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The Change of Interpersonal Relationship for Group Development in Digital Game-based Adventure Education Course

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Abstract: The development of physical adventure education activities has existed for a long time. However, there was little research concerning its applications and developments with technology. This research designed a digital game-based adventure education course with Tuckman's stages of group development. Six traditional adventure education activities were chosen to be developed into digital forms by Unity3D and were developed into three different platforms: desktop computers, tablets, and motion-sensing devices. Bales interaction process analysis was used to observe the development of group interactions of the participants during the experiment. The results showed that the interpersonal relationships between participants in groups can be effectively improved after the course.

Keywords: Adventure education, Digital game-based learning, group development, interaction process analysis.

1. Introduction

Adventure education is formed by risky and challenging activities experienced by students. The connotations of adventure education were thought and internalized through the personal experiences to the activities and group reflections after the activities led by the facilitators. For several decades, the activities of adventure education have been implemented in the physical form. Students have been grouped up and experienced the activities in the wild for a few days or even weeks. Group members had face-to-face contacts, went through the courses with members, and experienced their missions of activities from being strangers to partners. Goals for the activities were learned in the reflection sessions with the facilitators after each activity. Group members could use the lessons they learned in the daily life situations. However, few studies have presented insights of adventure education with digital games.

With the advance of technology, more and more teenagers are interested in digital games. Traditional adventure education activities are seldom their learning or leisure options. Conversely, teenagers are more apt to show themselves in the virtual world of games in terms of their real personalities, creative ideas, and internal emotions. Therefore, this research aims to investigate whether digital games can effectively become the medium for adventure education, and whether teenagers can establish interpersonal relationships more successfully.

The study aims to design a digital game-based adventure education course base on Tuckman's stages of group development. Six traditional adventure education activities that are difficult to be implemented due to location or weather limitations were chosen to be digitized into digital games and were integrated in accordance to the five stages of Tuchman's stages of group development. Bales interaction process analysis was used to observe the development of group interactions of the participants during the course experiment.

The game engine Unity3D was used as the development tool. With the advantages of cross-platform, high-simulation, and easy-manipulation, researchers transformed the six traditional adventure education activities into two computer games, two tablet games, and two motion-sensing games. After the course, students can not only learn positive interactive relationship of adventure education, but also have fun with digital games.

2. Literature review

2.1 Adventure Education

The courses of adventure education which takes days or even months to finish were originally long and extensive. In 2001, the essences of adventure education were devised into small-size courses which only took a few hours (Glass & Myer, 2001). Glass and Myer (2001) thought the learning effectiveness of adventure education courses should not only be analyzed with questionnaires. Research should increase observations and interviews to investigate students' learning effectiveness. They thought students' behaviors in groups would be affected by the individual state of mind. Consequently, they observed the performance of each student in the reflection session from the individual psychology side. For several years, studies in adventure education area were based on thematic course or activities. In company with Baldwin, Persing, and Magnuson (2004), Brown (2006) indicated that the difference between pre-test and post-test have been over-focused in those studies. Those studies ignored the change of students' behaviors and learning styles in the process of activities. In 2009, a detailed account of using qualitative research method, such as interviews and observations, was presented to explore the change of peer relationships, interpersonal skills, and students' self-concept during the process (Zmudy, Curtner-Smith, & Steffe, 2009).

In recent years, the design of adventure education course has been a fixed process in Taiwan and other countries. The course design was always based on Tuckman's stages of group development (Tuckman & Jensen, 1977). The five stages of group development were combined with suitable activities into the adventure education course. Through those activities, every group was developed to be a high-performance team. However, there were only a few studies that investigated the interaction details in the process. Therefore, this study aims to present a detailed analysis to the interaction process.

