International Journal of Multimedia and Ubiquitous Engineering
Vol.9, No.7 (2014), pp.347-358
http://dx.doi.org/10.14257/ijmue.2014.9.7.29

# A Natural User Interface for E-learning Learners : Focused on the Automatic Speed Control of Multimedia Materials

Minjae Park[1], Joohee Kang[1], Seongwon Park[1*] and Kwangsu Cho[2*]

[1]*Sungkyunkwan University, 25-2, Sungkyunkwan-ro, Jongno-gu, Seoul 110-745, Korea*
[2]*Graduate School of Information, Yonsei University, 50, Yonsei-ro, Seodaemun-gu, Seoul 120-749, Korea*
*{vrotoss, kangjooing, seongwon.ellie.park, kwangsu.cho}@gmail.com*

***Abstract***

*There are few previous empirical studies on an automatic speed control of multimedia materials based on a natural user interface (NUI) that distinguish note taking from watching to a lecture through nodding. This study conducted two experiments and an interview. First, in experiment 1, we found that there is significant relevancy between the participants' action of lowering their head and note taking. Second, we determined that nodding that lasts less than two seconds has no relationship to note taking. In experiment 2, we determined that the e-learning system with the automatic speed control of multimedia materials reported less learner manual control, clicking pause and rewind buttons, than the regular e-learning system. For the interview, the analysis shows that "The automatic speed control of multimedia materials" and "Note taking" influence "Participant's satisfaction" positively.*

***Keywords:*** *E-learning, Natural User Interface, NUI, Head Gesture, Nodding*

## 1. Introduction

According to predictions made by Tech Navio, USA, the global e-learning market will grow 7.9% over the period 2012-2016 [1]. In the future, the amount of on-line learners will increase because of advances in technology, such as smart mobile devices and a learning network. The characteristics of media learning empower individual learners to pursue self-directed learning, and allow learners to become responsible for various decisions associated with their learning endeavor and satisfaction [2]. Moreover, media players allow students to interact with their courses. For example, students can manipulate a keyboard or a mouse to pause and rewind the content played in the media player. Recently, the field of education has promised that the adoption of new interaction paradigms, such as a natural user interface (NUI), will be presented. This field is promising a direction towards more natural and effective learning experiences [3]. The NUI environment allows learners to manipulate media interface via natural gestures in accordance with intrinsic pattern of behavior [4]. A previous study shows that the most common action of learners is clicking pause and rewind buttons. Bassili & Joordens (2008) indicated that 47% of students expressed that the purpose of clicking a pause button is to note taking, and 63% of students expressed that the purpose of clicking a rewind button is to review material that is not clear [5]. In other word, controlling media players when watching to a lecture is an important feature in media learning. Di Vesta and Gray (1972) indicated that note taking is beneficial because it serves as an external storage mechanism. Notes were considered to be a record of the information that students

* corresponding author

ISSN: 1975-0080 IJMUE

encode [6]. Further, learners also believe that the very act of note taking helps them pay attention to the learning materials [7].

Chou and Liu (2005) reported that learner control is related to learning effectiveness and learning satisfaction [8]. Because media controls are used by learners to adjust media playback speed in order to take notes easily, such controls are important for enhancing learning effects. In fact, controlling a computer through natural interaction is more convenient for human beings [9]. Diverse studies have reported that learning through NUI enhances a learner's sense of presence and the flow of learning more than regular learning interfaces [4].

To the best of our knowledge, there are a few previous experimental studies that suggest new methods for pause and rewind functions based on NUI. And there is no empirical research to distinguish situations from nodding time whether they do note taking or not. In our previous research, we analyzed relationships between nodding time and note taking and simply experimented on learner who clicked pause and rewind buttons [10]. In this research, we reinforce research process and add sample as well.

In this research, we designed a system for the automatic speed control of multimedia materials through the learner's heard angle without direct manipulation of the mouse or keyboard in order to click pause and rewind buttons and analyzes the effectiveness of this system for learners.

The purpose of this study is to research the effects on learners of controlling multimedia materials automatically, such as through NUI. Research questions are following.

Research Question1: Does the leaners' head angle distinguish situations of note taking from those of watching to a lecture?

Research Question2: Does the automatic speed control of multimedia materials by the learners' head angle have an effect on learners' satisfaction?

