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A Situated Cultural Festival Learning System Based on Motion Sensing

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ABSTRACT
A situated Chinese cultural festival learning system based on motion sensing is developed in this study. The primary design principle is to create a highly interactive learning environment, allowing learners to interact with Kinect through natural gestures in the designed learning situation to achieve efficient learning. The system has the following characteristics: the learning activities and contents are designed according to the key elements of situated learning theory; the system combines augmented reality with a real environment to provide story-based learning situations for learners. The Lantern Festival is used as the learning objective of this study, and 74 students from four third to fourth-grade level classes at Shanhua Elementary School in Tainan City were recruited as the study participants. In the experiment, the students were divided into a control group receiving traditional teaching and an experimental group that employed the system developed in this study. To assess the proposed system, questionnaire analysis and learning achievement assessment were conducted. The questionnaire includes situated learning, learning materials and operating interaction. The learning achievement was assessed by using the t-test for pre-test and post-test. The experiment shows that the system can indeed enhance users' learning interest and outcomes.
Keywords: situated learning, motion sensing, Kinect, game based learning, cultural festivals.

INTRODUCTION

The Microsoft's Kinect and Nintendo's Wii have changed human-computer interactions. In recent years, motion-sensing control technology is used for such interactions, with natural gestures and postures replacing mouses or touch screens. For example, Ghose, Chakravarty,

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State of the literature

- Kinect, motion-sensing control technology is used for such interactions, with natural gestures and postures replacing mouses or touch screens.
- Kinect is suitable for use in digital learning as a tool for human-computer interactions.
- Typically, interaction in festival learning is achieved through virtual reality or the display of relevant images. These ways are unable to increase learner interest by allowing learners to personally experience cultural festival activities.

Contribution of this paper to the literature

- This study developed a motion-sensing based system for learning Chinese cultural festivals by using Kinect and integrating situated learning to design objectives for users to engage in situational interactive learning using motion sensing and virtual objects.
- Through virtual animated stories integrated into real-life settings, the proposed system can enable students to interact with virtual characters as if learning in an authentic story setting, thereby assisting them with attaining learning objectives.
- According to the experiment, the system increased students' interest and sense of novelty toward learning, thereby improving their learning motivations and outcomes compared with those of students who were taught using traditional methods.

Agrawal, and Ahmed, N. (2013) proposed a system for unobtrusive automated indoor surveillance of subjects in indoor environment using the Kinect sensor. Villaroman, Rowe, and Swan (2011) suggested that the launch of Kinect and its functional class libraries have allowed Kinect to flourish in different areas, including the design of natural user interfaces. Lou, Wu, Zhang, Zhang, and Chen (2012) proposed using Kinect and Wii Remote to control Windows in a multi-user interactive system that can be either desktop- or wall-sized. Such systems use the sensors in Kinect and Wii Remote to collect data from gestures, providing users with more precise control and a relatively natural experience. The aforementioned studies show that Kinect is an effective somatosensory interactive tool.

China has a long history during which numerous colorful festivals have been established, such as the Chinese New Year, Lantern Festival, Tomb Sweeping Day, Dragon Boat Festival, etc. These festivals are all cultural assets passed down from generation to generation. To explore how information technology can supplement teaching about festivals, Chen (2012) proposed an informal virtual learning system for studying the famous ancient painting Along the River during the Qingming Festival. This system used innovative multi-screen projection and interactive technology. Gouzouasis and Henderson (2012) examined the musical and educational outcomes of secondary students resulting from participation in band festivals, showing that participation in band festivals increased cognition and learning experiences among the students. In addition, students viewed band festivals as a positive learning experience, and overall, the social aspect of band festivals had a positive influence on adolescents. Participating in music festivals is motivational for and has a positive emotional impact on students, in which a satisfactory musical performance stimulates student pride and the sense of accomplishment.

