International Journal of Science and Engineering
http://140.133.4.61/IJSE/index.html

Exploring the Effects of Applying Motion Sensing Interaction Technology to Support Digital Guided Reading Activity

Shu-Yuan Tao[1]
[1] *Department of Multimedia Design, Takming University of Science and Technology, No.56, Sec.1, Huanshan Rd., Neihu District, Taipei City 11451, Taiwan*

Tsung-Yen Chuang[2,*]
[2] *Department of Information and Learning Technology, National University of Tainan, 33, Sec. 2, Shu-Lin St., Tainan City 700, Taiwan*

Yun-Hsuan Huang[2,3]
[3] *Department of Applied Foreign Languages, Chia Nan University of Science and Technology, No.60, Sec. 1, Erren Rd., Rende Dist., Tainan City 71710, Taiwan*

Abstract **-- The emergence of motion sensing technology has brought digital revolution and affected group and human–computer interaction. Traditionally, reading guidance activities were demonstrated as either the paper-based or keyboard and mouse-based reading guidance scenario which not only could limit the actions and interactions between the teacher and students but also reduce the interest and attention of students. Therefore, the purpose of this study is to integrate the Kinect device in proposing that a motion sensing technology interaction assisted the reading guidance system to facilitate 30 elementary school students in reading guidance learning activities. Students' interest, attention, and acceptance were investigated. Moreover, this study investigated the teachers' information literacy and acceptance of applying the motion sensing technology in teaching. The findings reveal that the positive impact of motion sensing technology interaction on teaching activities leads students to enhance interest and attention while engaging in learning activities. Additionally, these teachers believed that integrating motion sensing technology into teaching and learning activities could improve student participation and teacher–student interactions. The results of the study are discussed and implications are provided.**

Keywords **-- Information literacy, Kinect, motion sensing interaction technology, reading guidance**

I. INTRODUCTION

Reading has been one of major sources by which people obtain information, especially in the age of knowledge economy. As reading is a cradle of knowledge, cultivation of reading ability should start early. Taking Taiwan as an example, elementary schools positively promote related reading activities such as "Reading Passport," "Educational Programs of Library Use," and storybook reading guidance activities. The effectiveness of reading activities often depends upon learner interest and attention during the implementation of activities. As a result, environmental planning of reading activities and teacher guidance become significant [1-3]. With the development of information techniques and network technology, computer-assisted instructional activities have created diverse teaching contexts, influencing learner motivation, participation, and learning effectiveness. For example, the research of Scott, Mandryk and Inkpen [4] proposed a co-located groupware system to facilitate classroom collaborative interactions and revealed the students' perception of enjoyment of working on technology that supported cooperative activities. Therefore, supporting student reading activities by information technology and promoting learner interest and attention with it are issues worth exploring.

Traditionally, the scenario of reading guidance activities shows a teacher and each student holding a story book in their hands. In such a reading guidance context, elementary school students easily lose focus and are unable to follow the teacher in reading, which significantly reduces their engagement and pleasure. Nowadays, some reading passages have been transformed into briefing files, and through presentation software, the contents can be projected, greatly facilitating reading guidance activities. Although these technology-assisted reading guidance activities have increasingly replaced paper-based reading guidance activities, the keyboard and mouse-based presentations limited actions and interactions between the teacher and students [5]. In order to manipulate the presentation software, the teacher has to continuously go toward and face the computer, which results in preventing him/her from interacting closely with the students.

The emergence of embodied interaction technology has impacted the human–computer interaction (HCI) because it creates the opportunity of manipulating computers via noncontact mode [6-8]. This emerging technology offers exciting new ways to create fantastic play experiences and fosters interactions between players[9]. In addition, this kind of motion sensing interaction technology (MSIT) has not only influenced the revolution of human–computer interaction but also creates novel scenarios in computer-supported learning activities [10, 11]. The study of Lee, Huang, Wu, Huang and Chen [12] proposed an authentic learning playground to facilitate language learning; the results revealed that the students benefited through enhanced intrinsic motivation. The major characteristic of embodied interaction technology is allowing students to interact with the computer-supported learning system via body movement. Thus, it could create more classroom interactions and let students apply knowledge with context in the classroom. Therefore, this research

* Corresponding author: chuangyen@mail.nutn.edu.tw
DOI：10.6159/IJSE.2015.(5-2).01

advocates that digital reading contents presented on a big screen by MSIT may replace keyboard and mouse-based technology to assist reading guidance activities more efficiently. Furthermore, this research also looks into the interactions among the teacher, students, and reading contents supported by MSIT assisted reading guidance activities, as well as student attention and interest.

Eliciting users' attitudes regarding computer-supported activities can assist in ensuring adequate effectiveness; thus, studies widely assert that the perceptions of teachers and students play an important role related to acceptance and usage of technology in teaching and learning [13-15]. As the study of Teo, Lee and Chai [14] indicated, the teachers with positive computer attitudes tend to be more focused on using computers in teaching and learning activities resulting in more efficient strategies. Therefore, this research attempts to transfer readings into e-readings. With MSIT, the teacher will conduct reading guidance activities through actions like page flipping and prompting. Thus, it is necessary to understand teacher attitudes toward integrating this kind of technology into reading guidance activities. In other words, this research will discuss teacher perceptions of usefulness, ease of use, and use intention. In addition to teacher acceptance, student acceptance of MSIT-assisted learning activities is another important factor for learning effectiveness [16, 17]. Moreover, the device equipped with embodied interaction technology has been considered a learning tool to improve teachers' abilities in presenting and manipulating various kinds of digital materials [10]. Meanwhile, many researches have revealed that the information literacy of teachers is the key factor in attaining effectiveness while applying information technology to support teaching and learning activities [18-20].

