The Influence of Using Movement-based Game Integrating Guided-Discovery Teaching Model in Safety Education

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The Asian Conference on Education 2016
Official Conference Proceedings

Abstract
According to Ministry of Health and Welfare, accident has led death, especially for young adults and children. The iBaby Website analyzed children's accidents and discovered that home, traffic and water are first three places that occurred accidental events and cause children's death. Although daily safety is scheduled in students' formal program, the class time is still insufficient and students do not have the opportunity to practice. Guided-discovery teaching emphasize that students will discover concepts by practicing and movement-based games can retain students' attention and motivation. In this study, Guided-discovery Teaching model will be adapted in a movement-based game to improve primary students' daily safety education. The differences in learning motivation will further be compared and analyzed. Keller's ARCS model was applied to evaluate learning motivation. The results showed that the participants in the experimental group were more motivated in learning especially in the attention, relevance, and satisfaction subscale. The results will be valuable when instructors want to adopt movement-based game technology in developing instructional materials.

Keywords: Guided-discovery teaching model, movement-based game, ARCS model

Introduction

According to Ministry of Health and Welfare in Taiwan (2013), accident has led death, especially for young adults and children. The iBaby Website (2016) analyzed children's accidents and discovered that home, traffic and water are first three places that occurred accidental events and cause children's death. Although daily safety is scheduled in students' formal program, the class time is still insufficient and students do not have the opportunity to practice. The research showed providing opportunities and preparing environments for students to practice in safety education improve their learning effects (Jiao & Chai, 2012).

The game-based learning environment focuses on learner-centered learning and enables students to practice as well as trial and error. Game-based learning could also maintain students' attention and further stimulate learning motivation (Hao, Hong, Jong, Hwang, Su, & Yang, 2010). Moreover, Coleman asserted that the children in the age of 6 to 12 are in their essential stage of learning motor skills (Ross & Mico, 1980). Movement-based games enable intuitive manipulation and participants control games by body movements instead of mouse and keyboards. It becomes easier to manipulate and to be involved in the game environments for primary students. Movement-based games have been used in motor skills and surgery training (Verdaasdonk, Dankelman, Schijven, Lange, Wentink & Stassen, 2009). However, game-based learning does not assure better learning effects than traditional teaching. It is important to obtain the balance of entertainment and education by adopting appropriate pedagogy (Becker, 2006).

Guided-Discovery Learning Theory is modified from Discovery Teaching Theory, which was brought out by Bruner (1966). The Theory emphasize on learner's discovery and thinking. Research stated that learning is time-consuming with low efficiency when the guidance was limited (Skinner, 1968). Elementary students need guidance and assistance when they learn (Songer, Shah, & Fick, 2013). Teachers need to guide their students to explore and analyze in the appropriate timing. The Guided-Discovery Learning Theory includes three steps of learning circle and they are discovery, concepts and application. Teachers need to prepared appropriate learning environment for students to discuss and experience. Concepts refer to providing essential concepts that students need to comprehend. Application focuses on students' application the concepts they learned in the new scenarios. Although there is research to confirm the positive learning outcome from this model (Huang, 2012). Applying the model in movement-based games is still very limited.

Motivation is usually a predictor of students' learning achievement (Jeamu, Kim, & Lee, 2008). The most commonly used model that measures individuals' motivation is Keller's ARCS model (Keller, 1987). The model includes four factors and they are attention, relevance, confidence, and satisfaction:

1. Attention: Instructional materials will gain attention from learners and lead learners to explore learning tasks if designed properly (Mayer, 2003; Huang, 2010). How the instructional materials stimulate and sustain learners' interest becomes essential in this factor.

