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The Evaluation Framework for the Group Development Process of Adventure Education Game

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Abstract: It has been implemented for a long time about the development of physical adventure education activities. However, there were no papers to discuss the application in technology. This study uses Tuckman stage of team development to develop a digital games course of adventure education and chooses suitable process evaluative tools. Researchers can investigate the changes of members' interactive behaviors and group development with the tools. Finally, this study will use questionnaires to explore the learning effectiveness of adventure education and the satisfaction of the digital games course.

Keywords: group dynamics, adventure education, Digital Game-based Counseling,

1. Introduction

In the last several decades, adventure education was implemented in the physical form. Students have been grouped up and experienced the activities in the wild for a few days. Members experience their group activities from being strangers to partners. They went through the courses and have face-to-face contacts with members. Goals for the activities were learned in the reflection sessions after each activity. Students could use the lessons learned to situations in their lives. However, few studies have provided insights of using digital games for adventure education.

With the advance of science and technology, many teenagers are addicted to digital games, which are not intimate with the nature and are distant from the crowd. Traditional adventure education is seldom their leisure or learning options. Conversely, teenagers are more apt to present themselves in the virtual world, such as their ideas, emotions, and real personalities. If digital games become the medium for adventure education, do teenagers can establish the relationship with more people and communicate more easily? Are the learning effects same or better than the physical form? How to be changed the students' interaction?

This study presents the design of an adventure education course based on digital games following the principles described in the Tuckman stages of team development model. Qualitative data are collected to observe the processes of the team developments, to investigate the changes of the teams and members, and their problem-solving processes. The guidance teacher would lead students to review their gaming processes with the gaming records. Facilitators can understand the problems and find the right way to solve it on explicit gaming roles and integral gaming records. Members can reflect and internalize lessons learned in the reflections. The games have been made by the game engine – Unity3D. Combine adventure education and digital gaming elements, students not only can enjoy the fun of the games, but also can learn the connotation of adventure education. It is our ultimate goal to combine education with recreation.

2. Literature review

2.1 Adventure Education

Adventure education is a series of risky and challenged activities that experienced by students. By participating the activities, students think and internalized the connotation of adventure education through the personal experience of the activities and group reflections after the activities by the

guidance. Ideally, the students also apply what they learned in the activities to situations in their life. Traditionally, students passively learn in teachers' lectures without much interaction. On the other hand, teachers play the guidance role in adventure education. Students take initiations and learn by doing. As students internalize the knowledge in the learning process, they increase interests to participate the learning process and put conceptual contents into practice so that learning effectiveness can be improved.

The courses of adventure education were originally long and extensive. It takes days or even months to finish. Glass and Myer (2001) used the essences of adventure education to design small-size courses of adventure education which only takes a few hours. They thought the learning effectiveness of adventure education should not only be analyzed with questionnaires. Research should add observations and interviews to understand students' learning effectiveness. They thought the individual state of mind would affect students' behaviors in groups. Therefore, they observed students' performance in the reflection session from the individual psychology aspect. For several years, studies in adventure education have been based on thematic activities. Baldwin, Persing, and Magnuson (2004) as well as Brown (2006) pointed out that those studies have over-focused on the difference between pre-test and post-test. Those studies ignore the change of students' learning styles and behaviors in the process. Zmudy, Curtner-Smith and Steffe (2009) offered a detailed account of using qualitative research method by adding observations and interviews to investigate the change of students' self-concept, peer relationships, and interpersonal skills during the process.

More recently, the course design of adventure education has been a fixed process in Taiwan and abroad. The course design was based on Tuckman and Jensen's (1977) stages of team development model. The five stages were combined with the activities of adventure education. According to the characteristics of every stage, suitable activities were chosen to be used in the adventure education courses. Through the activities, groups were developed to be high-performance teams. Nevertheless, there were still only few papers that explore the details in the process. Thus, this research tries to present a detailed analysis to the learning process.

As the technology advances, network became a part of people's life in recent years. Teenagers are addicted to the online games. Physical activities are less effective and attractive comparing to the digital ones. It is also the goal of this research to apply digital technologies in the course without losing the effects of adventure education.