## 2. Literature Review

### 2.1. Interactions in E-learning

Interaction is one of the key elements that influence learning. Kearsley and Moore (1989) have identified three types of interactions that are important in learning: learner-content interaction, learner-instructor interaction and learner-learner interaction [11]. As computer technologies emerge, learner-interface interaction is proposed as an additional important interaction in e-learning [12]. Because learner-interface interaction is a process of manipulating tools to accomplish a task, clicking pause and rewind buttons is an element of the learner-interface interaction. Williams (1996) reported that learner control is an important feature in e-learning, because it allows learners to make decision by themselves [13]. This interaction is closely linked to metacognition because the learner can monitor his or her understanding of incoming information in order to control over its learning flow [14, 15]. Therefore, learner control has an effect on a variety of concepts, for example, goal and content selection, time management on a scale of tasks, etc. [16] For these reasons, capabilities of clicking pause and rewind buttons in e-learning is important in the implementation of metacognitive activities, such as planning how to approach a given learning task, monitoring comprehension and evaluating progress toward the completion of a task [8].

### 2.2. Natural User Interface

The advance of computing technology has affected human-computer interaction. Currently, NUI is highlighting intuitive actions, as an alternative to a command-line interface (CLI) or graphical user interface (GUI). Because the gesture recognition connects between

 

human motions and a computer very naturally, it is considered as a representative example of NUI [17]. As gestures are well suited for moving in three-dimensional space, it is easy to interact with a computer and diverse expressions. The development of this technology, especially the use of head gestures among various body gestures, is prevalent in the field of study about drowsiness [18]. Furthermore, the use of NUI has also been studied for disabilities [19]. In the field of education, activity based NUI is eased through a design which gives the learner the feeling that they are immediately and continuously successful. This aided by technology. NUI allows learners to carry out relatively natural gestures, and they quickly accustom the control of the computer application and manipulate the learning contents on the computer screen [20]. Besides, learner-computer interaction through gestures is frequently used for e-training. E-training refers to education training that acquires and enhances the capabilities necessary to perform tasks using communication and information technology, such as virtual reality and augmented reality, and devices such as head mounted displays. E-training allows learners to increase their sense of flow and presence as they experience a participatory learning system [4]. Previous studies have demonstrated that learner-interface interaction via natural gestures can be effective to learning.

## 3. Research Methodology

In this research, we conducted two experiments and an interview. In experiment 1, we measured the participants' nodding time and head angle in order to analyze the relevancy between note taking and nodding. Experiment 2 was performed after experiment 1 was finished. In experiment 2, we analyzed the difference between the number of pause button clicked and the number of rewind button clicked in the e-learning system with the automatic speed control of multimedia materials and the regular e-learning system. In the interview, we analyzed whether the automatic speed control of multimedia materials satisfied the participants, and the types of factors that affect learner satisfaction.

Twenty individuals participated in experiment 1. Eleven of the participants were male and nine were female. Eight of the participants were university students and twelve were graduate students. Eighteen participants are twenties. And two participants are thirties. Thirty individuals participated in experiment 2. Eighteen of the participants were male and twelve were female. Fourteen of the participants were university students and sixteen were graduate students. Twenty seven participants are twenties. And three participants are thirties. Thirty individuals participated in the interview conducted after experiment 2. The participants experienced with both the regular e-learning system and the proposed system. Table 1 shows demographics for experiment 1 and experiment 2.

**Table 1. Descriptive Statistics**

| | | No. of participants in experiment 1 | No. of participants in experiment 2 |
|---|---|---|---|
| Age | 20-29 | 18 | 27 |
| | 30-39 | 2 | 3 |
| Sex | Male | 11 | 18 |
| | Female | 9 | 12 |
| Job | Undergraduate student | 8 | 14 |
| | Graduate student | 12 | 16 |

### 3.1. Experiment 1

Figure 1 shows experiment environment. All participants watched to a lecture via a 21-inch monitor, and there were no limitations for using a keyboard and a mouse. They were provided a notebook and a ballpoint pen, in order to taking notes. To monitor the participants' nodding, a horizontally striped paper of size A1 was placed on the wall adjacent to the participant and line is at intervals ten centimeters on a paper. Two researchers observed each participant simultaneously, and four researchers reviewed the video clips. Experiment environment is shown in figure 1.

