Applying Wearable Technology in English Adaptive Learning and Evaluating Learning Performance

Shu-Chun Ho, Department of Software Engineering and Management,
National Kaohsiung Normal University, Taiwan
Sheng-Wen Hsieh, Department of Management Information Systems,
Far East University, Taiwan
Shin-Shian Sung, Department of Software Engineering and Management,
National Kaohsiung Normal University, Taiwan

The Asian Conference on Education 2016
Official Conference Proceedings

Abstract
Wearable technology is predicted as the next big shift in technology and innovation. The applications of wearable technology in teaching and learning are expected to accelerate learning performance in the education context. For example, language learning or musical instrument playing requires a lot of hours practice to create the ability and accumulate skills. Whether wearable technology can accelerate English as a second language learning (ESL) and improve learning performance has been considered as an interesting and important research question. The objective of this paper is to develop an adaptive learning system which applies wearable technologies, Mozbii-a color-ware tool, with Electroencephalography (EEG) to examine ESL learners' performance, experimenting with one hundred and six elementary students. We expect our proposed multi-sensory tangible approaches help the students in their ESL's learning performance. The findings of this paper contribute to the practice of wearable technology applications in ESL learning and teaching.

Keywords: English as a second language (ESL), Wearable Technology, Multi-sensory Tangible Learning, Adaptive Learning, Learning Performance

iafor
The International Academic Forum
www.iafor.org

Introduction

Technology makes good quality of human life (Park & Jayaraman 2003), it has expanded to different fields and has predicted that will grow rapidly from 2013 to 2019 at the technology market. Recently, it not only has great development on sport and health care, more and more academic articles get the research between digital learning and wearable technology, applying on kinds of teaching. We can help learners learn well by helping and integrate wearable devices with adaptive strategy, providing feedback and assistance (Valerie & Brendon 2003), expect to increase the learning performance. And different individuals will get different results actually.

Shams & Seitz proposed the importance of multiple sensory learning approaches in 2008, and in recently years, it tends to apply technology to English or mathematic learning and so on. However, children still can make good performance on learning knowledge. English is regarded as the second language for the human being, but it may face much difficulty when learning because of lack of proper advises, so we can achieve the goal that is expected (Chen et al 2015). Therefore, the purpose of this study is to integrate wearable with Mozbii, emphasized on English's importance. And design the individual learning by adaptive ways, make the learning process be more interesting, and understand the effect of this new teaching way on learning performance.

This study has three primary questions we want to realize: First, will adaptive learning affect the learner's learning performance and enhance the learning performance? Second, will the system affect the learner's learning attention through adaptive learning? Finally, compare to traditional teaching and analyze the learning satisfaction on students to create innovate teaching ways.

This paper is organized as follows: The next section provides an overview of the literature. The subsequent section presents a research method and process, then analyze the data in chapter 4, we describe the results of the research and end with the discussion and a summary conclusions.

Literature Research

2-1 English as second language (ESL)

According to the British Council survey in 2013, more than two billion people communicate with English in the IT, science, and business fields until 2020, and the number of non-native speakers exceeds that native speakers (Yuliya et al 2015). The way using technology to improve language learning can be traced back to a century ago when Clark used phonetic recorders for speech modeling (Juliana & Alfred 2014; Kuiper & Kuiper 2003). Over-depended on the traditional dictionary but dictionaries can't provide proper advice (Chen et al. 2016). Nowadays, students are more and more likely to get information on the Internet easily. As students are easily affected by new technology, some scholars have started to discuss the improvement of traditional English teaching. Technology can not completely overcome the difficulties of English learning and teaching, but it can be a springboard for the development of English teaching. For these learners, pictures, brief descriptions, and voices can build their strength through technological applications and new strategies and achieve