2. Relevance: Learners usually will be motivated if the content is aligned with their prior experiences and learning goals (Keller & Suzuki, 2004). This factor measures the extent to which how the instructional materials meet a leaner's needs.
3. Confidence: Learner will be more motivated to make more learning efforts if they perceive their learning experience as successful (Bohlin, Milheim, & Viechnicki, 1990; Keller, 2008). The extent to which how a learner's feeling of personal control and expected achievement is essential in this factor.
4. Satisfaction: Learners will be motivated when they are satisfied with their learning experience (Rodgers & Withrow-Thorton, 2005). Learners' prior experience will also influence their learning satisfaction.

In recent years, Kellers' ARCS model has been applied to design and evaluate instructional materials in learning environments such as computer-based tutorial, interactive learning environment, and game-based learning (Astleitner & Wiesner, 2004; Bolliger, Supanakorn, & Boggs, 2010; Huang et al., 2010). However, limited research has been done on learning environment integrating movement-based game technology. Moreover, experimental research of investigating users' learning effect and learning motivation in the movement-based game learning environment integrating guided-discovery teaching model is also very limited. The purpose of this research is trying to bridge the gap and provide recommendations for practitioners and researchers who are interested in integrating guided-discovery teaching model and movement-based game in safety learning.

Methodology

This was a quasi-experimental research study and two intact classes were used. The research was conducted in an elementary school in northern Taiwan and 63 students participated. A total of 47.17% of them were male and 52.83% were female. All students in the research were required to learn through movement-based games. The content in the movement-based games were highly related to the course content to help participants understand and review what they have learned from the class. One class was randomly assigned as Guided-discovery movement-based game (GDMG) group, which used movement-based game technology based on Guided-discovery teaching model in the class. The other class was named as non-GDMG group and the course was taught by movement-based game only. Both classes were all taught by the same instructor with the same content.

The entire treatment lasted for four weeks. The participants were required to take a pre-test before the treatment and a comprehensive post test after the treatment to help investigate if there is significant difference in learning outcome and satisfaction among groups. Both pre and post tests were highly related to the course content. The tests were provided by the instructor and reviewed by content experts.

The Instructional Materials Motivation Survey (IMMS) was designed by Keller (2006) to investigate learners' level of motivation toward instructional materials. It contains 36 questions with 5-point Likert-scale items that measure learners' motivational reactions to instructional materials. The IMMS is considered a valid instrument and has a documented reliability coefficient of .96 (Keller, 2006). In this study, the survey was modified to find out how movement-based game technology and

Guided-discovery teaching model affects students' learning motivation and the survey was administered at the end of the study. The modified instrument includes 25 Likert-scale items ranging from 1(strongly disagree) to 5 (strongly agree). The questions included (a) seven questions about attitudes towards attention in GDMG and non-GDMG instructional materials; (b) seven questions regarding students' attitudes towards relevance in both types of instructional material; (c) five questions related to confidence of using instructional materials and learning; and (d) six questions regarding attitudes towards learning satisfaction in both types of instructional materials.

After collecting the survey data, Cronbach alpha coefficients were calculated to determine the instrument's internal reliability. The instrument had a reliability coefficient of .96. Reliability estimates for each category were satisfactory: (a) attention (a= .87), (b) relevance (a =.84), (c) confidence (a=.85), and (d) satisfaction (a =.86).

The purpose of this study was to determine if GDMG improves motivation in students' safety learning by investigate how movement-based game technology and Guided-discovery teaching model integration affected students' attitude of attention, relevance, confidence, and satisfaction towards learning.

Results and Discussions

Independent t-test was used to answer research question "Is there a significant difference in learning motivation including subscales such as attention, relevance, confidence, and satisfaction in students using GDMG or not?" The Motivation Survey regarding students' motivation towards learning after integrating GDMG was administered to the students at the end of the four weeks of study in order to answer this research question. The survey includes four subscales and they are: (a) the level of attention brought by the GDMG and non-GDMG instructional materials; (b) the level of relevance from the GDMG and non-GDMG instructional materials; (c) the level of confidence in learning; (d) the level of satisfaction from the GDMG and non-GDMG instructional materials.