Following in this vein, the aim of this study is to integrate the Kinect device in proposing a "MSIT-assisted Reading Guidance System" to facilitate students' reading guidance activities. To examine the learning effectiveness of MSIT-assisted reading guidance activities, the study adopts 5th-grade English storybook reading guidance activities. The study investigates student interest, attention, and acceptance. In addition, a survey will be conducted to evaluate the information literacy of elementary school teachers as well as their acceptance of MSIT-assisted activities. To better understand the context of this study, related studies highlighting the utilization of MSIT as well as teachers' information literacy and acceptance of applying technology are reviewed, followed by the methods and results of the current study. The final section involves a discussion of findings and conclusion.

II. LITERATURE REVIEW

A. Motion Sensing Interaction

The emergence of embodied interaction technology has impacted human–computer interaction due to the fact that it creates the opportunity of manipulating the computer via noncontact mode [6, 7]. This embodied interaction technology has been widely applied in interaction entertainment and home videogames by well-known technology developers such as the Nintendo [21], Sony [22], and Microsoft[23]. The hardware to support motion sensing interaction issued by those technological developers is to fulfill the scenario of multiple users playing together on systems such as Wii remote, PlayStation, and Kinect. For example, Lee [24] demonstrated that integrating Wii remote and a projected image on a flat display surface is to act as if it were an interactive whiteboard system. Another case is that Kinect allows a lot of people to manipulate the computer simultaneously and so fulfills people to play together (Fig. 1). In addition, this kind of motion sensing interaction has not only influenced the revolution of human–computer interaction but also creates novel scenarios in computer-supported activities. For instance, Papanikolopoulos [25] did not employ the Kinect as a toy but as a medical tool that could streamline the diagnoses of mental disorders in children. Comparable with the Wii remote, the Kinect is a controller-free device that detects users' motions. Therefore, it allows users to operate the computer in natural human–computer interaction via recognition of gesture and speech, and skeleton tracking [6]. Moreover, the study of Chang, Chen and Huang [26] demonstrated that utilizing a Kinect-based system in physical rehabilitation could increase the participants' motivation for physical rehabilitation and results into better exercise performance.

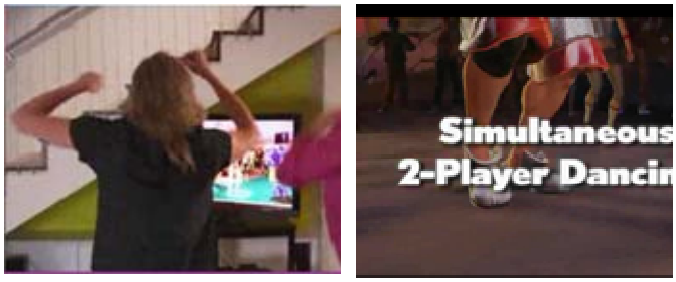

Fig. 1 Playing with Xbox-Dance2 (Xbox, 2013)

Based on the aforementioned characteristics of Kinect, the application of Kinect in learning activities has gained much attention in the field of education [7, 11, 27]. For example, the study of Marquardt, Beira, Em, Paiva and Kox [28] proposed a Super Mirror, which employed the Kinect to track ballet dancers' movements and live motions, and provided instructional feedback shown in the studio mirror to guide the dancer in learning ballet. Moreover, Álvarez and Peinado [29] have developed a serious game to facilitate medicine students in learning. For those students who played the game, the only HCI between the game and the player is the Kinect. By avoiding replicating the typical control of the keyboard and the mouse combined, it demonstrates a scenario toward immersive and narrative interaction in learning activities. In addition, the study of Chao, Chen, Yang and Yu [30] was to create 3D motion sensor teaching system and allowed teachers and students manipulated the 3D objects through the motion Sensor way. According to the aforementioned studies which proposed Kinect as an opportunity for HCI, thus, this study considers integrating Kinect in computer-supported reading guidance activities and further evaluates the effects of promoting interest and increasing concentration during the students' learning activities.

B. Information Literacy and Attitude of Accepting the Motion Sensing Interaction

Information technology (IT) and network technique are increasingly leading teaching and learning activities to become closely linked with employing computer-supported learning. In the sense of incorporating these information technology features into teaching and learning activities, the information literacy competency of teachers and students is essential not only for prompting teaching effects, but also for influencing learning effectiveness. Researchers and associations have attempted to define information literacy from many different perspectives. Among them the most widely known definition was proposed by the American Library Association [31], which involved the ability to recognize when and what information is needed, and how to acquire, evaluate and utilize the necessary information effectively. This definition of information literacy focuses on how to facilitate problem solving and decision making through managing and applying information. In the information age, however, Kuhlthau [32] indicated that information literacy should strongly relate to library skills and computer literacy due to the rising level of awareness of knowledge explosion and computers being essential to help identify, access, and obtain resources needed for problem solving and decision making. In other words, the synthesis of information literacy and requirements of computer literacy is that individuals need to satisfy the characteristics of information literacy, such as traditional literacy, media literacy, computer literacy, and network literacy [33].

