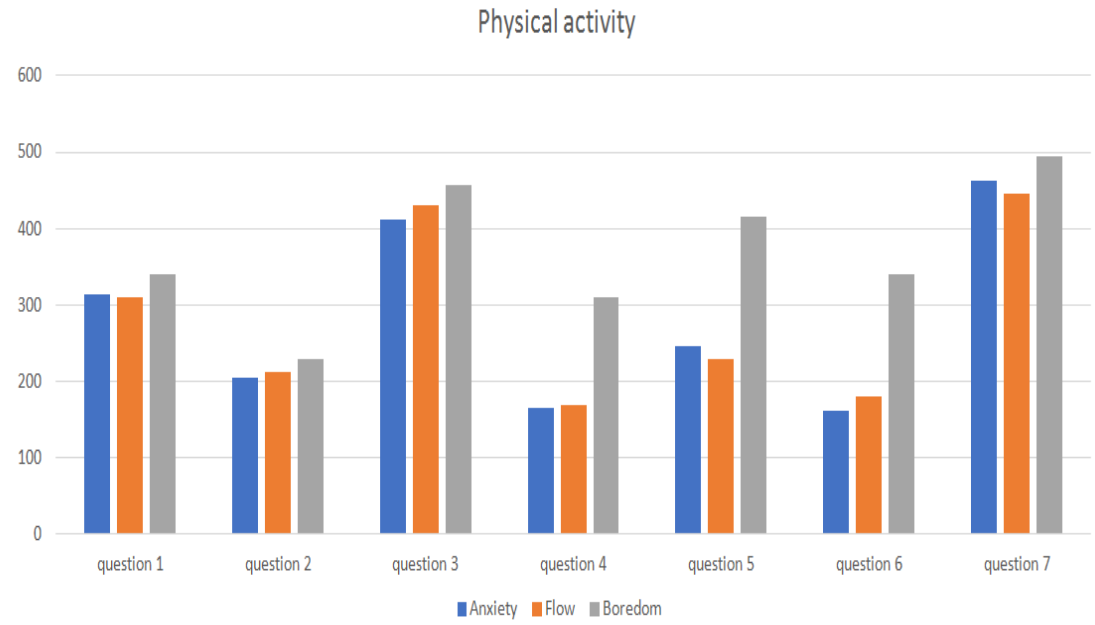


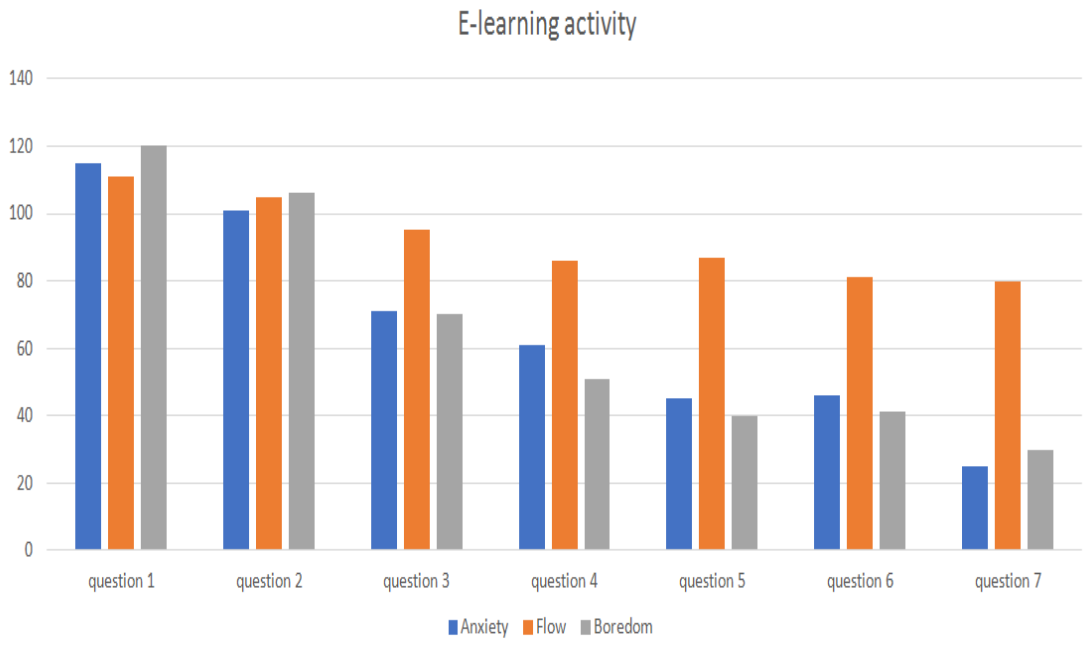
Figure 6.8 The research framework for "Anxiety group" "Boredom group" and "Flow Group"