Although Kinect is an effective interactive tool, the related research for applying Kinect to festival learning was not found, in the latest literatures. Typically, interaction in festival learning is achieved through virtual reality or the display of relevant images. Therefore, the primary objectives of this study are to determine how students can improve their learning outcomes by using highly interactive methods to learn about festivals. We shall use the interactive motion sensing controls of Kinect and the theory of situated learning as a basis for developing a Kinect-based cultural festival learning system. In other words, this system integrates Kinect's motion sensing capabilities and situated learning design to create a somatosensory Chinese festival learning activity for highly interactive learning. The research questions that guided this study are as follows:

(1) Does the developed system have the significant influence on the learning outcomes of learners?

(2) Does the situated learning have the significant influence on learning situation of learners?

(3) Does the interactive motion sensing controls of Kinect have the significant on learning motivations of learners?

LITERATURE REVIEW

Kinect

Kinect is a motion sensing input device used in the Xbox 360 console, which consists of four major components: an RGB camera, 3D depth sensors, a multi-array microphone, and built-in processing cores (Kinect for Windows) (Kinect for Windows, 2014). It can capture user limb movements and facial expressions and recognize voice commands; thus, users can employ gestures or voice commands to operate the Xbox system interface without having to use a handheld remote or pedal controllers.

In recent years, Kinect has been applied in numerous fields such as elderly care (Zhang, Conly, and Athitsos, 2015; Ofli, et al., 2016), anthropometrics (Clarkson, Wheat, Heller, & Choppin, 2016) and digital learning. By applying Kinect to digital learning, Tsai, Kuo, Chu, & Yen (2015) focus on developing the Kinect sensorassisted game-based learning system with ARCS model to provide kinesthetic pedagogical practices for learning spatial skills, motivating students, and enhancing students' effectiveness. They conclude that the Kinect sensor-assisted learning system promotes the development of students' spatial visualization skills and encourages them to become active learners. Cheong, Yap, Logeswaran, and Chai (2012) designed a cost-effective technology (including a multi-touch interactive whiteboard and a teaching station) to enhance the learning environment of a classroom. Their innovative use of a Kinect camera was based on Kinect's ability to send a fixed speckle pattern to a plane, track the reflected infrared light sources, and carry out the necessary processing to achieve an interactive multi-touch surface. Preliminary test results of the system indicated superior operability and interactivity compared with those of traditional computers. Chye and Nakajima (2012) developed a game-based learning system, enabling users to learn martial arts through games. Martial arts emphasize bodily movements; thus, this system can acquire relevant information through Kinect sensors. Subsequently, Chye and Nakajima evaluated their system using precision analysis, achieving a 100% user detection rate and high accuracy, but low precision. They therefore regarded Kinect as a suitable replacement for wearable sensors, asserting that it can be used in their proposed system through appropriate adjustments and arrangements. Lee, Huang, Wu, Huang, and Chen (2012) proposed a near-authentic environment in which students learn to use body movements, and analyzed how this learning technology can improve the learning motivation and outcomes of students.

Based on the aforementioned studies, Kinect is suitable for use in digital learning as a tool for human-computer interactions. The traditional activities of Chinese festivals (e.g., the Lantern Festival), including dragon or lion dances, releasing sky lanterns, bombing Han Dan, setting off beehive fireworks, and carrying lanterns, are essential in Taiwan. These engaging activities involve extensive physical movement, which encourage participation, and conform to motion sensing characteristics. Therefore, this study adopted Kinect as an interactive device for students to learn about cultural festivals.

Cultural Festivals

The related research on and application of Chinese culture has typically employed teaching materials in Chinese and few studies have investigated Chinese cultural festivals using digital teaching materials. We analyzed and compared Web sites relevant to Chinese cultural festivals (Chinese Festivals and Culture, 2014; Huayu World: Taiwanese Festivals, 2014; Huayu World: Chinese Festival Notes-24 Weather Market, 2014) and found the following four deficiencies: although these Web sites focus on digital learning materials related to Chinese festivals, they all contained incomplete information; their materials are comprised of text descriptions, images, and simple animations and lack interactivity; they lack a context for increasing user-Web site interaction; and they are unable to increase learner interest by allowing learners to personally experience cultural festival activities. Therefore, these deficiencies inspired us to conduct this research.