In educational contexts, integrating information technology in teaching and learning activities has empowered the effectiveness of learning by enhancing students' motivation, increasing engagement of learning activities, and cultivating knowledge building. However, within the field of educational technology, the challenge of promoting learning effectiveness is the ability of teachers not only to acquire information literacy competencies but also to apply instructional technology in the teaching and learning activities. Much research has revealed that the information literacy of teachers is the key factor for reaching effectiveness while applying the information technology in supporting teaching and learning activities [18-20]. For example, Wen and Shih [20] highlighted that teachers' information literacy should anchor on the competence of information knowledge, skills, and attitude. The more specific indicators of information knowledge involve the knowledge of laws and regulations of information technology, information security, information ethics, applications of computer network resources, and planning and managing curricula. Additionally, the skill dimension of information literacy is to emphasize not only the capability of computer network operations but also the skills of processing instructional materials and teaching resources management.

Even though teachers conform to a qualification in information literacy, acceptance of applying information technology in teaching is another important factor to influence teaching effectiveness [17, 34]. The research of Wen and Shih [20] has revealed that attitude has a great impact on improving the willingness of utilizing information technology on teaching activities. According to the assertion of Wen and Shih [20], attitude focuses on three standards which included IT cognition, IT learning, and IT application. In other words, only when the teacher recognizes the usefulness of IT and is willing to apply it in order to improve teaching, could it benefit computer-supported teaching and learning. For instance, the study of Teo, Lee and Chai [14] revealed that teachers' attitudes towards computers may act as either a facilitator or barrier to computer use in that teachers' possessing positive computer attitudes tend to be more focused on the use of computers in teaching resulting in more efficient strategies via utilizing computer technology. On the other hand, it was strongly mentioned that the student's attitudes, perceptions, and beliefs regarding the use of information technology in learning activities are critical issues [16, 17, 35, 36]. For example, the study of Terzis and Economides [37] indicated that the positive perception of playfulness is a mediator of intention to use computer-supported learning tools for the student, as well as perception of usefulness in contributing significantly to the students' goal expectancy and social influence.

Based on the aforementioned literatures highlighting that the aspects of information literacy and attitudes toward computers could mediate and facilitate teaching and learning activities, this study would take the information literacy of teachers into account as well as evaluating their attitudes toward utilizing the technology of motion sensing interaction in reading guidance activities. In addition, in order to understand the attitudes toward motion sensing interaction being utilized in students' reading guidance activity, the students' intention for future use is also explored in this study.

III. METHOD

This study combined a motion sensing interaction device with digital books to establish a digital interactive guided-reading system with motion sensing functions, supporting teachers to take on guided reading activities. This section will state the "MSIT-assisted reading guidance system", research participants, procedures, data collection, and data analysis.

A. MSIT-assisted Reading Guidance System

As shown in Fig. 2, this study applied digitalized techniques into book preview functions as well as a large and shared display to present digital contents. Kinect facilities can not only detect body movement and gesture but also activate some specific computer functions, so that teachers are able to operate digital book reading through Kinect. In addition, due to the convenient placement of Kinect facilities, users may select any desired location.

Fig. 2 The digital guided reading activity of English story books

This MSIT-assisted reading guidance system comprises three structures: motion sensing techniques, book digitization, and human-machine motion sensing interface (Fig. 3). The user interface in this system is displayed in the manner of a book case which constructed by the second structure of book digitization. For the user convenience, there are two categories shown in main menu, which are Chinese books and English books (Fig. 4). Although Kinect possesses functions such as detecting human skeletons, identifying images and sounds, this study applies the function of human skeleton detection to support human–computer interaction. Considering the user's convenience, the system focuses only on hand motions. When intending to select some function, for instance, the user moves his/her right hand over that book icon and then makes a fist, which immediately activates the selection function. For example, Fig. 4 to Fig. 5 demonstrates that the user selected the subcategory of "Chinese Books" via clenching his/her right fist.

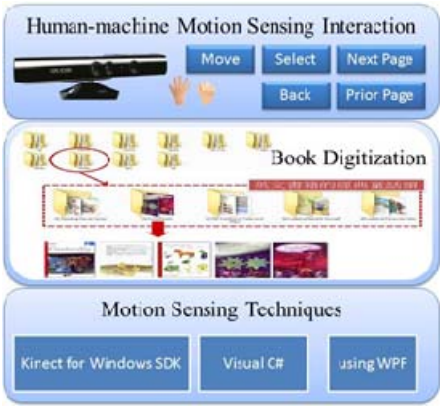

Fig. 3 Hierarchy of "MSIT-assisted reading guidance system"

In addition, the page flipping effect of "next page" is triggered by waving the right hand from right to left side. The page flipping effect of "previous page" is triggered by waving the left hand from left to right side as shown in Fig. 2. To close the digital book and return to the main menu, simply raise the right hand over the head.