Results

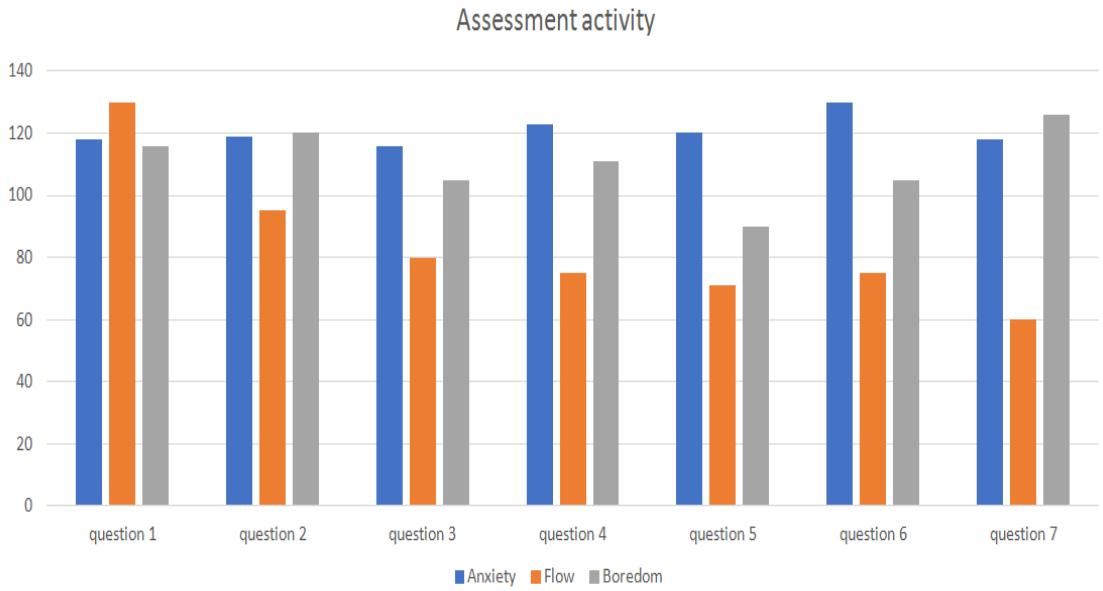
Therefore, the physical activity time of anxiety and flow group, there was no signification point. Whereas for boredom group, questions 4, 5, 6 spent too much time due to the question very easy (356, 400, 350 second). For e-learning activity, there is signification on flow group follow question 3-7 (average 90 second) but for other groups the average time was less than 20 second. Finally for the assessment group, the flow group spent less time than the other group around 10 second. For learning, the flow group would be best because the student trend to enjoy every activity instead of assessment (competition situation) for visit around the environment. Boredom group would be appropriate due to the Physical time and E-learning but it would also the needed more time to confirm the assessment time. Following the data we can confirm our hypothesis and to apply the concept of flow theory to game based learning.



Graph 6.4 the result of the Physical activity test



Graph 6.5 The result of the E-learning activity



Graph 6.6 the result of the assessment activity

6.5 The measurement of knowledge assessment II

An experiment design II of knowledge assessment was used to study the learning outcome between game-based learning for outdoor learning and traditional classroom learning. Participants were asked to assemble a group from the same school and randomly each school group was assigned into two groups. First group played our game-based learning from our framework with the same content from previous experiment. The second group was test on traditional classroom learning with the same content but involving a different method of learning.

