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Improving Teachers' Information Communication Technology (ICT) Pedagogical Practices by Infusing Gesture-based Technology (GBT) into Classroom Teaching

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Abstract **– Leap Motion is a kind of gesture-based technology (GBT) equipment which can give a lot of activities to classroom teaching process. In this paper, a teaching study based on Leap Motion was conducted to test the effect of Lea3p Motion on classroom teaching. The ADDIE model was used to conduct all the research, and a comparative experimental method used in which the teachers divided into an experimental group and a control group. During the analysis, quizzes and questionnaires demonstrated that these two groups show suitable performance on Information Communication Technology ability achievement tests; however, the experimental group`s teachers performed much better than the control group`s teachers. During the data analysis, it found that the Leap Motion teaching process can increase teachers` ICT pedagogical practice in five areas: ICT literacy, instructional design, instructional organization, instructional evaluation, and professional development.**

Keywords **– Geture-based Technology; Information Communication Technology; Classroom Teaching Process; Leap Motion; Pedagogical Practice.**

I. INTRODUCTION

Gesture-based technology (GBT) is a kind of popular technology to enhance human`s kinesthetic activity, particularly in the entertainment field. This technology has a variety of applications. Currently, there are three mainstream devices gamer teenagers' attention: Sony`s Play Station Move, Microsoft`s Kinect, and Nintendo`s Wii [1].

As with Virtual Reality (VR), GBT is also a highly promising technology for both training and simulation [2]. A reason to use GBT is that it can enhance teaching and learn [3]. GBT can also improve the development of humans' physical, cognitive, emotional and social feelings [4]. However, this research will not focus on PS Move, Kinect, or Wii.

Popular GBT currently also has many technical constraints [3]. Teaching processes need a smooth procedure, which is a serious operating problem for Kinect; however, the teaching method based on Kinect will result in wasted instruction time. Based on the information described above, an appropriate GBT is the key to enhancing the classroom teaching process and teachers` ICT pedagogical practice.

II. LITERATURE REVIEW

A. Leap Motion

Leap Motion is a type of GBT equipment that was designed by a new corporation. As an alternative to a mouse, Leap Motion is a hardware sensor device that supports hand and finger motions to interact with the computer without physically touching it. Compared with the above three entertainment devices, Leap Motion has certain strengths: This device is easy to use in many personal computer operating systems (e.g., Windows, OSX, and Linux) [5]. In addition to the entertainment purpose, this device has many educational applications [6], and it can quickly grasp one's gesture motion [7].

The strengths of Leap Motion mean it has a strong future for teaching and learning [3][5][8]. Leap Motion allows 40 cm of space in the front for users; therefore, it can immediately detect any hand or finger motion to control any item on the computer screen. Nevertheless, Leap Motion also has certain weaknesses, such as the connect line limit and easy loss of the tracking point. Accuracy is a large problem for Leap Motion [5][9] that has not yet been solved; this will reduce students` motivation to attempt to use this great device. Therefore, certain educational teaching tools are needed to compensate for Leap Motion`s weaknesses.

The technical traits of Leap Motion are naturally aligned with the teaching and learning process [5]. The Leap Motion controller originated from the design of grasp sensor technology; therefore, it has a suitable gesture-accurate function, which is easy for teachers to use in teaching and for student learning. Additionally, Leap Motion can control a computer`s operation without using the keyboard and mouse [10].

B. Teachers` ICT Ability

The Chinese office of the Ministry of Education published the teachers` ability standard in information technology in primary and secondary schools to provide an ICT ability standard for elementary school teachers. The standard includes five areas that are critical components of teachers` pedagogical practice.

1) Instructional Design by ICT:

The effective integration of ICT into teaching and learning is very important for teachers` pedagogical practices. However, when teachers use ICT in the teaching process, teachers seldom follow linear instructional design; this cannot be the best use of ICT in the classroom [11].

Because the control method of Leap Motion is that it tracks one's hand, hand motion and finger positions; this can hugely influence by the body`s physical training [12]. GBT can combine with Virtual Reality technology to improve simulation learning for students [13]. There is a research project, Seek, and Sign, which has used Leap Motion to support teenagers who have a hearing problem in learning sign language and in cognition development [14]. Because Leap Motion has the above strengths for students`

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physical learning, teachers need to redesign their pedagogical practice.