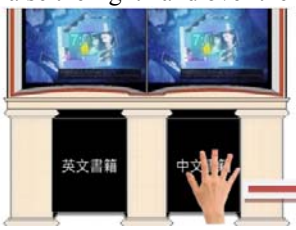

Fig. 4 Main menu of "MSIT-assisted reading guidance system"

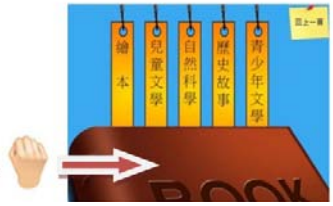

Fig. 5 The subcategories of "Chinese Books"

B. Participants and procedure

There were 30 participants who were fifth graders from an elementary school in northern Taiwan. The guided-reading activity which adopted English story books through the "MSIT-assisted reading guidance system" was 40 minutes long. After the activity, the participants were asked to fill out a survey to evaluate what they thought of such an English learning activity through the MSIT.

Besides, this study attempted to understand teachers' perspectives toward such a learning activity supported by the MSIT. Thus, this study collected the information of teachers' technological literacy, information-integrated teaching, experience of using MSIT, and the expectations of elementary school teachers in northern Taiwan toward applying MSIT to teaching.

C. Data collection and analysis

The data included two surveys from both participants' perspectives and teachers' perspectives. The following will be a detailed illustration of data collection and analysis.

3.3.1. The survey of learning activity

The data were collected from 30 participants, who filled out the guided-reading learning survey after the guided-reading activity. As shown in Table I, the learning survey involves four aspects: (1) self-efficacy and task value of learning English; (2) participants' perspectives toward presentation software used in English teaching; (3) participants' perspectives toward the MSIT used in English storybook reading; (4) intention toward future use. The first aspect of the survey was mainly to investigate the learning self-efficacy and task value, which were adopted from the Motivated Strategies for Learning Questionnaire [38] and further adapted to make the items better fit the experimental situation.

TABLE I

THE MAIN PURPOSES AND SAMPLE ITEMS OF THE QUESTIONNAIRE

Aspect	Purpose	Examples of question items
Self-efficacy and task value toward learning English	To identify participants' level of self-efficacy and task value in learning English	I'm confident in learning English. I think English learning is interesting. I like the subject matter of this English course.
Attitude toward learning English in class via presentation software	To identify concentration and interest of learning English via presentation software	Teaching through the computer projector clearly guides me to which part of the lesson the teacher has taught. Teaching through the computer projector makes me concentrate more in class.
Attitude toward learning English in class of manipulating digital material via motion sensing interaction	To identify concentration and interest of learning English of manipulating digital material via motion sensing interaction	Motion sensing interaction technology makes learning interesting. Teaching through the motion sensing interaction technology makes me concentrate more in class.
Intention of employing motion sensing interaction in the future	To identify the intention of participants in using motion sensing interaction to facilitate learning activity in the future	I hope that the teacher can often use the motion sensing interaction technology in English materials.

Regarding self-efficacy, the survey attempted to investigate participants' English learning competency, whereas the task value was to aim to understand participants' attention and preference. Besides, the teacher traditionally utilizes the presentation software to facilitate story book reading activity. In order to understand the participants' perception of the presentation software and MSIT-assisted

reading guidance system, the second and third aspects of the survey were to investigate the interest and concentration in learning English via these two kinds of instructional instruments. The last aspect of the survey was to identify the intention of using motion sensing interaction to facilitate learning activity in the future.

In total, there are 17 closed statements on a five-point Likert scale (from strongly disagree=1, to strongly agree=5). Each statement was reviewed by two primary school teachers. One was an English teacher instructing the participants in the experiment, and the other was a higher grade teacher. Therefore, the statements of the questionnaire can be appropriately understood by the participants who were primary school students in this study. The Cronbach's reliability (alpha) of the four aspects were 0.91, 0.89, 0.89, and 0.93, suggesting satisfactory reliability for analysis.

After the perceived aspects of the questionnaire were collected, this study implemented comparisons with rating scores for each aspect. Therefore, a t-test was used to unveil the influences of MSIT in facilitating reading guidance. In addition, for those participants with lower English learning self-efficacy, this study further examined their learning task value and attention in the activity assisted by the MSIT.

3.3.2. The survey of information literacy and MSIT

The survey regarding teacher perspectives included three aspects: demographic characteristics, information literacy, and attitude of accepting the MSIT. The teachers' demographic characteristics included age, teaching experience, teaching subject domain, teaching level, average hours of computer use per day, and the purpose for using the computer. In addition, five aspects were involved to explore the information literacy of teachers, i.e. computer literacy, internet literacy, software–hardware literacy, ethical literacy, and computer integrated instruction. The structure of the information literacy survey was adopted from the Information Literacy Standards for Teacher Education developed by the EBSS Instruction for Educators Committee [39] and further adapted to make the aspects and items better fit the situation of elementary school teacher. There were a total of 39 closed statements on a five-point Likert scale (from strongly disagree=1, to strongly agree=5). Moreover, the question of whether motion sensing interaction technique can be integrated successfully into learning activities relies on the teachers' acceptance of information technology. So this study collected the teachers' experience of using MSIT. Through three aspects, namely ease of use, usefulness, and willingness to use in future, this study probed into the teachers' perspectives toward integrating MSIT into learning activities. These three aspects were adopted from the Technology Acceptance Model [40], which were a total of 8 closed items on a five-point Likert scale.

The survey was sent to 50 elementary school teachers in northern Taiwan, and the data were collected from 49 completed questionnaires. Table II displays the participant demographics. The Cronbach's reliability (alpha) of the five aspects of information literacy were 0.93, 0.91, 0.93, 0.91, and 0.82, indicating that the analysis was adequately reliable. Additionally, the Cronbach's reliability (alpha) of the three aspects concerning perceptions of acceptance of MSIT were 0.90, 0.86, and 0.90. It also indicated that the analysis was adequately reliable.