2.2 Digital games in counseling area

Digital game-based learning (DGBL) has been gradually emphasized in recent years. The purpose is to improve students' learning motivation and effectiveness through digital games. Face to face interviews were usually used in the traditional counseling which may build up intangible stress to the participants that were unhelpful to bridge the communication gap. It always took lots of time to drop one's guard that only can be done by counseling psychologists. Without proper temptations, teenagers kept losing their interests when doing activities in a confined room. It is supposed that digital games can help the counseling activities to be carried out smoothly. Taking the advantages of digital games can lower down the stress to them and help them to focus on the counseling issues. To help people to have in-depth understanding to themselves and are willing to make necessary changes are the purposes of counseling. It is worth to try to unload the defenses of participants and achieve the purposes of counseling.

In the last two years, many digital games were developed based on adventure education and counseling activities were developed by our team (Hsu & Shih, 2013), and were used in the individual and group counseling. Their research results show that the learning effectiveness of digital counseling games perform equal or even better than the traditional ones, as well as the attention and motivation of the students in participating of the adventure education activities. It is proved to be feasible to implement the teaching methods of digital game-based learning in the courses of adventure education or counseling area.

2.3 Interaction process analysis

Bales interaction process analysis (IPA), which is widely used and is especially suitable to analyze problem-solving groups, is an analysis tool about group interactions. Task dimension and socio-emotional dimension were the two dimensions of interactive behaviors that IPA considers. The two dimensions are opposite to each other (Bales, 1950). In the recent years, studies range from group efficacy, parent-child relationships, and counseling were focused on observing the physical group activities. Some studies explored about the use of technology to help researchers to record game dialogs. Interaction observations were recorded by computer-assisted tools (e. g. Nam, Lyons, Hwang,

& Kim, 2009; Severino & Messina, 2010). Those studies all indicated that communication is easy to observe and record with computers, but the on-line group interactions are less effective than face-to-face ones. There were some studies of adventure education using IPA to observe group members' interaction process. However, observations to the group interactions in the digital games were rare to find.

3. The digital game-based adventure education course

Tuckman (1977) thought the groups development go through stages sequentially, thus, the theory described the process in five stages. However, members' negative behaviors such as bad communications and misunderstandings in the storming stage would hinder group development. In this situation, group members had to face and solve their problems in order to move forward to the next stage, and thus become high-performance groups. Table 1 describes the individuals and groups situations for each stage of group development.

Table 1: Situations of group development in Tuckman's five stages (Tuckman, 1977)

	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 other.
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.

Two books about adventure education, "Experiential education- learning from 150 games" (Hsieh, Wang, & Chuang, 2008) and "Experiential education: theory and practice" (Kuo, Liao, & Shih, 2009), were used to identify suitable activities for the digital counseling games. The activities were designed to be conducted in groups of five members. The design of the digital game-based adventure education course was based on Tuckman's stages of group development. The five group development stages are described as follows.

Forming: Members meet each other for the first time. Everything is strange for them. The warm-up activities are chosen to let them share, communicate, and give opinions frequently so that the members can be familiar with each other. The initial group relationship is built by group members. The purpose of the first stage activity is to create group relationships, breaking fixed conceptions, and making reflections. The game which is chosen to digitize for this stage is Polar Bear and Hole (Figure 1). At the beginning, a story which provides hints for the task is presented in the game. The facilitator throws dices three times for giving hints. After that, members observe, discuss, and induce for correct answers following the logistics of the story.

Storming: The activities which need deep communications between members to finish the

missions are contained. In this stage, all members have to discuss the group problems with their internal dialogues and work together to complete the tasks. The group problems and personal weaknesses are improved by themselves. After this stage, groups can become high-performance teams. The purposes of the activities in this stage are cooperation, communication, respect, breaking fixed conception, problem-solving, trust, and reflection. Cooperative Puzzle (Figure 2) and Chessboard Maze (Figure 3) are used in this stage. In Cooperative Puzzle, three puzzle pieces out of total of fifteen puzzle pieces are distributed to each member. All five members in the group have to work together to assemble five equal-size squares with puzzle pieces. Members can exchange puzzle pieces with others without discussion. They can only give out puzzle pieces and may not ask from others. The purpose of the game is to make members pay attention to others' needs and realize their roles in the group. In Chessboard Maze, only one person can play at a time. Each member has to pass the 9x5 chessboard which is full of landmines with only one path. The member has to start over again when he goes through the wrong path. Every failure leads to point deduction. To generate gaming strategies together through members' experience, challenge obstacles, break fixed conceptions, and trial-and-error, and to build the trust between members are the goals of the game.