Grammarly 11/23/2016 1:17 PM
Comment [1]: Deleted:,

Grammarly 11/23/2016 1:17 PM
Comment [2]: Inserted: es

Grammarly 11/23/2016 1:17 PM
Comment [3]: Inserted: t

Grammarly 11/23/2016 1:17 PM
Comment [4]: Inserted: s

Grammarly 11/23/2016 1:17 PM
Comment [8]: Deleted:n

Grammarly 11/23/2016 1:17 PM
Comment [5]: Inserted: y

Grammarly 11/23/2016 1:17 PM
Comment [6]: Inserted: the

Grammarly 11/23/2016 1:17 PM
Comment [7]: Inserted: is

Grammarly 11/23/2016 1:17 PM
Comment [9]: Deleted:be

Grammarly 11/23/2016 1:17 PM
Comment [10]: Inserted: the

Grammarly 11/23/2016 1:17 PM
Comment [11]: Inserted: the

Grammarly 11/23/2016 1:17 PM
Comment [13]: Deleted:s

Grammarly 11/23/2016 1:17 PM
Comment [12]: Inserted: he t

step-by-step learning outcomes (Kathy 2014).

Grammarly 11/23/2016 1:17 PM
Comment [14]: Deleted:,

2-2 Adaptive Learning (AL)

The definition of adaptive mainly emphasizes on the design of learners' learning environments according to one individual characteristic. Different individuals will get different results and different performance in the learning process (Shute & Towle 2003). And the system can provide answers through immediate learning, so as to achieve the role of knowledge feedback. However, the greatest system should involve different activities and teaching methods, so that learners can receive the different knowledge transmission and presentation. It seems that learning opportunities are no longer limited by applying flipping classroom, compared to traditional learning, will be more interesting and more easily accepted. The objective of adaptive learning is to provide appropriate instructional contents for each learner at the right time and the proper time. We are now focused on how to build a good learning attention and attitude in digital learning and learning content. We present a simple introduction and describe the research model.

Grammarly 11/23/2016 1:17 PM
Comment [16]: Deleted:s

Grammarly 11/23/2016 1:17 PM
Comment [15]: Inserted: ed

Learners can obtain the learning materials by the learning design, and teacher can understand the state and offer a feedback rapidly on time. Combing adaptive strategy with education technology field can be divided into three modes, personalized learning path, personalized learning content, and personalized presentation. The adaptive approach provides learners with appropriate online learning path in according to personal demanding, and guide. After finishing the learning task we can analyze the results or performance and feedback, offer the mistakes and wrong places in the end.

Grammarly 11/23/2016 1:17 PM
Comment [17]: Inserted: The a

Grammarly 11/23/2016 1:17 PM
Comment [18]: Deleted:A

Figure 1. Adaptive process

The goal of adaptive e-learning is aligned with exemplary instruction: delivering the right content, to the right person, at the proper time, in the most appropriate way-any time, any place, any path, any pace (NASBE, 2001)。There’re different parts in adaptive system, first, the activities we deliver to them must let students understand the creativity of courses. If learners are looking forward to the learning outcomes, we must actively integrate into the curriculum inside; second, the course must be presented to learners in diversified ways by a concept or rule, so that the adaptive mechanism can provide individual learners’ learning path and measure learners' learning attitude. At the same time, when the learners learn to fail or ineffective, also give another presentation, and immediately get the content (Shute & Towle 2003). The diversity of teaching ways needs to include different visual effects, such as text and image comparison, or in different images to render the same concept. Third, learners are provided with a final learning activity that reflects learners' knowledge on learning and integrates it. In the end, the system will support and assist learners to spend time learning, not just enjoy the effort of using the system to easily identify learners' cognitive components (Shute & Towle 2003).