2.2 Group dynamics

People get together without interaction. It does not mean a group. For several decades, many people have taken many different explains about group. In 1991, Johnson and Johnson's (1987) conception about group is value for studies from now on. They thought the group mainly consisted of two or more individuals which conform to some conditions: (1) Interact with each other; (2) Rely on each other; (3) Sense of belonging to group and each individual is recognized by other members; (4) Follow group rules; (5) Cross influence to each other; (6) Looking for group benefits and rewards; (7) Achieve common goals. As group is working, group needs to support by energy. One of the most widely cited theories of group dynamics has come from Kurt Lewin in 1930s. Though the following development of the theory diverges to different directions, all in all, group dynamic investigates and describes the members' behavior changes in the group or between groups.

One analysis method about group interactions is Bales' interaction process analysis (IPA) which is especially suitable to analyze problem-solving groups. IPA considers interactive behaviors from two dimensions including task dimension and socio-emotional dimension. The two dimensions are opposite to each other. According to Bales' research, two different behaviors can make a balance along with the group development. For the typical problem-solving groups, the ratio of task dimension and socio-emotional dimension behaviors approaches 2:1 (Bales, 1950). It can be seen that task dimension behaviors are mostly used to achieve group goals, and socio-emotional dimension behaviors are used to allow success group develop. Members' interactions can be easily recorded in detail by IPA. Behaviors are considered to be data which can be observed, synthesized, and analyzed. From the recorded data, group development problems can be identified and solved so that group efficacy can be raised. IPA was widely used in the recent years. Studies range from counseling, group efficacy, and parent-child relationships that focused observing the physical activities. Some studies investigate about the use of technology to help researchers record web and game dialogs. Nam, Lyons, Hwang, Kim, and Severino (2009) as well as Messina (2010) have used computer-assisted tools for recording

observations. But those researchers all pointed out one thing that communication is easy to record and observe with computers, but group interactions are less effective than face-to-face communication. Soong (1989) thought that group process is an interactive process, and interaction is the core condition in groups. Members have to interact with each other to increase group effectiveness, and so does it in the adventure education courses. In the related studies of adventure education, there are some studies using IPA to observe members' interactive process of outdoor activities. However, there is few to investigate members' interactions in the digital games especially for adventure education.

Hill interaction matrix (HIM), on the other hand, is also an interactive analysis method. It is used on the developing groups and treatment groups (Hill, 1977). It synthesizes group interaction patterns with a multi-dimensional matrix. HIM mainly records group members records grouctions by work and content vectors. It has four advantages: (1) High surface efficacy; (2) Cover all spoken languages that are meaningful statements; (3) Easy to teach and learn; (4) Record the communication process instead of making generalization of structure and behaviors (Pan, 1999). Content vector includes questions concerning topic, group, personal, and relationship, within which general interests, group, personal, inter-relational problems are included. Work vector includes responsive, conventional, assertive, speculative, and confrontational oral presentation types. Through HIM, researchers can identify treatable behaviors. Most researchers use HIM on counseling and medical arena. Because the analysis process of HIM is too complex, many researchers developed scales to expedite the process. So far, HIM has not been seen to be used in the group development process analysis in adventure education.

Sociometry is designed by Jacob Levy Moreno (1934) which is mainly used to observe the transformation of group structure. The method is to assess the fondness of group members to others. Through interviews and questionnaires, Sociometry can show the hierarchical relationships between members graphically, such as exclusiveness, popularity, attractions, influence, and so on. When group structures change, sociogram shows the changes. Sociometry was widely used in different fields. It was first used in educational counseling such as therapy, diagnosis, and evaluation. Later, it was used on enterprise, military, industry fields, and so on. The topics include leadership style, work assignments, group morale, and group organization.

2.3 The activity process of adventure education

Interactive analysis is used in both physical and virtual groups. The groups can be divided into two types: (1) Task groups are those to achieve goals and missions. ; (2) Developing and treatment groups are those focus on individual or group treatments. Internal changes are observed for these groups.

The activities of adventure education can be divided into three stages (Henton, 1996): (1) Brief: Before activities begin, facilitators have to talk to students about activity rules, goals, situations, and restriction. It is to raise students' attention rules and goals. (2) Activity: Students start to experience activities. Facilitators play the role of assistants who help students finish the courses. They are not lecturers in class. (3) Debrief: Facilitators help the students to understand the meanings of the activities through reflections. Students internalize the connotations of adventure education. When in the activities, the group functions as a task group. The goal is problem-solving and mission completion. When in debrief, the group functions as the developing and treatment group. Therefore, in order to effectively observe and analyze the adventure education course with digital games, different analysis methods and tools are needed.