Norming: After the stage of storming, members start re-thinking about their relationships in the group. With communications, members start to trust each other. Members create greater effectiveness and achieve group goals more rapidly. The goals of the activities in this stage are communication, leadership, reflection, and cooperation. Moon Ball (Figure 4) is used in this stage. The ball is patted by group members to keep it in the air as long as they can. To train members to use strategies to cooperate with each other is the purpose of the game.

Performing: Members now are in great interactions and have skilled cooperative strategies after going through the frustrations and difficulties in the previous activities. The goals of the activities in this stage are trust, cooperation, leadership, communication, and reflection. Group Balance (Figure 5) is used in this stage. Three people are required to play the game. One member keeps his balance on the board and the other two members keep pushing the board upward on the two opposite sides until reaching the top. To increase members' cooperation strategies, reliance, and face the challenges are the purpose of the activity.

Adjourning: Group development process comes to the end. Members encourage each other and share their experiences. Having existing members to leave, new members to join, and start a new cycle, are the situations the members in the group must face. The goals of the activities are communication, trust, leadership, cooperation, and reflection. Calculator (Figure 6) is used in this stage. Thirty ladybugs are marked from numbers 1 to 30 in a garden on the screen. The goal is to catch the bugs serially as fast as possible. Five seconds would be added as punishments rules were violated. Four chances were given to each group and the best one would be the final score of the group. To train members to solve problems and communicate are the purposes of the activity. It strengthens group concepts and identifies their roles.

Those games in this study were devised for adventure education which required highly interactions and simulations. Therefore, Unity3D game engine was used to develop those games. With its great performance of simulation, members can become immersed as if they were in the real scene. The game engine also provides cross-platform publication such as IOS, XBOX360, Android, Web, Wii, and PC. Because physical activities vary, the digital games designed for this course had to be presented in different formats and platforms to fulfill the needs. Using Unity3D to make cross-platform games also saved time.

Figure 1. Polar and Hole

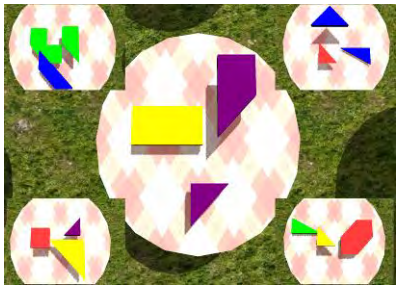

Figure 2. Cooperative Puzzle

Figure 3. Chessboard Maze

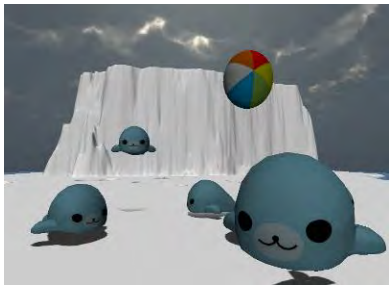

Figure 4. Moon Ball

Figure 5. Group Balance

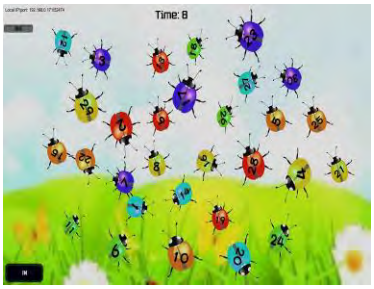

Figure 6. Calculator

4. Experimental Design

In this research, six digital games were included in the course that adults or teenagers were ideal targets for. Therefore, thirty college students aged between 19 and 25 from Taiwan were randomly recruited to participate in the course. The experiment was divided into three sessions in three different days. Two groups, with five members in each group, were guided by a facilitator to take the course in a day; the whole course lasted for six hours. Audio and video recordings were made during the experiment for later observations with Bales interaction process analysis (Figure 7).