Grammarly 11/23/2016 1:17 PM
Comment [19]: Inserted: s

2-3 Multisensory Tangible Learning

The way about multi-sensory teaching to enhance the memory has been a long story, and a series of multiple sensory techniques have been used in early teaching courses to enrich learning and motivate learners (Montessori, 1912). DfES (2004) defines multiple sensors as the use of visual, auditory, kinesthetic patterns at the same time. Multi-sensory learning techniques have also been shown to contribute to the learning and development of foreign languages (Kalivoda, 1978). At the most basic level, our brains are receptive to activity through five senses, see, hear, touch, smell, and taste (Jubran 2012).

Grammarly 11/23/2016 1:17 PM
Comment [20]: Inserted: ,

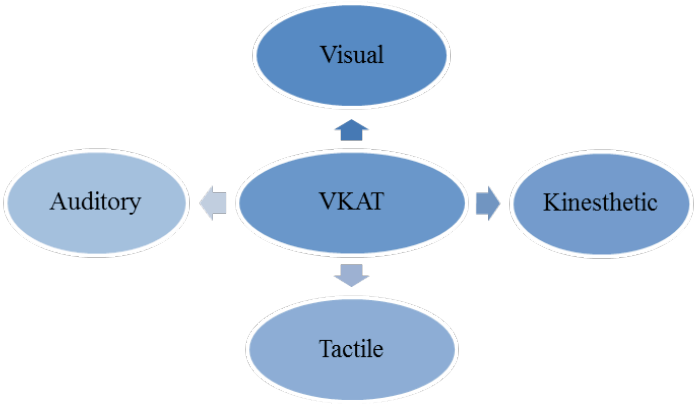

Figure 2. VAKT Model

Different people with different senses have different perception and experience, but most people learn through multiple senses, will learn better. New teacher follows the wisdom of Confucius: "I have heard but I have forgotten; I have seen so I remember; I did so I know it." When a learner devotes his or her whole heart, he learns to use multiple senses to learn. The multi-sensory teaching approach is an effective method for learners. In general, multi-sensory means that present information in three or more patterns, such as vision, touch, and hearing. Visual presentation involves the use of graphical organization to construct the curriculum, auditory means the details of the discussion or loud reading; touch contains the content of the object-oriented presentation and can be held in the actual experiment. Overall, it is not difficult to implement a multi-sensory approach. In fact, there are already many teachers using this method. This is a very important strategy. However, it is necessary to review the three models and try to integrate them better. Jubran 2012).

Grammarly 11/23/2016 1:17 PM
Comment [21]: Inserted: The m

Grammarly 11/23/2016 1:17 PM
Comment [22]: Deleted:M

Grammarly 11/23/2016 1:17 PM
Comment [23]: Deleted:,

Table 1. Multisensory Tangible Learning

Authors	Theme	Theory	Method	Variables	Findings
Jubran 2012	Using multi-sensory approach for teaching English skills.	Multi-Sensory Approach	Experiment	Gender	As a result of this experience, the researcher concluded that students were more engaged in learning when they were given a chance to use all their senses.
Faivre et al 2014	Multisensory Integration in Complete Unawareness.	Multi-Sensory Approach, global-neuronal-workspace theory	Experiment	Semantic relations and prime-target congruency	Our findings reveal that the relations between conscious and unconscious integrative processes are more complex than sometimes assumed (Mudrik et al., 2014).
Mitchel & Weiss 2011	Cross-Modal Effects in Multisensory Statistical Learning.	Multi-Sensory Approach	Experiment	Test type	We found that learners were able to segment both the visual and auditory input streams successfully.
Lim et al 2011	Multisensory Convergence with a A network of Spiking Neurons.	Multi-Sensory Approach, Graph theory	Experiment	In strength	The results show that the proposed convergence model is enough to produce various types of neurons
Laur´ıa 2016	A multimedia And multisensory guidebook for cultural towns.	Multi-Sensory Approach	Experiment, Survey	Two user groups	Finally, an integration of the guidebook informative Contents would be useful. For instance, one thinks about specific food information for people with food disorders.