2) Instructional Organize by ICT:

An excellent pedagogical ICT not only has a creative instructional method but also can apply instructional organization to structure teaching. Therefore, how does one effectively organize the work of instructional design? Stephanie A., et al. (2008) indicated that tools and techniques are necessary to complete instructional design projects [15]. These tools or techniques are project management tools that will help assure students can complete the given task. Muhammad S. H. (2014) also indicates that the members need to educate in a cooperative capacity [16]; this is necessary to enable people who are involved in a cooperative group to pool their resources and knowledge to meet their needs individually. The Leap Motion technology can provide students with an opportunity to cooperate with each other during the teaching process, and Leap Motion can provide an instructional model to enhance autonomous collaboration [17].

3) Instructional Evaluate by ICT:

Any research needs to evaluate the experiment`s effects, students` thoughts, or technology`s functions if scholars want to justify their conclusions [18][19][20]. An effective evaluation method needs to test people`s feelings, that is, their moods, feelings, and affections regarding the teaching process. Researchers have created an experiment for a human motion for musical control and expression using Leap Motion [8][21]. During their teaching processes, teachers have found that Leap Motion can provide positive effects for students such as increased attention, independence and motivation [8].

4) Teachers` Professional Development by ICT:

In addition to the subjects, there is a very close relation between ICT and the professional development of teachers [22][23][24]. The growth of Information and Communication Technologies (ICT) has added new options for teachers' professional development [25], but there is also need to enhance pedagogical practices for all teachers regarding how to integrate ICT in teaching and to learn [26]. As a new emergent GBT, Leap Motion can smoothly integrate into the teaching environment and help teachers with speech (Kessler, 2013) because Leap Motion associated with speech and gestures due to its special control method [17].

C. Research Questions

Regarding Leap Motion and the relation between Teachers` ICT ability and Leap Motion, as described, few scholars have conducted an advanced experiment or theoretical research. There are certain research problems regarding Leap Motion, as listed below:

- What type of Leap Motion technology portfolio is the most effective for teaching?
- How does one integrate Leap Motion into the classroom to improve teachers' pedagogical practice?
- Can the process of using Leap Motion during teaching increase teachers' ICT ability?

III. LEAP MOTION TEACHING PROCESS

D. Design Leap Motion Teaching Process

The teaching process based on the technology of Leap Motion is also a type of instructional design process because Leap Motion is a GBT that cannot use in the pedagogy process alone. Instructors need highly efficient guidelines to improve the impact of the teaching process using Leap Motion. Regarding instructional design, the ADDIE model is an excellent method to develop instructional resources and a technology design method [27].

The ADDIE model includes five elements, or circle processes: analysis, design, development, implementation, and evaluation. This research will apply Leap Motion in the teaching process alone and with the above five design processes.

1) Analysis

The purpose of this research is to improve the ICT pedagogical practices of elementary school teachers; therefore, the objects of the teaching process are elementary school teachers. Currently, the elementary school teachers have the strong practical ability in the ICT application; many have grasped the technology and had the motivation to use the technology in their teaching process. Unfortunately, teachers cannot provide an appropriate pedagogical practice to students because students cannot accept more abstract thoughts when these teachers lack an understanding of ICT pedagogy theory [28].

2) Design

To fulfill elementary schools' teachers' needs, which include enhancing pedagogical practice, and to provide the opportunity to increase cognition regarding the theory of ICE pedagogy, the teaching process based on Leap Motion technology requires a combination of tools, activities, and capabilities before the experiment.

Phase 1: For teaching tools, to integrate Leap Motion into the classroom`s ICT pedagogy, the researcher collected PPT, courseware, and the Leap Motion app as teaching tools.

Phase 2: For teaching activities, the teacher needs to maintain a balance between teaching and learning. Therefore, teaching activities will include teaching, cooperation, and presentation.

Phase 3: For teaching abilities, teachers need design instruction, an organization of teaching activities, and evaluation of student learning; also, they need to participate in comprehensive professional development according to the literature review described above.

Based on the three design aspects of tools, activities, and capabilities, the Leap Motion teaching process diagram can create. These three aspects also have an interactive relationship with each other.

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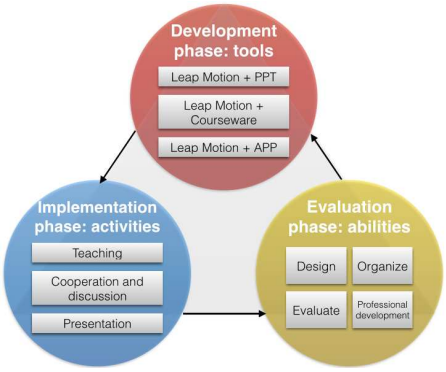

Fig. 1. The design circle of Leap Motion teaching process

3) Development

During the development phase, the research needs to develop additional tools to support the Leap Motion teaching process.