Participants

The participants were 40 students, aged between 13 and 16, selected from various secondary schools around Chiang Mai province, Thailand. There were 20 students in each of the two groups: “classroom group” and “outdoor group” groups. The selected participants all had previous experience in mobile games. It is necessary to note that some participants had prior knowledge on location based game such as pokemon go but for this experiment. We used the same content with both groups who needed to learn between during test of this experiment in order to in order to make sure there is no significant difference of prior knowledge among the participants.

Design

An experimental design was used to address the hypotheses. Two groups were formed for the experiment in order to answer the research question: “what is the difference between these two methods of learning between game-based learning for outdoor learning and classroom learning in terms of the learning outcome. Participants were randomly assigned into two groups with a different method of learning. For mobile based learning in a classroom, 20 students had to learn under the conditions set up in a classroom setup which consisted of material of learning through tablet. For mobile based learning outdoor classroom group, 20 students had to play as the same seen in experiment 1 (see figure 6.10).

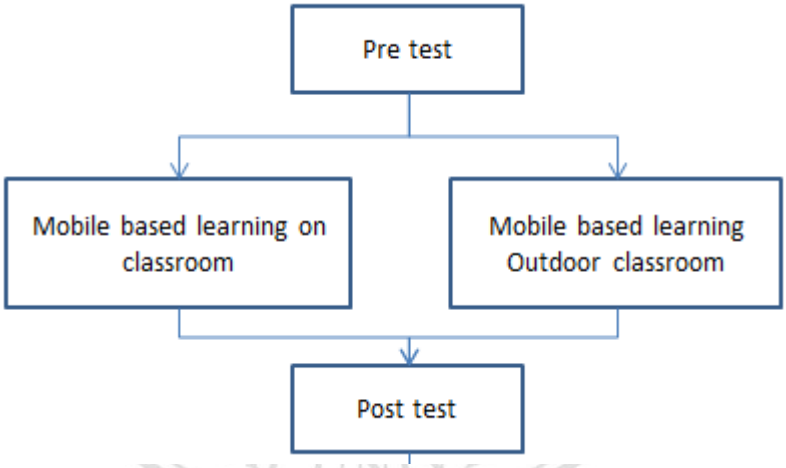


Figure 6.9 The measurement of knowledge assessment II

For each group, the game time was separated into three sessions beginning from 10.00 am to 12.00 pm with a lunch break between 12.00 pm and 13.00 pm. We arranged the location for mobile based learning in an outdoor classroom environment on Chiang Mai zoo and another with Cholprathanpateak school. We begin with a pretest session, since participants never learn the content before. The second session aimed to measure the learning performance. The results were compared between the two groups i.e. “classroom group” and the “outdoor classroom group” in order to see how different the participants measured in terms of their learning performance. In this session, we let two groups play at the same time since this Game-based learning for outdoor activities is to

play individually. The final session studied was to review the post-test in order to measure between two groups.

Results

	N	*x*	*s.d.*
classroom	20	5.67	.81
Outdoor classroom	20	5.84	.83

Discussion

To summarize, the Outdoor classroom group would be better than the traditional classroom group but it is not significantly (5.67 and 5.84). However, the mobile-based learning for outdoor classroom is better than in terms of motivation and fun from previously conducted experiments by other researchers.

6.6 Conclusion

In this chapter, describing the research that we proposed to study the outcome of our game-based learning for the outdoor learning's framework. We measured the effect of motivation, fun and learning outcome model we proposed in Chapter 3.

The evaluation of motivation and fun, the measurement of fun by flow measurement (DFS) was higher than average (DFS = 0.651). For motivation, there were two design experiment taken into consideration during the assessment of learning. In summary for experiment I, the investigated motivation of game elements showed great effects on the learning response. Another experiment, the investigated game elements showed a higher impact on both the measured responses of the "Gamified" group. Moreover, game elements levels and trophies achieved proved to have a significant effect on participants' performance. In term of evaluating the learning outcome, the experiment showed that our framework can improve the learning time compared to the anxiety and boredom groups, but cannot improve the performance in term of traditional classroom learning.