Grammarly 11/23/2016 1:17 PM
Comment [24]: Inserted: A n

Grammarly 11/23/2016 1:17 PM
Comment [25]: Deleted:N

2-4 Wearable Technology

According to Clark (1918), the use of phonograph recordings to establish pronunciation models for language learners, the use of techniques to improve language learning dates back almost a century ago (Chau & Lee 2014). Current Trends talking about Internet of Things (IOT) has evolved its business model in the IT field, and wearable technology has expanded to include health, medical and other sections. In this study, the Neurosky electroencephalogram (EEG) instrument consists of two sensor disks, one touching your forehead and the other touching your left earlobe in a clip. It must be connected via USB to the computer and transmit brain wave data, it needs to install the software system so it can be used. (Mark 2012)

Grammarly 11/23/2016 1:17 PM
Comment [26]: Inserted: s

Table 2. Mindwave values

Value	Hz	Definition
α wave	8-12	Imagination, relax
β wave	12-30	Sober, Stress, Tension, Anxiety
θ wave	4-8	Subconscious, Deep sleep, Perception, Emotion
δ wave	0.5-4	Unconscious

2-5 Learning Performance

Learning performance refers to the change of learners' knowledge, skills and attitudes after finishing the course. It is a measure of a learner's learning achievement and is one of the main items in teaching quality evaluation. A basis for improvement and adjustment for learners and teachers. The core of learning effectiveness assessment is to assess the learner's knowledge level, explicit behavior due to knowledge, and analyze the participation in the learning process, and use the test to evaluate the learning effect, and the learning performance will be affected by the learner's learning pattern, Learning curriculum, and teaching patterns (Milos et al 2014). Cognitive load, instructional research, and methodological design affect each other, so they need to be analyzed together to achieve the best learning outcomes. Many previous studies have shown that learners' learning motivations and cognitive outcomes are influenced by interactions with the learning curriculum and are related to the effectiveness of the learning process.

Research Method

3.1 Research Architecture

The study process is divided into eight steps, which will be described in detail below. The first step is to confirm the research motivation and purpose according to the current development of information technology field. After defining the scope and object of the study, the relevant research and literature will be explored. As shown in Figure 3, the design of the system and adaptive strategy will be carried out. After the system experiment, with the fore knowledge of English test, in the follow-up to analyze the performance of learning.

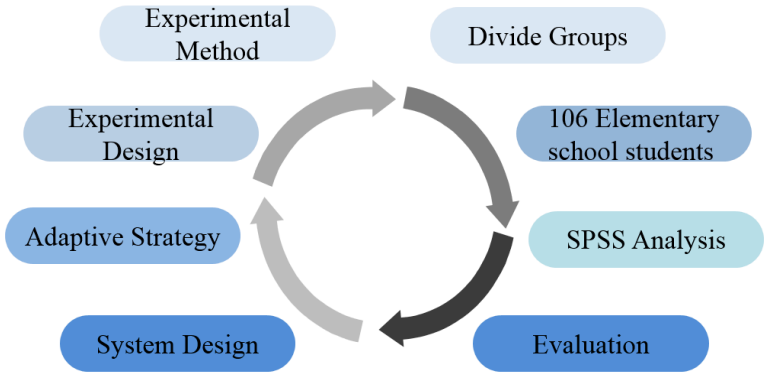

Figure 3. Research Architecture

In the research process, we explain the system operation manual for about 10 minutes, test and learn with the adaptive learning system about 30 minutes, use the gap of pretest and posttest to compare the learning performance among four groups and provide questionnaires for students of understanding the learning satisfaction.