Situated Learning

Situated learning was proposed by Dewey (1938) who believed that knowledge is related to a social context, but not solely to the object within the context; it is gained through the process of continuous interaction within the context. Many scholars have proposed definitions for the composition of situated learning. For example, McLellan (1996) proposed the following eight key components of situated learning: stories, reflection, cognitive apprenticeship, collaboration, coaching, multiple practices, articulation of learning skills, and technology.

In one previously developed application, Ting, Tzu, Gwo, and Hui (2008) used radio-frequency identification to develop a context-aware learning system based on situated learning, in which portable equipment, sensors, and wireless networks were used to achieve ubiquitous learning. The system was implemented in a learning environment during a natural science activity on butterfly ecology; it guided students to observe natural phenomena, which facilitated effective learning. Yoau, Shu, and Hong (2011) investigated "combined situated learning with E-learning" and established an online traffic rule situational E-learning system. After experimental teaching, they conducted a questionnaire survey. By statistically analyzing data, they demonstrated that the achievements and motivation of experimental group students who received combined situated learning with E-learning were significantly higher than those who were taught using traditional methods.

The situated learning design in this study is based on the eight key components proposed by McLellan (1996). Through virtual animated stories integrated into real-life settings, the proposed system can enable students to interact with virtual characters as if learning in an authentic story setting, thereby assisting them with attaining learning objectives.

SYSTEM DEVELOPMENT

System Environment

In this study, a Kinect-based situated learning system for educating learners about cultural festivals is developed; this system comprises the user- and server-end, as shown in Figure 1. On the user-end, users connect to a PC, on which the developed learning system is installed using Kinect, to engage in somatosensory learning about cultural festivals. Furthermore, users can review their learning portfolios on PCs. On the server-end, the backend database stores learning videos, relevant information, and user learning portfolios for users to access when needed.

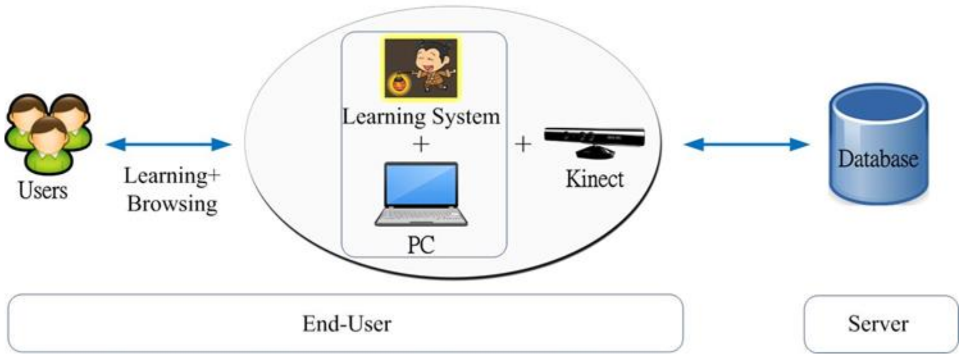

Figure 1. System Environment

System Architecture

The architecture of the system developed in this study includes three components: the Kinect somatosensory learning tool, graphical user interface (GUI) for learning and browsing, and databases (**Figure 2**):