The participants' nodding was observed and the number of times that the participants lowered their head was counted. These metrics were analyzed to determine the number of times that the participants simultaneously lowered their head and took notes. All experiments were recorded on video clips. The subject of the lecture was English that the lecture is delivered by a famous TOEIC (test of English for international communication) instructor. English grammar content was chosen because there is a significant amount of note taking required for grammar lectures, and such an activity is extremely important for the subject. In addition, English is a popular subject in Korea. GOM Media Player was used as the media player for e-learning, because it is the most popular media player in Korea.

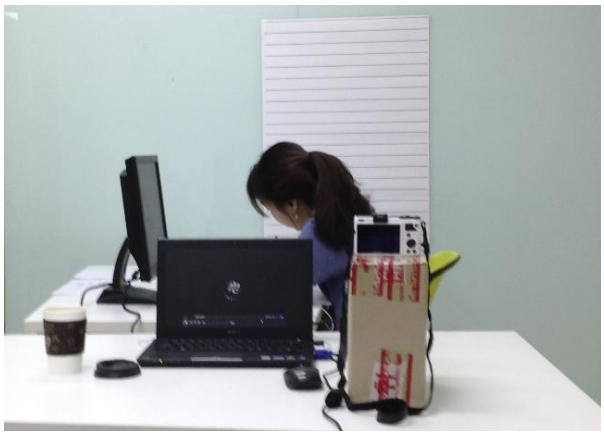

**Figure 1. Experiment Environment**

### 3.2. Experiment 2

Experiment 2 was divided into two sessions, the A session (regular e-learning system) and the B session (proposed e-learning system) and all individuals participated in both sessions in a within-subjects design. Like a previous experiment 1, all participants watched a lecture and manipulate a media player using a mouse and a keyboard anytime they want. GOM Media Player was used as the media player, GOM Media Player is most famous media player in Korea and pause and rewind buttons are easy to control. In GOM Media Player, the playback speed is increased when the "x" key is pressed on the keyboard, and it is decreased when the "c" key is pressed. In figure 2 shows speed control on GOM Media Player.

In the A session, the participants studied the lecture as usual with the regular e-learning system. In the B session, the participants studied the lecture with the proposed system using the automatic speed control of multimedia materials. The researchers controlled the playback speed depending on the angle of the participants' head. When a participant lowered his or her head and stayed more than two seconds, a researcher reduced the playback speed to 0.8x, which is 0.2 times slower than the lecture's normal speed. After the participant raised his or

 

her head, the playback speed was returned to normal. The horizontally striped A1 paper placed adjacent to the participant was used to identify the head angle. Two researchers observed each participant simultaneously, and four researchers reviewed the video clips. Researchers can observe difference in the participant's head angle between the watching a lecture and taking notes.