Grammarly 11/23/2016 1:17 PM
Comment [27]: Inserted: the

Grammarly 11/23/2016 1:17 PM
Comment [28]: Inserted: ing

Grammarly 11/23/2016 1:17 PM
Comment [29]: Deleted:e

Grammarly 11/23/2016 1:17 PM
Comment [30]: Inserted: g

Grammarly 11/23/2016 1:17 PM
Comment [31]: Inserted: amo

Grammarly 11/23/2016 1:17 PM
Comment [32]: Inserted: the

Grammarly 11/23/2016 1:17 PM
Comment [33]: Deleted:betwee

3.2 Research Process

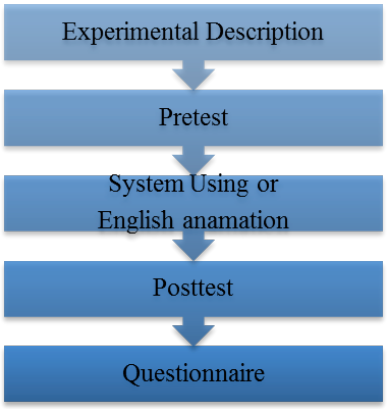

Figure 4. System Process

3.3 Data

The study was conducted in Kaohsiung and Tainan in the summer of July and August 2016. There were 106 elementary school students, including 4 to 6 grades, and a total of 106 pre-tests and post-tests, collecting posttest satisfaction questionnaires.

Grammarly 11/23/2016 1:17 PM
Comment [36]: Deleted:,

Grammarly 11/23/2016 1:17 PM
Comment [34]: Inserted: s

Grammarly 11/23/2016 1:17 PM
Comment [35]: Inserted: s

Grammarly 11/23/2016 1:17 PM
Comment [37]: Inserted: the

Table 3. Group definition

Number	**interactive (with Mozbii)**	**no interactive (Traditional)**
with the adaptive strategy (with Neurosky)	32(Integrated)	24(Neurosky)
no adaptive strategy (Traditional)	26(Mozbii)	24(Control)

3.4 Environment

Table 4. Environment and devices

Field	Brand	Requirements
iPad	Samsung	Windows
System	App	Android Studio, JAVA
Tool	Mozbii	Bluetooth 4.2
Tool	Neurosky	Bluetooth 4.0, Software, Battery4

Data Analysis

We use English pretest to examine whether there are different on English proficiency, The results showed that there was no significant difference in English language knowledge among the four groups($F = 1.284$, $p = 0.626 > 0.05$).

Pretest	N	Mean	Std.	F
Control	24	50.20	26.35	1.284
Neurosky	24	50.10	10.43	
Mozbii	26	51.44	11.49	
Integrated	32	60.78	35.9	

However, after a time spent on use, the posttest results showed that the four groups of students in the relevant knowledge of the English language significantly different ($F = 8.34$, $p < 0.001$). In addition, after Scheffe expost test, we found that the integrated group of posttest results is higher than the mozbii group, brain wave group and control group.

Grammarly 11/23/2016 1:17 PM

Comment [38]: Inserted: is

Grammarly 11/23/2016 1:17 PM

Comment [39]: Deleted:are

Posttest	N	Mean	Std.	F	Post Hoc
Control	24	50.41	25.02	8.34***	Integrated > Mozbii *
Neurosky	24	60.72	13.70		Integrated > Control ***
Mozbii	26	2.98	19.28		
Integrated	32	80.54	29.22		Integrated > Neurosky *

Findings

We found that children are curious and feel excited on contacting new technology tools, and the students' learning satisfaction are generally higher than others, accepting new different ways. The study found that the integrated group learning results are higher than the brain wave group and the mozbii group, and even higher than the traditional teaching control group.

Conclusions

Through the use of wearable technology can trigger the interaction of different fields or events, so that the system perceives the related information of learners (Strohrmann et al, 2013; Strohrmann, Seiter, & Tröster, 2014), and thus provide feedback, so that learning and the environment closely linked, this learning model is called "context-aware learning" Context-aware learning (Dey, 2001). At the same time, the learning system can analyze the learners' learning state and interaction under the situation learning, and provide personalized and adaptive learning support and guide, which is called "adaptive learning" (Adaptive learning, which is broadly defined as a process that fits the learner by adjusting the behavior or function of the system (Gómez, Zervas, Sampson, & Fabregat, 2014).