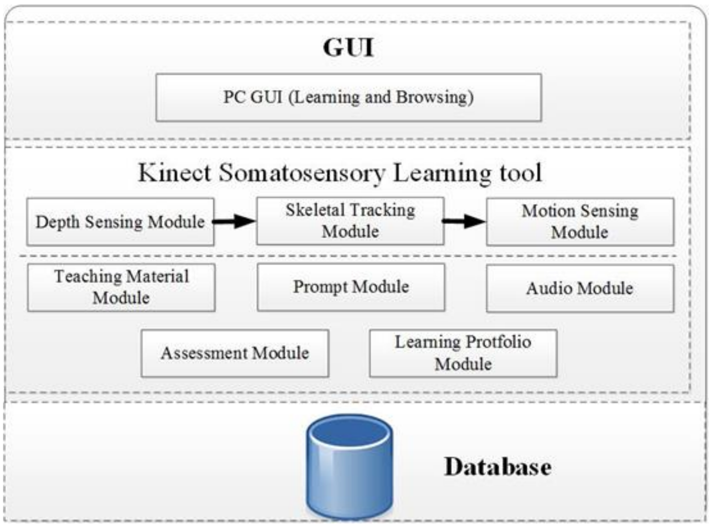

Figure 2. System Architecture

(1) GUI for Learning

PC GUI is the system's graphical interface on computers, through which users can learn and browse by using the Kinect interactive tool.

(2) Kinect Somatosensory Learning tool

This tool is used to acquire and process data relevant for users during learning activities. The functions provided by this tool are as follows:

- Depth Sensing Module: This component acquires the depth and location within a measurement space to ascertain the current location of the user.
- Skeletal Tracking Module: This module processes depth images to establish the coordinates of users' body joints, such as hands, head, and torso.
- Motion Sensing Module: This module receives images detected by Kinect and generates a depth image using light coding technology.
- Teaching Material Module: This module displays teaching material to the user in text, images, audio, or video formats.
- Prompt Module: This provides related explanation during learning.
- Audio Module: This module provides related audio during learning.

- Assessment Module: This module assesses users' learning outcomes based on data regarding their learning activities.
- Portfolio Module: Information related to the learner's learning process is recorded by this module, including the date of use, the learning process and the learning scores. These records are stored in the database so that learners can directly connect to the web to observe their own process.

(3) Database

Video recordings of users during their learning activities and relevant information are stored in the database for subsequent learning outcome assessments, which enable users to be aware of their learning progress.

Situated Learning Design

We designed the proposed situated learning in the system based on the eight key components proposed by McLellan.

(1) Stories: Building virtual people with real or virtual scenes into learning materials to allow learners to more easily adapt to the context of the story.

(2) Reflection: After a learner completes the learning part of a course, a learning test is offered to the learner, providing space for reflection.

(3) Cognitive apprenticeship: Providing demonstration activities with dynamic images to act as a learning reference for learners.

(4) Collaboration: The modules are equipped with an instant messaging function. If the leading story is given for a period of time and the learners do not discover the learning objectives, they are reminded to enter the interactive area and to interact with other learners to ask for advice. In addition, a one or two player game is designed allowing two learners to carry out the interactive learning together during the activity.

(5) Coaching: The learning sequence of the course depends on the learners. The learning prompts for each learning unit are provided and the researchers provide assistance if necessary.

(6) Multiple practices: After a learner completes a course, the module provides a relevant test so that the learner can understand the result of their learning. After scoring, the learner can rapidly return to the questions and take the test again.

(7) Articulation of learning skills: The 3D animation, images, audio, stories, tests are provided to learners successively. Therefore, the learners know how to obtain knowledge and access all the functions presented to the users at one time.

(8) Technology: The Kinect 3D animation learning tools are provided to enhance the learners' telepresence.