PPT is the most popular additional teaching tool currently in the classroom. The teacher uses Leap Motion to control the PPT display, which will provide the teacher with a much better play process. The designer needs to provide larger buttons, pictures, and a motion area instead of a mouse-based PPT.

This research will choose two types of courseware, Uclass, and iFlybook, as the additional teaching tools during the teaching process. The process uses Leap Motion; the courseware can also provide students with clear guidelines when they focus on the teaching content.

Many Leap Motion applications that were provided by the Leap Motion store also strengthens this technology. “Form & Function 3D” is a 3D model app of Leap Motion; this can provide students with a clear model regarding people`s bodies, and users can control the different body parts. This app allows students to understand the functions of the parts.

In the development phase, teaching tools need to be developed by the teachers to provide help with their pedagogical practice. This process can also help teachers use the teaching tools in their implementation phase.

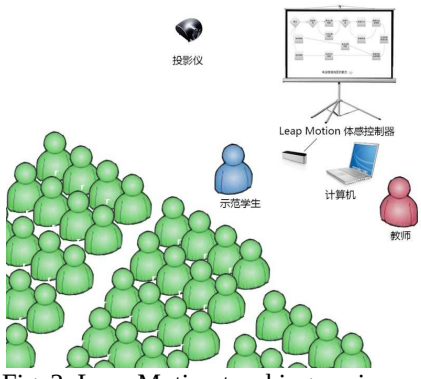

Fig. 2. Leap Motion teaching environment

E. Implement Leap Motion Teaching Process

This research based on a project of Qingyuan elementary school teachers` training in Guangdong province; this operate by the College of Educational Information Technology of South China Normal University. The purpose of this project is to train elementary school teachers` ICT ability through theory and practice teaching over the course of one week. Therefore, the objects of study were all originated from elementary schools, which located in different areas of Qingyuan.

The research includes three phases: teaching, cooperation, and presentation. Different teaching phases have different teaching tasks and teaching purposes.

This research also provided a chance for the teachers to share their thoughts regarding the main task so that they can modify the solutions of problems, provide instructions for the plan, and provide proper pedagogy in their practice. Peer seminars were provided twice during the research process; nearly every teacher shared their thoughts regarding the attitude, method, and philosophy on how to integrate ICT into the teaching process.

In the teaching process, elementary school teachers need to develop their speech content and design the instructional interaction with students. Finally, researchers express certain advanced questions regarding the pedagogy and thoughts on the speaker`s instructional design. During this process, each speaker increases their professional development using ICT and enhances their confidence regarding the use of Leap Motion in the teaching process.


Fig. 3. Teaching interactive process based on Leap Motion

IV. EVALUATION

F. Methods

There are two types of research methods were utilized to examine the consequences of the project. In total, 43 elementary school teachers participated in the research evaluation. All these teachers originated from elementary schools in Qingyuan, Guangdong province.

Teachers divided into two groups: an experimental group and a control group. There were 16 teachers (12 males and four females) in the experimental group, who conducted the experiment in the Longping Centre elementary school. There were 27 teachers (11 males and 16 females) in the control group, who operated in the Dadong elementary school. Although there was no difference in the teaching content and activity between these two groups, the teaching tools were different. The experimental group taught and cooperated with Leap Motion, and the control group taught and cooperated using general teaching tools that excluded Leap Motion.

Regarding the protest, all the groups` teachers were requested to complete quizzes to clarify their basic ICT

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ability. Additionally, regarding the post-test, researchers provided all teachers with the ICT ability quiz (edition 2) and questionnaire; this was later used to clarify teachers` ICT ability based on the teachers` ICT ability standard.

G. Results

The results of the study described in the following sections; these divided into three aspects. These three aspects are ICT ability achievement test, a questionnaire on the different groups' abilities, and a questionnaire on the teachers` instructional ICT abilities. Furthermore, the questionnaire data on the different groups' abilities and the questionnaire on the teachers` instructional ICT abilities originate from the same questionnaire, which is the questionnaire on teachers` ICT abilities. As a different perspective, the objective of the questionnaire on the different groups' abilities was to test the differences in the two groups; the other was to test whether this research would enhance the experimental group's teachers after training.

The data of this empirical research is available to all of the participants and others who interest in this topic, so the data saved on Baidu cloud disc and available to readers of this paper (website: http://pan.baidu.com/s/1o6ZShF8, password: read). However, to protect the privacy of the participants, all the private information will be replaced by the code "V".