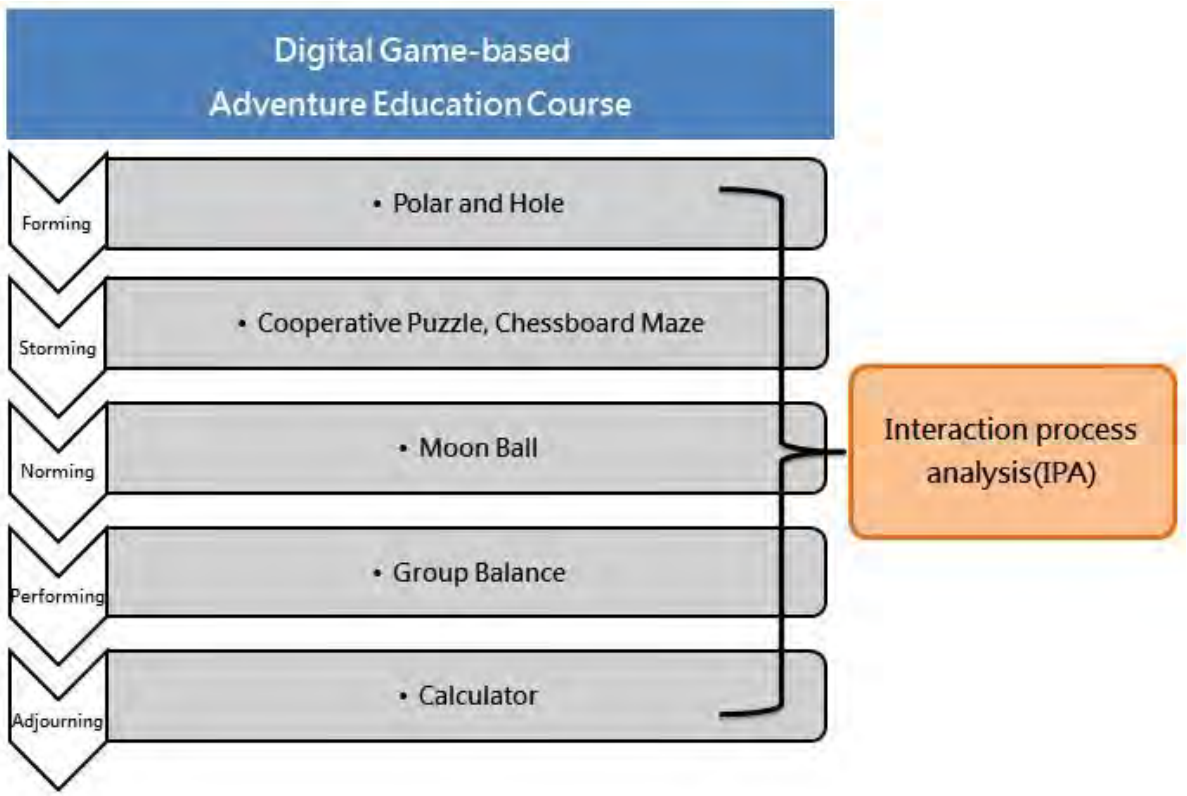

Figure 7. The flowchart of experiment procedure

According to IPA, members have to solve group problems in two dimensions. 1. Task dimension. The contents of dialogues were the situations which group members have to ask, solve, guide, order, and suggest. Task-oriented interactions were classified in this dimension. 2. Socio-emotional dimension. The contents of dialogues were the situations which concern the acceptances, coordination, conflicts, and opinions in group members. Socio-oriented interactions were classified in this dimension. During the process of group development, all interactions and dialogues were recorded according to the schemes stated in Table 2. With the data which are recorded by IPA, the group development problems can be resolved and identified (Bales, 1950).