Learning Materials Design

The theory of situated learning was used to design the learning materials and to construct comprehensive learning objectives and content. The learning objective of this study was to understand the Lantern Festival, which contains five components, as shown in **Figure 3.**

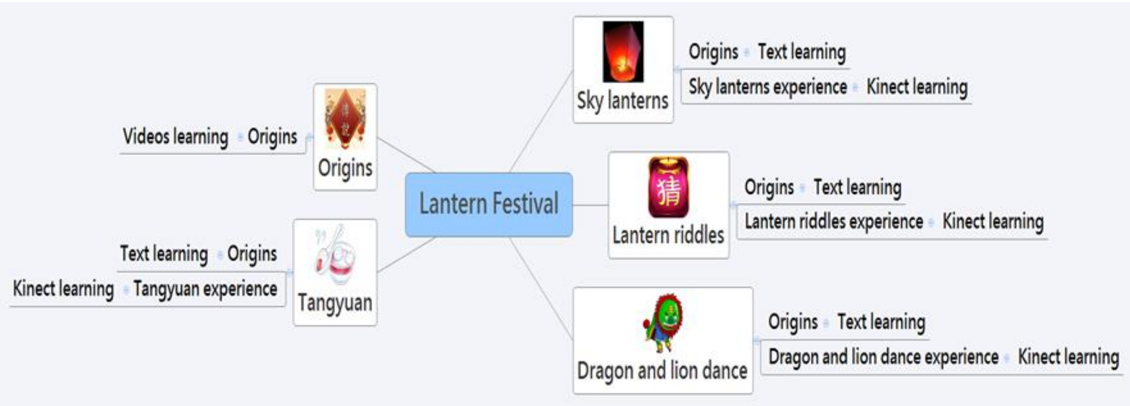

Figure 3. Learning Materials

(1) Origins: Educational videos on the origins of the Lantern Festival are designed.

(2) Sky lanterns: This component includes an introduction to the origin of sky lanterns and experiences of releasing sky lanterns. The learning contents are as follows:

- Textual descriptions on the origins of releasing sky lanterns are provided for students.
- A situational description is provided for users to complete logical-mathematical problems (presented on the sky lantern) on the screen.
- Once the problem is solved, the sky lantern ascends, during which users can control the ascending speed of the sky lantern by performing stepping motions.
- Scores are assigned when the lantern successfully reaches its destination; the system records the users' times and scores.

(3) Tangyuan (sticky rice dumplings): This component introduces the origin of tangyuan and allows users to experience how tangyuan are made. The learning contents are as follows:

- Textual descriptions on the origins of contemporary tangyuan making are provided to students.
- A situational description is provided for users to solve logical-mathematical problems.

- To achieve scores, users must use a specific hand gesture to assist the virtual character in completing its task; the system then records the users' times and scores.

(4) Lantern riddles: This component provides an introduction to the origin of lantern riddles and allows users solve lantern riddles. The learning contents are as follows:

- Textual descriptions on the origins of lantern riddles are presented to students.
- A situational description presenting a lantern riddle appears on the game interface.
- Users must select the correct answer to the riddles; the system then records the users' times and scores.

(5) Dragon and lion dance: This component includes an introduction to the origin of dragon and lion dance and experiences of Dragon and lion dance.

- Textual descriptions on the origins of dragon and lion dance are provided for students.
- A situational description is provided for users to complete the experiences of dragon and lion dance. The main somatosensory learning activity is a one or two player ball game. When the game starts, a ball will start falling from the main screen and the learner must touch the ball with his left hand or right hand. When the hand touches the ball, the ball will bounce up to the top and then descend; in addition, the score pluses 1 point. The game will continue to repeat this process. The game time is limited to 30 seconds. When the ball drops outside of the play area or the time is up, the game is over. When the game starts, the number of falling balls is the same with the number of players.
- Scores are assigned when the activity ended; the system records the users' times and scores.
- Learning situation assessment: after completion of the activity unit, the system will display and record the learners' learning situation, containing the scores and times.