3. Research Methods

This study mainly relies on qualitative research method supplemented by questionnaires. Research processes have three steps:

Design: This study's experiment is based on the theory of adventure education. Researchers choose suitable interactive analysis in group dynamic. Interaction process analysis (IPA) can be used in Activity; Hill interaction matrix (HIM) can be used in Debrief. Then, researchers begin to develop the adventure education course with digital games that are made up of activities in accordance to the Tuckman stages of team development model.

Execution: Based on Interpersonal Behavior Survey (IBS) (Mauger & Adkinson, 1993), participants are divided into three groups: High social interaction group, Low social interaction group, and mix. Then, participants fill out the pre-questionnaire to understand their acknowledgements to the

adventure education course and their expectations about the digital games. During the course, observation will be conducted (1) Unstructured observation. Researchers record the interactive process with the interaction analysis chart. (2) Participant observation. Facilitators are the observers. Researchers participate the course to have an inside look of the group situation. At the end of every activity, the participants fill out the questionnaire of sociometry. The group development pattern was shown in the short-term sociogram. Other than that, the course will be recorded entirely with video. After the course, the participants will fill out the post-questionnaire. Facilitators will interview some groups and the individuals which are special cases in the course.

Analysis and discussion: Data analyses have two parts: (1) pre-and post-questionnaire comparison: From the pre- and post-questionnaire comparison, researchers investigate the learning effectiveness of the adventure education course, and participants' satisfaction level to the digital games. (2) Process analysis: Researchers compares the observation results, short-term sociograms, videos, and facilitators' interviews to visualize the changes of group interactive process which shows the transformation of group structures. Finally, the study will discuss the results, problems, and corresponding suggestions that are to be improved.

4. The digital games based adventure education course

The games in this study are for adventure education which require highly realistic. Therefore, Unity3D game engine is chosen to develop the games. Besides simulation, this game engine has high performances in particle effects and physical collision. Players can be immersed as if they are in the real scene. Unity3D also supports cross-platform publication such as PC, IOS, Android, XBOX360, Wii, and Web. Since the physical activities vary, the digital games of the adventure education course have to be presented on and with different platforms to serve the needs. It saves time to use Unity3D to make cross-platform games.

Tuckman (1977) thought the development of groups go through stages and in order, therefore, the theory describe the process in five stages. However, members' negative behaviors in the storming stage such as misunderstanding and bad communication can hinder group development. In this condition, groups need to be high-performance groups to move forward to the next stage. The individuals and groups situations for each stage are described in Table 1.

Table 1: Situations of group development in Tuckman's five stages

	Individual situations	**Group interaction situations**
Forming	1. Explore, feel strange to everything. 2. Both individual and group goals are not clear. 3. Look for his position in the group.	1. All members are not familiar with each other. 2. Finish personal works without group work.
Storming	1. Look for the individual goals 2. Have personal opinions, dealing with works from their own angles. 3. Have influence in group.	1. Form small groups. 2. Groups have abilities to divide the works to each member, and can complete simple missions.
Norming	1. Understand group goals. Individuals are team-oriented. 2. Accept others' opinions and views, and make adjustments. 3. Personal motivation. Members take roles in groups.	1. Cooperation. Members finish all missions successfully. 2. Groups work on the same rhythm. Understand personal roles and values.
Performing	1. Identify with group goals. Have personal ideals. 2. Look for further growths and changes. 3. Help partners to grow from each other.	1. Have great interactions and work skills. 2. Have great group climate. Cover and support each others.
Adjourning	1.Share self-reflections and experiences. 2.Produce common memories in the development process. 3.Say goodbye. Start next cycle.	1. The cycle ends. Review and share the process of group development, common experiences, and memories.

Researchers refer to “Experiential education- learning from 150 games” (Hsieh, Wang, & Chuang, 2008) and “Experiential education: theory and practice” (Kuo, Liao, & Shih, 2009) to identify appropriate activities of adventure education for developing the digital games. The course works with groups of five people. The course designs with a series of digital games based on Tuckman’s team development model. The five group development stages are explained as follows.