TABLE II

TEACHERS DEMOGRAPHICS

	Demographics	Frequency	Percentage
Age	20─30	2	4.1%
	30─40	22	44.9%
	40─50	20	40.8%
	Above 50	5	10.2%
Education	College (including secondary school teachers' education programs)	15	30.6%
	Graduate School (including accredited programs)	18	36.7%
	Normal University and Education Programs in College	12	24.5%
	5-year Normal Junior College, 4-year Normal College, and 4-year Junior College	3	6.1%
	Doctorate	1	2.0%
Position	Director、Section Lead (excluding Information Section Lead)	15	30.6%
	Subject Teacher	10	20.4%
	Home-room Teacher	23	46.9%
	Information Section Lead and Teachers	1	2.0%
Daily average hours of computer use	Be1ow 1 hour	2	4.1%
	1─2 hours	14	28.6%
	2─4 hours	13	26.5%
	4─8 hours	16	32.7%
	Above 8 hours	4	8.2%
Purpose of computer use	Entertainment	1	2.0%
	Entertainment, Internet use	1	2.0%
	Entertainment, work, Internet use	18	36.7%
	Work	12	24.5%
	Work, Internet use	17	34.7%

After the perceived aspects of the questionnaire were collected, this study implemented comparisons with rating scores for each aspect. On the other hand, the study conducted the ANOVA to examine the attitude of acceptance of MSIT based on the experiences of utilizing MSIT.

IV. RESULTS AND DISCUSSIONS

A. Perceptions of MSIT in Facilitating Reading Guidance

Table III shows the summarized attitude of students' learning English in four aspects: perception of learning English, the attitude toward learning English by presentation software, attitude toward learning English by MSIT, and intention of future using MSIT. According to the t-test analysis of the survey results, the mean score of perception of learning English indicated that the participants rated their perceptions significantly higher than neutral: M=4.15, SD=.93, t=9.75, p<.001. From the point of view of English learning

self-efficacy and task value, "I'm confident in learning English" was rated 4.27 on average by the participants. Regarding interest, "I think learning English is interesting" and "I like the subject matter of this English course" were respectively rated 4.00 and 4.13. However, 7 out of the participants' ratings were on average lower than 3.5, excluding one student with 5-point English performance. This study will further examine the other six students' awareness of MSIT assisted learning.

TABLE III.

SUMMARIZED ATTITUDE OF STUDENTS' LEARNING ENGLISH

N=30	Mean	SD	Cronbach α
Perception of learning English	4.15	0.93	0.91
Attitude toward learning English by presentation software	4.32	0.78	0.89
Attitude toward learning English by MSIT	4.54	0.66	0.89
Intention of future using MSIT	4.50	0.95	0.93

Concerning the mean score of attitude toward English learning in class via **presentation soft ware**, the participants rated the perceptions significantly higher than neutral: M=4.32, SD=.78, t=12.81, p<.001. On the other hand, the mean score of attitude toward learning English in the class which manipulated digital material via motion sensing interaction also is significantly higher than neutral: M=4.54, SD=.66, t=16.81, p<.001 (Table III). In addition, comparing the differences of these two aspects, the results show that the attitude toward learning via MSIT is significantly higher than the other one, in which the t-value and p-value were -2.38 and 0.024 (p<0.05) respectively. Overall, the reading activity assisted by the MSIT scored higher on average than that assisted by the presentation software as shown in Table IV. Regarding participant attention, for example, the statistical results of "Teaching through the computer projector clearly guides me to which part of the lesson the teacher has taught" were M=4.57 and 4.33, SD=0.73 and 0.99. The statistical results of "Teaching through the computer projector makes me concentrate more in class" were M=4.53 and 4.00, SD=0.82 and 1.14. Pertaining to participant interest in the technology-assisted classroom, the statistical results of "I think it's much more interesting" were M=4.57 and 4.33, SD=0.73 and 0.96; the statistical results of "I think it's terrific!" were M=4.60 and 4.53, SD=0.72 and 0.78. This study concluded that compared with the traditional presentation software, the MSIT made English storybook reading even more interesting to the participants and also raised their attention. In other words, increased attention could foster the student to follow the reading progress in class.

Additionally, the mean score of intention of using MSIT in future learning activity revealed that the participants rated their perceptions significantly higher than neutral: M=4.50, SD=.95, t=11.57, p<.001. For example, the statistical results of "I hope that the teacher can often use the motion sensing interaction technology in English materials" and "Motion sensing interaction technology makes learning interesting" were M=4.40 and 4.60, SD=1.04 and 0.93. In other words, the participants commit to the attraction of interface in human–computer interaction with the MSIT in learning activity. The aforementioned findings imply that the features of integrating motion sensing interaction with learning activity could make the class more interesting to students and further engage them to concentrate on the learning activity. Consequently, it may engage students in the learning activity and enhance students' motivation to learn.

TABLE IV.