System Interface

The learning interface contains the following four parts as shown in **Figure 4.**

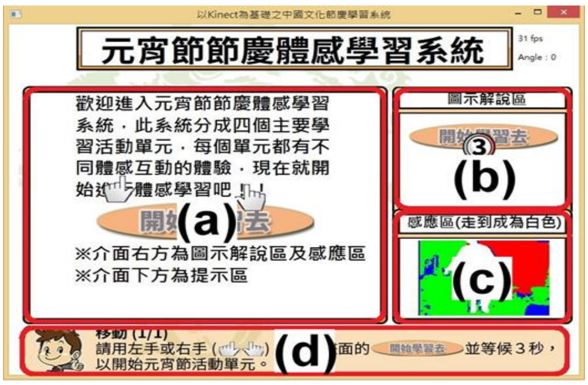

Figure 4. System Interface

(a) Learning activity area: Learners learn and interact with virtual objects in this area.

(b) Action prompt area: This area provides dynamic motion to act as the reference for the current learning activities.

(c) Sensing area: This area displays whether the learner has entered the correct sensing range. When the body's color in the sensing area is identified to be white, it means that the learner can begin to learn.

(d) Tips area: This area provides the text and audio guide for the current learning activity.

For example, when a learner enters the sky lantern learning unit, the related text and audio situated story is displayed to the learner as shown in **Figure 5**. After the learner understands the origin of sky lantern, the learner then enters the somatosensory learning through bodily/kinesthetic motion as illustrated in **Figure 6**. The learner must bring both hands up and down in a swinging motion to raise the sky lantern to the sky.

Figure 5. Text and audio introductions of sky lanterns

Figure 6. Learning about sky lanterns through somatosensory learning

When a learner enters the tangyuan learning unit, the related text and audio situated story is displayed to the learner as shown in Figure 7. After the learner understands the origin of tangyuan, the learner then enters the somatosensory learning through bodily/kinesthetic motion as illustrated in Figure 8. The learner must bring both hands in a specific hand gesture to make tangyuan.

Figure 7. Text and audio introductions of tangyuan

Figure 8. Learning about tangyuan through somatosensory learning

Development Tools

The hardware and software used to develop the system are described as follows: As for the hardware, we use notebooks (Acer Aspire E5-571G), Kinect and a projector are used. For software, this study uses Visual Studio 2012 C#, Microsoft SQL Server 2012, Kinect for Windows SDK Beta, Microsoft Windows 8.1 and SPSS 19.0.

EXPERIMENT AND RESULTS

Due to the constraints in human resources and time, to evaluate the effectiveness of the developed system, an experiment was conducted with participants from two third-grade classes and two fourth-grade classes at Shanhua Elementary School in Tainan City, comprising a total of 74 students. These students were divided into a control group which was taught using traditional learning methods and an experimental group which used the system developed in this study, where each group contains one third-grade class and one fourth-grade class. As the selected school uses heterogeneous grouping, the two groups had the same learning experience.

Experimental procedure

The steps of the experiment are as follows: the experimental time for each learner is about one hundred minutes.

Step 1. The motivation and purpose of this study was explained to each group. This phase took 10 minutes for each group.

Step 2. Each group completed the pre-test. This phase took 15 minutes for each group.

Step 3. Learners in the experimental group were taught how to use the proposed system, which took approximately 10 minutes.

For the control group, the basic course information was explained, which took approximately 10 minutes.

Step 4. For the experimental group: the learners learned to use the system, which took approximately 40 minutes for each learner as shown in Figure 9.

For the control group: the learners learned in the traditional manner, which took approximately 40 minutes.

Step 5. Each group completed the post-test, which took approximately 15 minutes for each group.

Step 6. For the experimental group, the 37 learners completed the questionnaire, yielding a 100% return rate, which took approximately 10 minutes.

For the control group, the learners shared their learning experiences, which took approximately 10 minutes.

Figure 9. The experimental group's somatosensory learning

Measurement tools

A pre-test and post-test were used to assess the learning outcomes of the students. The pre-test comprised 10 selection items, giving a full score of 100. The post-test also comprised 10 selection items, giving a full score of 100. Both the items of the pre-test and post-test were designed by a domain expert.