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

Functional dimension	Content categories	Code

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
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
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. Research Results

The changes of interpersonal relationship of the group members were shown in this section. All the results were analyzed by encoding the dialogues occurred during the experiment sentence by sentence with Bales interaction process analysis.

According to Tuckman's thesis, groups had to go through four group development stages before becoming high-performance teams. Differences of values and concepts that caused conflicts between members occurred during the group development process. Those conflicts were solved after personal adjustments, interpersonal communication, leader's coordination, and members' compromises, and the groups would start to become effective ones. The needs for coordination and communication increased when the groups undergone the stage of storming. Facilitators should encourage the group timely when the groups hesitated. Facilitators played an important role in every stage of group development. Members reached consensus on mission completions or problems solving after the stage of storming. Therefore, the frequency of group interactions peaked at the stage of storming and started decreasing when the members were on the same wavelength at the stage of norming and performing.

The interactions of Group 1, 2, 3 and 4 were mainly distributed into the dimensions of positive reactions, attempted answers, and questions defined in Bales interaction process analysis in every stage of the course. The groups faced and solved the problems positively with positive communications, and caused less negative interactions that might affect the group developments. Negative reactions mostly occurred when the groups were solving the Chessboard Maze in the stage of storming. The frequency of negative reactions in stage of storming was more than other stages. It was because the game was designed to let the members experience frustrations and failures.

Although the distributions of interaction contents of all groups were similar, the frequency of interactions of Group 5 and 6 were much less than the former groups. These two groups finished the mission of Chessboard Maze in the stage of storming smoothly without a great amount of trials and errors that they had no chance to build up the cornerstone of positive interactions and group understanding. Consequently, the frequency of interactions of the activities in the stage of adjourning which need great understandings and strategies to get better scores sprang up to finish the work that should be done before.

The interaction frequencies of group 1, 2, 3 and 4 were shown in Figure 8. The frequencies of interactions of the four groups reached a peak in the stage of storming. After a great amount of adjustments, communication, and coordination, better scores were reached easily with excellent understandings to each other. The interactions of group 2 and 3 in Calculator in the stage of adjourning were more than in Chessboard Maze in the stage of storming. From the observations of the researchers, the reasons that caused the differences might be the lack of the explicit strategies and the guidance of a leader. The members needed further discussions on the execution of strategies to get better score in the stage of adjourning.

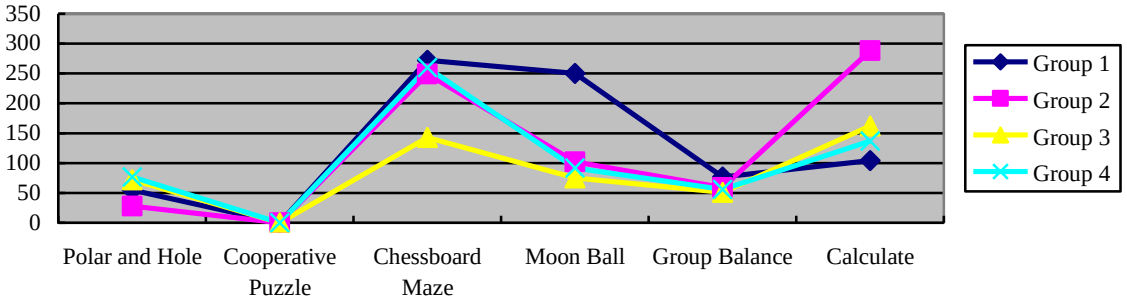

Figure 8: the line graph of interaction frequencies of Group 1, 2, 3 and 4.

As shown in Figure 9 below, the frequencies of interactions of group 5 and 6 in the stage of storming were lower than the former groups. The performances of the later stages would be affected without sufficient adjustments, coordination, and compromises in the stage of storming. Therefore, that would be worth discussing.