Forming: Members meet each other for the first time. They feel strange about everything. In this stage, warm-up activities are chosen to let members communicate, share, and give opinions frequently so the members can be familiar with each other. Members build the initial group relationship. The goal of the first stage adventure education activity are breaking fixed conception, creating of group relationship, and making reflection. The game digitized for this stage is Polar Bear and Hole (Figure 1). The game starts with a story which provides hints for the task. The facilitator throw dices three times for giving hints. Then the members discuss, observe, and induce for correct answers following the logistics of the story.

Storming: This stage contains activities which prevent oral communications between members. All members have to work together to complete the tasks. In this stage, members try to discuss the group problems with their internal dialogues. Their personal weaknesses and group problems are improved by themselves. Groups can be high-performance teams. The goals of the adventure education activities in this stage are problem-solving, cooperation, trust, breaking fixed conception, communication, respect, and reflection. The games which are used in this stage are Cooperative Puzzle (Figure 2) and Chessboard Maze (Figure 3). In Cooperative Puzzle, everyone gets three puzzle pieces out of total of fifteen puzzle pieces. All five members in the group need to work together to put up five equal-size squares with puzzle pieces. Members can exchange puzzles with others without discussion. They can only give out puzzle pieces, but cannot ask for them. The goal of the game is to make members realize their roles in the group, and pay attention to others’ needs. The game Chessboard Maze is played by only one person at a time. There is only one path to pass the 9x5 chessboard which is full of landmines. When the player goes through the wrong path, he has to start over again. Every failure leads to point deduction. The group has to change player whenever the landmines is intrigued. The goal of the game is to build the trust between members, and to generate gaming strategies together through trial-and-error, members’ experience, break fixed conceptions, and challenge obstacles.

Norming: After storming, members start re-thinking about relationships between individuals in the groups. Through communications, members start to trust each other. Members achieve group goals more rapidly and create greater effectiveness. The goals of the adventure education activities are leadership, communication, cooperation, and reflection. The game used in this stage is Moon Ball (Figure 4). Members pat the ball cooperatively to keep the ball in the air as long as they can. One person cannot pat the ball twice continuously. The goal of the game is to train members to use strategies to cooperate with each other.

Performing: After going through the difficulties and frustrations in the previous activities, members now have skilled cooperative strategies and are in great interactions. The goals of the adventure education activities in this stage are leadership, trust, communication, cooperation, and reflection. The game used in this stage is Group Balance (Figure 5). The game requires three people to play. One member keep balance of the board and the other two members push the balance board upward on the two sides until reach the target height. The purpose of the activity is to increase members’ reliance, cooperation strategies, and face the challenges.

Adjourning: Group development process comes to the end. Members share their experiences and encouragement to each other. Groups start to have existing members to leave, and new members to join. Groups start a new cycle. The goals of the adventure education activities are leadership, trust, communication, cooperation, and reflection. The game used in this stage is Cycle Maze (Figure 6). Members first read a maze map and try to memorize it. Then, they get fourteen pieces of boards to construct the maze as they memorized. The purpose of the activity is to train members to solve problems and communicate. It strengthens their group concepts and identifies their roles.