A questionnaire with a five-point Likert scale was also used to measure the effectiveness of the proposed system. There were 7 questionnaire items for the "situated learning" dimension, 4 questionnaire items for the "learning materials" dimension and 6 questionnaire items for the "operating interaction" dimension.

Results

Learning outcome

As follows, a paired samples t-test and independent samples t-test are used to assess the learning outcomes of the experimental group and control group, respectively.

Table 1 shows the paired samples t-test results of the pre-test and post-test for the experimental group, in which the t-value is -6.687 and the p-value is .000 (<0.001). This shows that the difference between pre-test and post-test scores is quite obvious.

Table 1. Paired samples t-test results of the pre-test and post-test for the experimental group.

Experimental group	NO.	Mean	SD	t
Pre-test	37	62.16	17.018	-6.687
Post-test	37	80.27	10.668	

***p<0.001

Table 2 shows the paired samples t-test results of the pre-test and post-test for the control group, in which the t-value is –4.793 and the p-value is .000 (<0.001). This shows that the difference between pre-test and post-test scores is quite obvious.

Table 2. Paired samples t-test results of the pre-test and post-test for the control group

Control group	NO.	Mean	SD	t
Pre-test	37	63.78	16.219	-4.793
Post-test	37	73.24	12.705	

***p<0.001

The measure the difference between the two groups, in terms of the post-test results of the learning outcome, an independent-sample t-test was also analyzed. **Table 3** shows the result of the analysis, in which the t-value is -2.576 and the p-value is .012 (< .05). This shows that the two groups both made significant progress, but the improvement made by the learners in the experimental group was much more significant than that of the control group. Therefore, the developed system has the significant influence on the learning outcomes of learners.

Table 3.The difference between the two groups, in terms of the results of the learning effectiveness post-test

Post-test	NO.	Mean	SD	t
Experimental group	37	80.27	10.668	-2.576
Control group	37	73.24	12.705	

*p<0.05

Questionnaire analysis results

(1) Reliability Analysis

Concerning questionnaire reliability, the Cronbach's α coefficient was used to measure the internal consistency of the scale. A coefficient value α of 0.7 or above indicates high reliability. Reliability analyses of the various dimensions all showed an α of 0.7 or higher (Wagner, 2007). The Cronbach's α values for the above three dimensions were 0.872, 0.859 and 0.857, respectively, and the α of the overall scale was 0.937, as shown in **Table 4**, confirming the reliability of the questionnaire.

Table 4 Questionnaire reliability analysis

Dimension	Number of questions	Cronbach α
Situated learning	7	0.872
Learning material	4	0.859
Operating interaction	6	0.857
Overall	17	0.937

(2) Descriptive Statistical Analysis

Analysis of the average score and standard deviation further applied according to the dimensions and the corresponding items. For standard deviation, the larger the standard deviation, the lesser the users' agreement with the items asked. However, smaller standard deviation indicates that there is greater user agreement with the items asked. In this study, the standard deviation is set as 1, in accordance with previous study (Chen, Chiu, Huang and Chang, 2011). That is, if the standard deviation is greater than 1, users agree less with the items asked, but if the standard deviation is less than 1, users are in greater agreement with the items asked.

The results of the analysis of the situated learning dimension are shown in **Table 5**, where the total average of the mean and the standard deviation are 4.637 and 0.653, respectively.

Table 5. Statistical analysis of the situated learning dimension

NO	Question Items	Mean	SD
A1	Situated learning caught my curiosity.	4.702	0.520
A2	Situated learning enabled me to remain highly focused while learning.	4.540	0.691
A3	Situated learning enabled me to learn at ease.	4.676	0.626
A4	I found the situated learning method highly entertaining.	4.730	0.560
A5	Situated learning enabled me to identify my learning problems.	4.568	0.801
A6	Situated learning improved my learning outcome.	4.622	0.545
A7	Situational learning attracted me to learn actively.	4.622	0.828
Average		4.637	0.653

The results of the analysis of the teaching materials dimension are shown in **Table 6**, where the total average of the mean and the standard deviation are 4.649 and 0.606, respectively.