1) ICT Ability Achievement Test

Table 1 shows the mean score (Mean) and standard deviation (SD) results of the ICT ability achievement test for the two groups. Due to the limits of the objects' number and the non-normal distribution, a non-parametric test method used for the analysis. The results of the ICT ability achievement test indicate that there was a significant difference between the pretest and the post-test in both the experimental group ($p = .001 < 0.05$) and the control group ($p = .00 < 0.005$). Moreover, to compare the two groups' test results, the Mann-Whitney U test was conducted to justify the significant difference between the pretest and post-test. Specifically, these two groups all increased their ICT ability achievement; however, the score of the experimental group is higher than the control group (Mean = 6.16 > 4.37). It is also worth noting that the standard deviation of the experimental group is lower than that of the control group.

Table 1. Results of ICT ability achievement test

	Experimental group (N=16)		Control group (N=27)	
	Mean	SD	Mean	SD
Pretest	4.20	0.923	2.96	1.190
Posttest	6.16	0.908	4.37	0.952

2) Questionnaire on Different Group Ability

Table 2 shows the results of the questionnaire on different groups' teachers` ability. This questionnaire involves a scale that includes five items. In this study, the experimental group showed strong performance; the post-test index mean score is higher than that for the pretest (Mean = 0.52 < 0.68). For the index scale, both the pretest and post-test attain strong performance (pretest mean score = 0.52 > 0.5, post-test mean score = 0.68 > 0.5) for the teachers` ICT ability. Additionally, the standard deviation of the post-test is slightly lower than that of the pretest (SD = 0.104 < 0.107).

Table 2. Results of the questionnaire on different group teachers` ability

	Experimental group (N=16)	
	Mean	SD
Pretest	0.52	0.107
Posttest	0.68	0.104

3) Questionnaire on Teachers` Instructional ICT Ability

Table 3 shows a different index score for the teachers` instructional ICT ability. Because the scale of every index is 1 to 5, the post-test mean score of the experimental group can be found from the score compared with the mean pretest score. All the indexes (i.e., ICT literacy, instructional design, instructional organization, instructional evaluation, and professional development) attained suitable performance during the teaching process. Additionally, all the index mean scores of the post-test are higher than the mean pretest scores.

Table 3. Results of the teachers` instructional ICT ability

Item	Experimental group (N=16)	
	Pretest Mean	Posttest Mean
ICT literacy	2.80	3.60
Instructional design	2.35	3.26
Instructional organize	2.83	3.56
Instructional evaluate	2.52	3.31
Professional development	2.53	3.31

H. Discussion

The results gathered from the ICT ability achievement test shows that there was a large significant difference between the pretest and the post-test in the experimental group, and there was a difference between the experimental group and the control group. This evidence shows that the Leap Motion teaching process can greatly enhance teachers` ICT ability. Although the two groups all achieved a large increase compared with the beginning of the teaching, the experimental group achieved much better performance. Therefore, Leap Motion can enhance users` attitude towards educational ICT and enhance teachers` ICT pedagogical practice.

The results of the questionnaire on teachers` ICT ability reveal that Leap Motion, as a GBT, can provide teachers with the opportunity to find solutions to problems, cooperate with each other, and inspire emotion on ICT; also, it can assist teachers in their professional development. Although the mean scores are not high (i.e., ICT literacy post-test mean score = 3.60) compared with the scaled standard, all the indexes of the teachers attained higher performance than before (i.e., ICT literacy post-test mean score = 3.60 > 2.80). These results indicate that Leap Motion can enhance different objects` ICT ability, whereas different teachers have different basic abilities in educational ICT.

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V. CONCLUSION

In this paper, a teaching process based on Leap Motion was utilized to test the effect of Leap Motion in the classroom. The teaching process includes five circles (ADDIE): analysis, design, development, implementation, and evaluation. After integrating the Leap Motion tool into teaching activities, this research found that the teaching process can enhance teachers` ICT ability. Comparative research methods used in this study; teachers divided into an experimental group and a control group. Through the analysis process of the quizzes and questionnaires, these two groups were shown to have suitable performance in ICT ability achievements; however, the experimental group`s teachers performed much better than the control group`s teachers regarding the ICT test score. The Leap Motion-based teaching process also can increase teachers` ICT ability. Leap Motion is a type of GBT based equipment that was designed by a new corporation.

VI. ACKNOWLEDGMENT

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