1. ARCS: Attention

A composite score from questions 1, 6, 13, 15, 19, 22 and 25 was used to determine students' motivation in the attention perspective. Composite score ranged between 7 and 35. There was statistically significant difference in attention brought by the instructional materials between GDMG and non-GDMG groups ($t=5.86$, $df=61$, $p<0.01$). The 95% Confidence Interval indicates the true mean difference (3.57) may range from $3.18<\mu<6.43$. On average, participants in the GDMG group ($M=26.19$, $SD=3.83$) regards the instructional materials to be more attentive than the non-GDMG group ($M=20.24$, $SD=5.17$). The results are shown below in Table 1.

Types	Mean	Std. Deviation	N
GDMG	26.19	3.83	32
Non-GDMG	20.24	5.17	31
Total	23.26	5.26	63

Table 1. ARCS: Attention

2. ARCS: Relevance

A composite score from questions 4, 9, 11, 16, 18, 21, and 24 was used to determine the extent to which the instructional materials relate to learners' need and daily life. Composite score ranged between 7 and 35. There was no statistically significant difference in the level of relevance from the instructional materials between GDMG and non-GDMG groups ($t=1.21$, $df=61$, $p=.29$). The 95% Confidence Interval indicates the true mean difference (3.92) may range from $-.24<\mu<2.39$. On average, participants in the GDMG group (M=26.59, SD=3.73) regards the instructional materials to be as relevant as the non-GDMG group (M=20.25, SD=4.38). The results are shown in Table 2.

Types	Mean	Std. Deviation	N
GDMG	26.59	3.73	32
Non-GDMG	20.25	4.38	31
Total	23.44	4.05	63

Table 2. ARCS: Relevance

3. ARCS: Confidence

A composite score from questions 3, 5, 12, 17, and 23 was used to determine whether the instructional materials improve learners' confidence. Composite score ranged between 5 and 25. There was no statistically significant difference in the level of confidence between GDMG and non-GDMG groups ($t=1.27$, $df=61$, $p=.31$). The 95% Confidence Interval indicates the true mean difference (.78) may range from $-.46<\mu<1.92$. On average, participants in the GDMG group (M=17.29, SD=2.73) were as confident as those in the non-GDMG group (M=17.08, SD=3.48). The results are shown in Table 3.

Types	Mean	Std. Deviation	N
GDMG	17.29	2.73	32
Non-GDMG	17.08	3.48	31
Total	17.19	3.39	63

Table 3. ARCS: Confidence

4. ARCS: Satisfaction

A composite score from questions 2, 7, 8, 10, 14, and 20 was used to determine participants' satisfaction toward instructional materials. Composite score ranged between 6 and 30. There was statistically significant difference in learners' satisfaction after using the instructional materials between GDMG and non-GDMG groups ($t=3.16$, $df=61$, $p<0.01$). The 95% Confidence Interval indicates the true mean difference (1.92) may range from $.61<\mu<3.28$. On average, participants in the GDMG group (M=21.59, SD=3.37) regards the instructional materials to be more attentive than the non-GDMG group (M=18.41, SD=4.25). The results are shown below in Table 4.

Types	Mean	Std. Deviation	N
GDMG	21.59	3.37	32
Non-GDMG	18.41	4.25	31
Total	20.03	4.28	63

Table 4. ARCS: Satisfaction

The purpose of this study was to investigate the motivation of using movement-based game technology and Guided-discovery teaching model in safety learning. The findings of this study confirm that GDMG motivates learners' interest of learning safety in primary education. As for their motivation in learning, participants in the GDMG group have a more positive attitude towards attention, relevance, and satisfaction than those in the non-GDMG group. Many users asserted that GDMG improves their learning and are willing to use GDMG in the education field. These may lead to GDMG users' higher satisfaction with the instructional materials. From the motivation questionnaire, there were no significant difference in users' confidence for preparing exams, this may result from short treatment period and insufficient study time due to equipment issue. A better class arrangement and shorten calibration time is recommended for better performance.

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