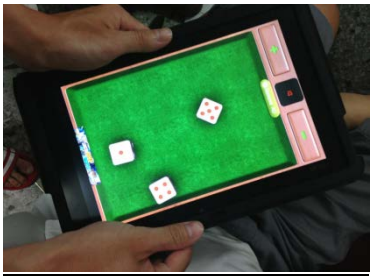

Figure 1. Polar Bear and Hole

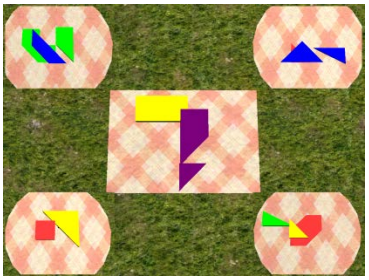

Figure 2. Cooperative Puzzle

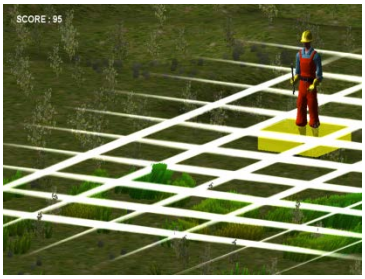

Figure 3. Chessboard Maze

Figure 4. Moon Ball

Figure 5. Group Balance

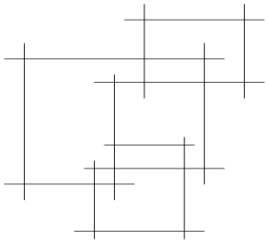

Figure 6. Cycle Maze

5. The evaluation framework for group development

This paper adopts some physical activities which are based on theory. Physical activities base on Tuckman's stages of team development model. Unity3D is used to develop the adventure education course with digital games. In every stage, researchers use suitable interactive analysis method to observe and record. Interaction process analysis (IPA) will be used in Activities; Hill interaction matrix (HIM) will be used in Debrief. Finally, researchers use sociogram to make the graphs which can show the change of group structure. The processes of the reflection and members' interaction in course are recorded by interactive analysis (Figure 7).

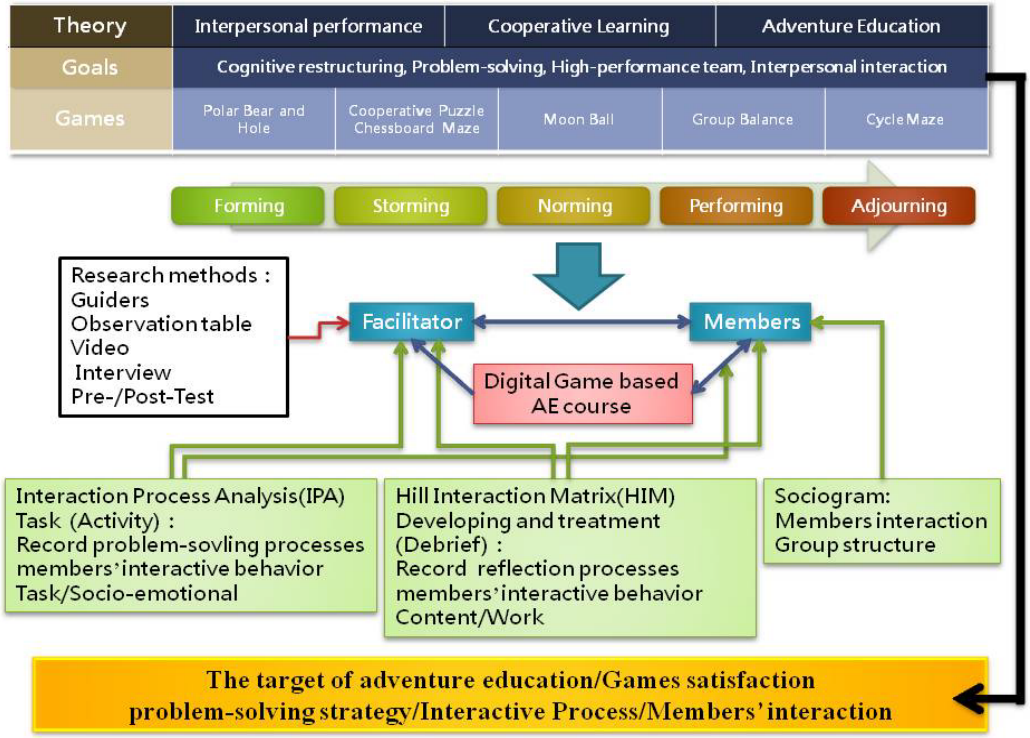

Figure 7. Research structure

5.1 Interaction Process Analysis(IPA)

According to Bales' (1950) interaction process analysis, groups have to solve problems in two dimensions. 1. Task dimension: The contents of discussion are the situations which members have to solve, suggest, ask, order, and guide. Task-oriented interactions are classified in the areas. 2.

Socio-emotional dimension: The contents of discussions are the situations which concern the coordination, opinions, acceptances, and conflicts in members. Socio-oriented interactions are classified in the areas. In Table 2, during the group development process, all interactions can be recorded. Through the data which are recorded by IPA, the group development problems can be identified and resolved.