SELECTED STUDENTS PERCEPTION OF GUIDING READING BY PRESENTATION SOFTWARE AND MSIT

N=30	Guiding Way	Mean	SD
Teaching through the computer projector clearly guides me to which part of the lesson the teacher has taught	Presentation software	4.33	0.99
	MSIT	4.57	0.73
Teaching through the computer projector makes me concentrate more in class	Presentation software	4.00	1.14
	MSIT	4.53	0.82
I think it's much more interesting	Presentation software	4.33	0.73
	MSIT	4.57	0.96
I think it's terrific	Presentation software	4.53	0.78
	MSIT	4.60	0.72

Moreover, considering the six participants with a lower perception in their attitude toward English learning, the rate of perceptions of assistance by MSIT were M=4.17and SD=0.83. Moreover, the results showing their attitude toward continuing using MSIT were M=3.75 and SD=1.54. Noticeably, one student's ratings in these two aspects were 2.80 and 1.00, both much lower than the mean. Yet, in comparison with the lower perception in attitude toward English learning, another student's responses to these two aspects were both 5. Based on these results, this study concluded that for those students with lower English learning self-efficacy and task value, MSIT assisted reading activities may elevate their English learning interest and attention so as to improve their learning motives.

B. Teachers' Information Literacy and Acceptance of MSIT

Table V shows the investigation of teachers' information literacy and acceptance of MSIT. Concerning teachers' information literacy, the mean scores of computer literacy, internet literacy, software and hardware literacy, information ethics literacy, and information and teaching integration indicated that the participants rated all their perceptions significantly higher than neutral: computer literacy (M=4.44, SD=.49, t=27.96, p<.001); internet literacy (M=4.00, SD=.69, t=15.16, p<.001); software and hardware literacy (M=3.67, SD=.80, t=10.19, p<.001); information ethics literacy (M=4.37, SD=.48, t=26.98, p<.001); information and teaching integration (M=4.33, SD=.51, t=25.10, p<.001). As to information facilities used in teaching, all the teachers employed the computer in teaching. Eleven out of them would adapt their own notebook computer in order to adequately deliver some special teaching materials. This result demonstrated that the teachers with a stronger sense of self-efficacy not only utilized information technology but also facilitated it in lesson teaching.

As to whether teacher acceptance of MSIT would influence the successful use of the technology, this study investigated the teachers' perspectives toward ease of use, usefulness, and willingness to use MSIT in future. The mean score in each aspect indicated that the teachers rated all their perceptions significantly higher than neutral: ease of use ($M=3.44$, $SD=.71$, $t=9.27$, $p<.001$); usefulness ($M=3.84$, $SD=.61$, $t=15.35$, $p<.001$); willingness of use in future ($M=3.73$, $SD=.69$, $t=12.61$, $p<.001$). In addition, 22.4% of the teachers have experience of using motion sensing interaction facilities for over 6 hours; 32.7% of them have never tried MSIT. Based on this information, three groups were compared by ANOVA in this study: a group who had used MSIT for over 6 hours, a group who had no experience, and a group who had used MSIT for 0–6 hours. There were no significant differences across these three groups in ease of use ($F(2,46)=1.178$, $p=0.317$), usefulness ($F(2,46)=0.479$, $p=0.622$), and willingness to use in future ($F(2,46)=0.471$, $p=0.627$). That is to say, neither having experience of MSIT or not affects teachers' intention in utilizing the MSIT into teaching and learning activities in the future.

TABLE V.
SUMMARIZED TEACHERS' INFORMATION LITERACY AND ACCEPTANCE MSIT

N=49	Mean	SD	Cronbach α
Computer literacy	4.44	0.49	0.93
Internet literacy	4.00	0.69	0.91
Software and hardware literacy	3.67	0.80	0.93
Information ethics literacy	4.37	0.48	0.91
Information and teaching integration	4.33	0.51	0.82
Perception of MSIT toward ease of use	3.44	0.71	0.90
Perception of MSIT toward usefulness	3.84	0.61	0.86
Willingness to use MSIT in future	3.73	0.69	0.90

Further examination of the perception of "I think combining the motion sensing interaction technology and the computer can promote learning activities" and "I think using motion sensing interaction technology in classroom activities can elevate student interaction" revealed positive acceptance with a mean of 3.96 and 3.98 respectively. Based on dominant educational theories, attitudes have a great impact on behaviors in facilitating the results of actions. Therefore, the results implied that a teacher with sufficient information literacy and assent in applying MSIT in learning activity could promote the learning effect while utilizing this kind of human–computer interaction in teaching activity.

V. CONCLUSIONS

This study proposed a MSIT-assisted reading guidance system in supporting teachers to take on guided reading activities. The emergence of motion sensing interaction technology allows users to operate the computer in a natural human–computer interaction via recognition of gestures and speech, and skeleton tracking. This study conducted an experiment which supported elementary school students in reading guidance activities and further examined the effectiveness of participants' interest and attention as compared with traditional presentation software. The participants' responses revealed that their attitudes of interest and attention toward facilitating reading guidance via MSIT were significantly higher than the traditional presentation software. Moreover, MSIT provides an alternative channel to facilitate HCI. The intention of integrating MSIT in learning activities showed significantly higher than neutral, which correlates with their interest and attention. In other words, MSIT added learning pleasure, which not only appealed to their interest and attention but also brought positive effects on reading activities. Such effects let those students grow confidence in MSIT-assisted learning activities. For the participants with lower perception, the rate of their perceptions of assistance by MSIT was significantly higher than neutral. This means that the students with lower English learning competence and interest raised learning interest and attention. Future study may extend the duration of MSIT-assisted guidance reading activities and observe whether it effectively promotes their learning interest and attention as well as enhancing engagement.