In this study, the limitations of the study include that, it need to improve the accuracy of the device itself, and the interference of signals and links between many devices in the same location using at the same time. In the future, we hope to integrate more wearable science and technology into different fields to learn or use in different areas, even with the context of perception and measurement of heart rate, so that learners can feel as if in the right environment to experience more interesting learning. How to use the wearable technology to make learners interact closely in a good learning environment through context-awareness and record the interaction generated in the learning process as the basis for learning to guide and adapt to real-time, will be worthwhile to explore.

References

Chau, J., and Lee, A. (2014) "Technology-enhanced language learning (TeLL): An update and a principled framework for English for Academic Purposes (EAP) courses." Canadian Journal of Learning and Technology, 40(1).

Chen, W. F., Chen, M. H., Chen, M. K. L., and Ku, L. W. (2016) "A Computer-Assistance Learning System for Emotional Wording" *IEEE Transactions on Knowledge and Data Engineering,* 28(5), 1093-1104.

Francis, W.S., Tokowicz, N., and Kroll, J.F. (2014) "The consequences of language proficiency and difficulty of lexical access for translation performance and priming", *Memory & cognition*, 42(1), 27-40.

"Intelligent Adaptive Learning: An Essential Element of 21st Century Teaching and Learning." White Paper, (2014).

Jubran, S. (2012) "Using multi-sensory approach for teaching English skills and its effect on student's achievement at Jordnian schools." European Scientific Journal, 8(22), ISSN: 1857 – 7881.

Juliana, C., and Alfred, L. (2014) "Technology---Enhanced Language Learning (TELL): An Update and a Principled Framework for English for Academic Purposes (EAP) Courses." *Canadian Journal of Learning and Technology*, 40(1).

Kathy, B. (2014) "Digital Stories: A 21st-Century Communication Tool for the English Language Classroom." English Teaching Forum, United States.

Kuiper, A., and Kuiper, K. (2003). "Constructing vocational aspirations linguistically. Globalization", *Societies and Education*, 1, 223-240.

Milos, L., Vojkan, V., Srecko, S., and Jelena, V. (2014) "Using Supplementary Video in Multimedia Instruction as a Teaching Tool to Increase Efficiency of Learning and Quality of Experience." *The International Review of Research in Open and Distance Learning*, 15(3).

Mark, G. (2012) "NeuroSky MindWave: Fun with Brainwaves." www.netwoekworld.com

Obaid, M.A. S. (2013) "The Impact of Using Multi-Sensory Approach for Teaching Students With Learning Disabilities" *Journal of International Education Research*, 9(1).

Shute, V., and Towle, B. (2003) "Adaptive E-Learning" *Educational Psychologist*, 38(2), 105-114.

Sun, P. C., Tsai, R. J., Finger, G., Chen, Y. Y., and Yeh, D. (2008) "What Drives a Successful E-Learning? An Empirical Investigation of the Critical Factors Influencing Learner Satisfaction." *Computer & Education,* 50(4), 1183-1202.

Grammarly 11/23/2016 1:17 PM

Comment [40]: Inserted: z

Grammarly 11/23/2016 1:17 PM

Comment [41]: Deleted:s

Wendy, S.F., Natasha, T., and Judith, F.K. (2014) “The Consequences of Language Proficiency and Difficulty of Lexical Access for Translation Performance and Priming.”

Whyte, S., and Alexander, J. (2014) “Assisted Language Learning (CALL): towards a developmental framework.” *Canadian Journal of Learning and Technology*, 40(1).

Yuliya, A., Lori, N.M., and Brian, H. (2015) “Negotiation, Embeddedness, and Non-Threatening Learning Environments as Themes of Science and Language Convergence for English Language Learners.” *Studies in Science Education*, 51(2), 201-249.

Contact email: 610477204@mail.nknu.edu.tw