Table 2: Bales' interaction process analysis (Bales, 1950).

Functional dimension		Content categories	Code
Socio-emotional	Positive reactions	Shows solidarity, raises other's status, gives help and rewards.	F
		Shows tension release, jokes, laughs, shows satisfaction	E
		Agrees, shows passive acceptance, understands, concurs and plies.	D
	Negative reactions	Disagrees, shows passive rejection, formality, with olds help.	D
		Shows tension, asks for help, with raw out of field.	E
		Shows antagonism, deflates other's status, defends or asserts self.	F
Task	Attempted answers	Gives opinion, evaluation, analysis, expresses feeling and wish.	C
		Gives suggestion, direction, implying autonomy for other.	B
		Gives task orientation, information, repeats, clarifies and confirms.	A
	Questions	Asks for orientation, information, repetition or confirmation.	A
		Asks for opinion, evaluation, analysis and expression of feeling.	B
		Asks for suggestion, direction and possible ways of action.	C
Code	A: Problem of orientation. B: Problem of evaluation. C: Problem of control.	D: Problem of decision. E: Problem of tension-management. F: Problem of integration.	

5.2 Hill's Interaction Matrix(HIM)

Hill interaction matrix is divided into two vectors: Content and Work. The analysis is used on investigating the developing groups and treatment groups. This analysis is based on the contents in group interactive process instead of the tasks (Hill, 1977).

Content vector reviews the dialogue of group interactions. It includes four aspects. 1. Topic: It includes only the discussion content but nothing about the group or members. 2. Group: Anything about group development, such as activity implementation, leadership style, group work strategies. 3. Personal: Anything about group members. It focuses on behaviors of individual members. 4. Relationship: It discusses members' interactive situations or relationships between members and group.

Work vector reviews the situations of group works. It includes five aspects. 1. Responsive: The interaction is generated by facilitators. Members only give short answers and show reactions. It is mainly designed for members who do not have social interactions or responses. 2. Conventional: The interaction includes greetings and chats. It has no influence to groups. It provides basic group functions. 3. Assertive: Members talk about themselves. It is about the interaction of protestation and refusal. The interaction is mainly argument, hatred, or malevolence. 4. Speculative: Members handle group situations with rationality during discussions. Through rational discussion, personal observation and comprehension about situations are improved. 5. Confrontative: The interaction is about group leaders who face problems they do not want to face. The interaction is normally risky and tensional.

5.3 Sociogram

Sociogram is a way which uses graphs to display members' interpersonal relationships in the particular situations. The graph uses geometrics, names or codes to represent members. According to the past research, round shape represents females, and triangles represent males. Incomplete shapes or colored figures represent member absence. The graph has three layers. Members who are identified the most times are placed at the center of the sociogram. Members who are identified the least times are placed at the edge of the sociogram. Arrows are used to show members who are identified by others. Double headed arrows are used to show members who identify each other. Dashed-line arrows are used to show members who are rejected by others. The group structure can thus be observed and presented with sociogram.

During the course, tools are used to analyze the process. 1. Video: the whole process is recorded on video which will be coded and analyzed afterwards. 2. Unstructured observation: Researchers use observation sheet designed with the interaction analysis model to record members' interactions in the process. 3. Participant observation: Facilitators are the leaders of the course. They observe groups from the internal view of the group. 4. Interview: Through the interviews, researchers can perceive the group changes and interactions more in-depth. 5. Sociogram: After every Activity and Debrief, members fill the sociogram questionnaires. Researchers can observe the change of group structures. 6. Interaction process analysis: The interactions which record on the video are systematically analyzed by sentence syntactic. The interactive behaviors in Activity can be recorded completely. 7. Hill interaction matrix: Same as interaction process analysis. The interactive behaviors in Debrief can be recorded completely.

6. Conclusion

The digital games developed in this study are different from those commercial games. They are educational games. The games have educational goals but also interesting. In this research, researchers implement digital games into adventure education course which attract teenagers. The course is designed with Tuckman's stages of team development mode. The results of this research expect group members to learn the connotations of adventure education. Therefore, researchers choose interactive analysis to design the evaluation framework so that the change of group developments can be recorded and presented. It can generalize the arrangements about groups and the change of group structure, members' interactions, and social skills.

Acknowledgements

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