Concerning the teachers' information literacy, the results were significantly high. The findings showed that they were capable of teaching with the computer and commonly used the computer to support teaching materials and grading work. This implies that they had confidence in the use of information technology facilities and commonly applied them in teaching. Regarding teacher perceptions of ease of use, usefulness, and willingness to use in future, the results evidenced that they were positively inclined to accept MSIT and had no difficulty in using it. Further, these teachers believed that integrating MSIT into teaching and learning activities could improve student participation and teacher–student interactions, which corresponds with the students' responses shown in the study.

In summary, this study concludes that the positive impact of MSIT on teaching activities lead students to enhance interest and engagement of attention in learning activities. Despite the encouraging results, it is evident from similar studies that it is advisable to extend the duration of MSIT-assisted activities in order to screen out the disturbing factor of novelty effects. In addition, to determine whether MSIT also benefits other learning activities, it is worth not only applying MSIT, together with other information technologies and pedagogies, to other learning contexts such as game-based learning and collaborative learning, but also to evaluate the learning effects and engagement of learning.

VI. ACKNOWLEDGMENTS

The authors would like to thank the National Science Council and the Ministry of Science and Technology in Taiwan for financially supporting under the research project number: NSC101-2511-S-147-002, NSC101-2511-S-148-001, NSC102-2511-S-024-006, and MOST 103-2511-S-024-009.

REFERRENCES

[1] S. Hidi, "Interest, reading, and learning: Theoretical and practical considerations," *Educational Psychology Review,* vol. 13, no. 3, pp. 191-209, 2001.

[2] S. Hidi, and K. A. Renninger, "The four-phase model of interest development," *Educational psychologist,* vol. 41, no. 2, pp. 111-127, 2006.

[3] A.-H. Kim, S. Vaughn, J. K. Klingner, A. L. Woodruff, C. K. Reutebuch, and K. Kouzekanani, "Improving the reading comprehension of middle school students with disabilities through computer-assisted collaborative strategic reading," *Remedial and Special Education,* vol. 27, no. 4, pp. 235-249, 2006.

[4] S. D. Scott, R. L. Mandryk, and K. M. Inkpen, "Understanding children's collaborative interactions in shared environments," *Journal of Computer Assisted Learning,* vol. 19, no. 2, pp. 220-228, 2003.

[5] Y. Yang, and L. Li, "Turn a Nintendo Wiimote into a handheld computer mouse," *Potentials, IEEE,* vol. 30, no. 1, pp. 12-16, 2011.

[6] R. Francese, I. Passero, and G. Tortora, "Wiimote and Kinect: gestural user interfaces add a natural third dimension to HCI." pp. 116-123.

[7] N. Villaroman, D. Rowe, and B. Swan, "Teaching natural user interaction using OpenNI and the Microsoft Kinect sensor." pp. 227-232.

[8] P. L. Nguyen, V. Falk, and S. Ebling, "Building an Application for Learning the Finger Alphabet of Swiss German Sign Language through Use of the Kinect," *Computers Helping People with Special Needs*, pp. 404-407: Springer, 2014.

[9] L. Meng, and H. Xinyuan, "G.: The Research and Experiment about Interactivity and Immersion of Virtual Reality," *International Journal of Digital Content Technology and its Applications (JDCTA), Volume7, Number13*, 2013.

[10] H.-m. J. Hsu, "The potential of Kinect in education," *International Journal of Information and Education Technology,* vol. 1, no. 5, pp. 365-370, 2011.

[11] K.-W. Chen, F.-C. Hsu, Y.-Z. Hsieh, and C.-H. Chou, "To design an interactive learning system for child by integrating blocks with Kinect." pp. 20-22.

[12] W.-J. Lee, C.-W. Huang, C.-J. Wu, S.-T. Huang, and G.-D. Chen, "The Effects of Using Embodied Interactions to Improve Learning Performance." pp. 557-559.

[13] P. A. Ertmer, "Teacher pedagogical beliefs: The final frontier in our quest for technology integration?," *Educational technology research and development,* vol. 53, no. 4, pp. 25-39, 2005.

[14] T. Teo, C. B. Lee, and C. S. Chai, "Understanding pre‐service teachers' computer attitudes: applying and extending the technology acceptance model," *Journal of computer assisted learning,* vol. 24, no. 2, pp. 128-143, 2008.

[15] Y. Zhao, and G. A. Cziko, "Teacher adoption of technology: A perceptual control theory perspective," *Journal of Technology and Teacher Education,* vol. 9, no. 1, pp. 5-30, 2001.

[16] R. Bates, and S. Khasawneh, "Self-efficacy and college students' perceptions and use of online learning systems," *Computers in Human Behavior,* vol. 23, no. 1, pp. 175-191, 2007.

[17] P.-C. Sun, R. J. Tsai, G. Finger, Y.-Y. Chen, and D. Yeh, "What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction," *Computers & Education,* vol. 50, no. 4, pp. 1183-1202, 2008.

[18] C. S. Chai, J. H. Ling Koh, C.-C. Tsai, and L. Lee Wee Tan, "Modeling primary school pre-service teachers' Technological Pedagogical Content Knowledge (TPACK) for meaningful learning with information and communication technology (ICT)," *Computers & Education,* vol. 57, no. 1, pp. 1184-1193, 2011.