Table 6. Statistical analysis of the teaching materials dimension

NO	Question Items	Mean	SD
B1	The teaching materials were rich in content.	4.676	0.626
B2	The content of the teaching materials was clear and easy to read.	4.541	0.605
B3	The content of the teaching materials was something that I could use.	4.649	0.633
B4	The related knowledge provided in the learning materials could help me learn.	4.730	0.560
Average		4.649	0.606

The results of the analysis of the operating experience dimension are shown in **Table 7**, where the total average of the mean and the standard deviation are 4.626 and 0.644, respectively.

Table 7. Statistical analysis of the operating interaction dimension

NO	Question Items	Mean	SD
C1	The system's operation interface was very clear.	4.568	0.728
C2	The system's operation interface was easy to use.	4.648	0.588
C3	The system's operation interface triggered learning motivation.	4.622	0.721
C4	It was convenient to engage in learning using the Kinect operation mode.	4.676	0.580
C5	The system could correctly complete the action I made.	4.649	0.484
C6	The system could help me learn even more easily.	4.595	0.762
Average		4.626	0.644

Discussion

In the questionnaire, the average of the mean is larger than 4.6 and the standard deviation is smaller than 1 for each dimension. This means that the learners gave high affirmation of the proposed system, and good reviews of this kind of learning. That is, the situated learning has the significant influence on learning situation of learners and the interactive motion sensing controls of Kinect also has the significant on learning motivations of learners.

In the proposed situated learning, the two items with the highest and second average scores among all of the question items are "I found the situated learning method highly entertaining", and "Situated learning caught my curiosity", and their corresponding scores were 4.73 and 4.70, respectively, for the above items. Therefore, the two key components "Story" and "Technology" can indeed enhance the learners' learning interesting and motivation. Item "Situated learning enabled me to learn at ease" is the fourth score among all of the question items. The three key components "Coaching", "Cognitive" and "Multiple practices" can be very easy and stress-free learning for learners. This can also be verified from the observation and score of sticky rice dumplings, which is one of the somatosensory activity. Because in the activity, learners obtained great progress through the guidance, constant practice and peer competition. In the somatosensory activity of dragon and lion dance, 36 learners are divided into 18 groups, each group has 2 learners and proceeds the 2-player ball game. Most of the groups get the good scores under the prompt of system and mutual collaboration. For example, the scores of learners 1and 2 are 14, 21 respectively in 5th group and the total score is 35; the scores of learners 1and 2 are 11, 13 respectively in 8th group and the total score is 24. But there are five groups failed to effectively achieve collaboration. For example, the scores of learners 1and 2 are 15, 1 respectively in the first group and the total score is 16; the scores of learners 1and 2 are 11, 0 respectively in 12th group and the total score is 11. In the future, the key component "Collaboration" which concepts and methods can be further integrated into the situational activities.

CONCLUSION

The paired samples t-test and independent samples t-test are used to assess the learning outcomes of the experimental group and control group. The paired samples t-test results of the pre-test and post-test for the experimental and control groups all show that the differences between pre-test and post-test scores are quite obvious. However, the difference between the two groups, in terms of the post-test learning outcome results show that the two groups both made significant progress, but the improvement made by the learners in the experimental group was much more significant than that for the control group.

This study developed a motion-sensing based system for learning Chinese cultural festivals by using Kinect and integrating situated learning to design objectives for users to engage in situational interactive learning using motion sensing and virtual objects. According to the experiment, the system increased students' interest and sense of novelty toward learning, thereby improving their learning motivations and outcomes compared with those of students who were taught using traditional methods.

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