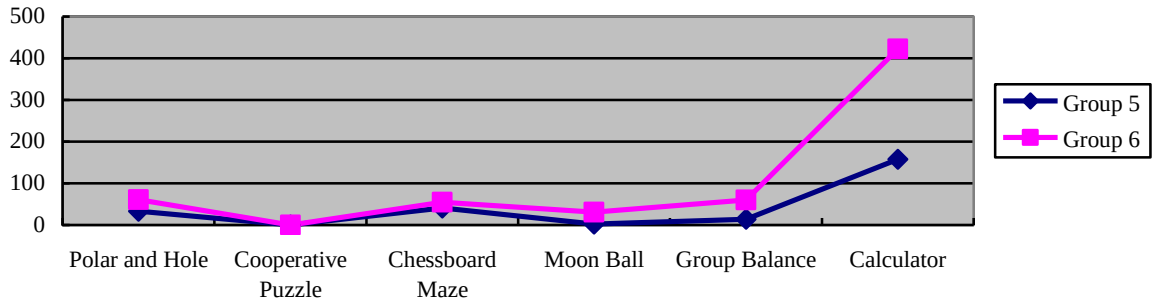

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Figure 9: the line graph of interactive frequency of Group 5 and 6

6. Conclusion

Six theory-based traditional adventure education activities that were difficult to be implemented due to limitations of bad weathers, restrictions of rules, and documenting problems were developed into digital games with Unity3D. Unlike commercial games, those digital games which were combined with Tuchman's stages of group development aimed to put considerations to provide joy to the learners, and at the same time to reach the purposes of adventure education. The research questions were set to observe the process as digital games were used as the medium of adventure education, and the interaction patterns of interpersonal relationships in digital game-based adventure education course.

The purpose of this study was to investigate whether the members in each group can turn strangers into a high-performance team after taking the course designed in this study. After the analysis by Bales interaction process analysis, the results showed that no matter how fast the group developed, all six groups had become positive high-performance teams after the course. Group development efficacy was heavily depended on the adjustments, communication, and coordination they experienced in the game.

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References

Baldwin, C., Persing, J. & Magnuson, D. (2004). The role of theory, research, and evaluation in adventure education. *Journal of Experiential Education*, *26*(3), 167-183.

Bales, R. F. (1950). *Interaction Process Analysis.* Chicago: University of Chicago Press.

Brown, M. (2006). Adventure education and physical education. In D. Kirk, D. Macdonald, & M. O'Sullivan (Eds.), *The Handbook of Physical Education* (pp. 685–702). London, England: Sage Publications Ltd.

Glass, J. S., & Myers, J. E. (2001). Combining the old and the new to help adolescents: Individual psychology and adventure based counseling. *Journal of Mental Health Counseling*, *23*(2), 101-114.

Hsieh, C. M., Wang, J. Y., & Chuang, H. W. (2008). Experiential education-learning from 150 games. Taiwan, Taoyuan: AAEE.

Hsu, Y. J., & Shih, J. L. (2013). Developing computer adventure education games on mobile devices for conducting cooperative problem–solving activities. *International Journal of Mobile Learning and Organisation*, *7*(2), 81-98.

Kuo, T. Y., Laio, S. H., & Shih, H. Y. (2009). *Experiential education: theory and practice*. Taiwan, Taichung: Far Du.

Nam, C. S., Lyons, J. B., Hwang, H. S., & Kim, S. (2009). The process of team communication in multi-cultural contexts: An empirical study using Bales' interaction process analysis (IPA). *International Journal of Industrial Ergonomics*, *39*(5), 711-782.

Severino, S., & Messina, R. (2010). Analysis of similarities and differences between on-line and face-to-face learning group dynamics. *World Journal on Education Technology*, *2*(2), 124-141.

Tuckman, B., & Jensen, M. (1977). Stages of small group development revisited. *Group and Organizational Studies*, *2*(4), 419-427.

Zmudy, M. H., Curtner-Smith, M. D., & Steffen, J. (2009). Student participation styles in adventure education. *Sport, Education, and Society*, *14*(4), 465-480.