[19] M. MANĚNOVÁ, M. Skutil, and P. Zikl, "Taking advantage of ITC by teachers at the primary school." pp. 48-52.

[20] J. R. Wen, and W. L. Shih, "Exploring the information literacy competence standards for elementary and high school teachers," *Computers & Education,* vol. 50, no. 3, pp. 787-806, 2008.

[21] Wii, "Wii is more," *(Retrieved May, 2013), http://www.nintendo.com/wii*, 2013.

[22] PlayStation, *(Retrieved May, 2013), http://asia.playstation.com/*, 2013.

[23] X. Kinect, (*Retrieved May, 2013), https://www.microsoft.com/en-us/kinectforwindows/*.

[24] J. C. Lee, "Hacking the nintendo wii remote," *Pervasive Computing, IEEE,* vol. 7, no. 3, pp. 39-45, 2008.

[25] N. Papanikolopoulos, "Minnesota Prof. Uses Xbox Kinect For Research," *(Retrieved May, 2013), http://minnesota.cbslocal.com/2011/03/14/minnesota-prof-uses-xbox-kinect-for-research/*, 2011.

[26] Y.-J. Chang, S.-F. Chen, and J.-D. Huang, "A Kinect-based system for physical rehabilitation: A pilot study for young adults with motor disabilities," *Research in developmental disabilities,* vol. 32, no. 6, pp. 2566-2570, 2011.

[27] B. Lunt, J. Ekstrom, H. Reichgelt, M. Bailey, and R. Leblanc, "IT 2008: the history of a new computing discipline," *Communications of the ACM,* vol. 53, no. 12, pp. 133-141, 2010.

[28] Z. Marquardt, J. Beira, N. Em, I. Paiva, and S. Kox, "Super Mirror: a kinect interface for ballet dancers." pp. 1619-1624.

[29] N. Álvarez, and F. Peinado, "Exploring body language as narrative interface," *Interactive Storytelling*, pp. 196-201: Springer, 2012.

[30] C.-H. Chao, Y.-C. Chen, T.-J. Yang, and P.-L. Yu, "Intelligent Classroom with Motion Sensor and 3D Vision for Virtual Reality e-Learning." pp. 27-33.

[31] ALA, "Information Literacy," *(Retrieved May, 2013), http://www.ala.org/tools/atoz/profresourcesinfolit/information_literacy*, 1974.

[32] C. C. Kuhlthau, *Information Skills for an Information Society: A Review of Research. An ERIC Information Analysis Product*: ERIC, 1987.

[33] C. R. McClure, "Network Literacy: A Role for Libraries?," *Information Technology and libraries,* vol. 13, no. 2, pp. 115-25, 1994.

[34] F. G. Barbeite, and E. M. Weiss, "Computer self-efficacy and anxiety scales for an Internet sample: Testing measurement equivalence of existing measures and development of new scales," *Computers in Human Behavior,* vol. 20, no. 1, pp. 1-15, 2004.

[35] T. M. Link, and R. Marz, "Computer literacy and attitudes towards e-learning among first year medical students," *BMC Medical Education,* vol. 6, no. 1, pp. 34, 2006.

[36] N. Mattheos, A. Nattestad, M. Schittek, and R. Attström, "Computer literacy and attitudes among students in 16 European dental schools: current aspects, regional differences and future trends," *European journal of dental education,* vol. 6, no. 1, pp. 30-35, 2002.

[37] V. Terzis, and A. A. Economides, "The acceptance and use of computer based assessment," *Computers & Education,* vol. 56, no. 4, pp. 1032-1044, 2011.

[38] P. R. Pintrich, "A manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ)," 1991.

[39] EBSS, "Information literacy standards for teacher education," *(Retrieved May, 2013), http://crln.acrl.org/content/72/7/420.full (EBSS Instruction for Educators Committee)*, 2011.

[40] F. D. Davis, "Perceived usefulness, perceived ease of use, and user acceptance of information technology," *MIS quarterly*, pp. 319-340, 1989.

BIOGRAPHIES

Shu-Yuan Tao is currently an Associate Professor at the Department of Multimedia Design in Takming University of Science and Technology. She received her Ph.D. degree from the Department of Computer Science & Engineering in Yuan Ze University, Taiwan. Her research interests include computer-supported collaborative learning and digital game-based learning.

Tsung-Yen Chua ng is currently an Associate Professor of the Department of Information and Learning Technology in National University of Tainan. He earned his Ph.D. degree from the Department of Curriculum and Instruction at The Pennsylvania State University, specializing in instructional design and play theories. He chose his supporting field from the Department of Instructional Systems for his doctoral study. Currently his research focuses on digital game-based learning, instructional design, creativity, media literacy, cognitive development, and occupational therapy. He designs, builds, and studies ways for digital games to enhance thinking and learning in various fields. Other interests include the use of design activities as a behavioral therapy, and uses of digital game systems in cognitive learning.

Yun-Hsuan H uang is an instructor of the Department of Applied Foreign Languages at Chia Nan University of Science and Technology, Taiwan. Currently, she is a Ph.D. candidate of the Department of Information and Learning Technology at National University of Tainan, Taiwan. She received her M.A. in Linguistics from Eastern Michigan University and M.S. in Instructional Technology and Media from Teachers College, Columbia University. Her research interests include technology-assisted language learning, digital game-based learning, technology-mediated communication, and mobile learning.