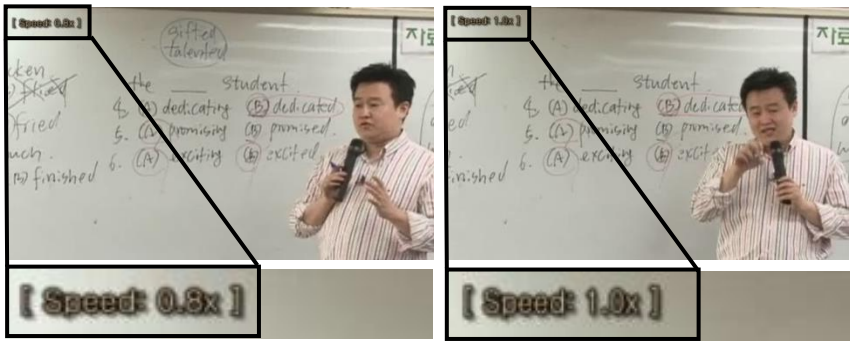


**Figure 2. Speed Controller of Multimedia Materials in GOM Media Player**

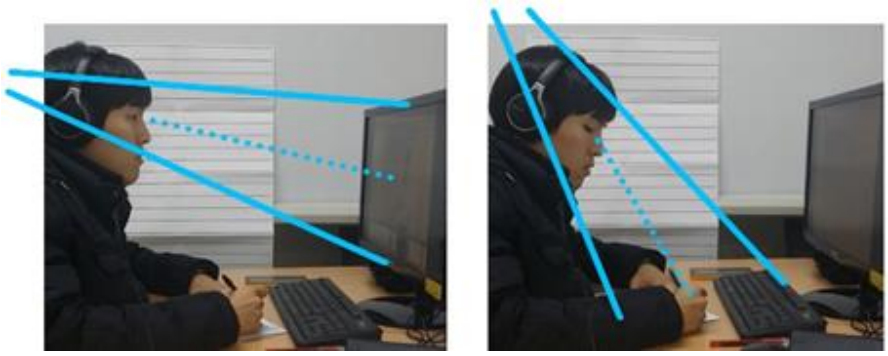

**Figure 3. Head Angles of Watching a Lecture (left) and Taking Notes (right)**

### 3.3. Interview

Thirty individuals participated in the interview conducted after experiment 2. The participants experienced with both the regular e-learning system and the proposed system. Each participant was interviewed for approximately 20 minutes. One researcher asked questions and the other researcher observed the participant. We asked the participants about the automatic speed control of multimedia materials through a learner's head angle, the change of playback speed and tone and the circumstances of note taking. The participants were also asked about their behavior they did in experiments. All participants agreed to record their interview, and the participants' answers were recorded in writing. The written interview script was analyzed through content analysis. The script was coded as a separate meaning unit and important words were selected. The full text was analyzed.

After experiment 2, the participants are asked about the proposed e-learning system with the automatic speed control of multimedia materials. First, the questions are about a participant's study habit in e-learning. The questions are such as these: How many times do you use the e-learning system a week? How many times do you click pause and rewind buttons during e-learning? Second, the questions are about the automatic speed control of multimedia materials. The questions are such as these: What do you think of speed control of

multimedia materials? How many times did you click pause and rewind buttons usually? Third, the questions are about note taking. The questions are such as these: Is the automatic speed control of multimedia materials helpful to your note taking? Does the automatic speed control of multimedia materials has an effect on a quality and quantity of your note taking? Lastly, we asked about the participant's satisfaction. The questions are such as this: Which session do you prefer between the manual speed control session and the speed control session?

## 4. Results

### 4.1. Experiment 1 Results

In experiment 1, we counted the number of participants' nodding. In addition, it was verified whether the participants took notes when they lowered their head.

First, there was significant relevancy between the participants' action of lowering their head and note taking. Participants were taking notes, confirming the spelling and grammar, or preparing their next note taking. However, some nodding was unrelated. For example, certain participants nodded in order to agree or to lift a pen. The participants' nodding duration and frequency varied from each other. However, the participants lowered their head longer than two seconds when taking notes.

Further, nodding that lasted less than two seconds had no significant relationship to note taking. Such instances of nodding occurred simply to verify their note taking or to nod in agreement. Table 1 lists the experimental data for the duration of head lowering. For the duration of head lowering that lasted less than two seconds, only 6% of the participants took notes. For the duration of head lowering that lasted more than two seconds and less than five seconds, 58% of the participants took notes. However, for the duration of head lowering that lasted more than five seconds, 91% of the participants took notes. Moreover, for the duration of head lowering that lasted more than two seconds and less than five seconds, the participants performed short note taking. Therefore, table 2 indicates that the minimum of time to apply the automatic speed control of multimedia materials is two seconds.

**Table 2. Relationship between the Duration of Lowered Head and Amount of Note Taking**

| | Duration of lowered head (t: seconds) | | |
|---|---|---|---|
| | $t \leq 2$ | $2 < t \leq 5$ | $5 < t$ |
| No. of times head was lowered | 182 | 116 | 148 |
| No. of times notes were taken | 11 | 67 | 134 |
| No. of times notes were taken / No. of times head was lowered | 6% | 58% | 91% |

### 4.2. Experiment 2 Results

In the A session, the average number of pause and rewind buttons clicked is 1.63 times per participant and a standard deviation is 1.16. In the B session, the average number of pause and rewind buttons clicked is 0.23 times per participant and a standard deviation is 0.50. As table 3 indicates, the proposed system with the automatic speed control of multimedia materials is more adjustable than the regular e-learning system. Table 3 shows comparisons

 

between the regular e-learning system (A session) and the proposed system with the automatic speed control of multimedia materials (B session) on the use of the media player's pause and rewind buttons.

**Table 3. Comparisons between Two Sessions on Average Number of Pause and Rewind Buttons Clicked**

| Manual speed control (A session) | | Automatic speed control (B session) | |
|---|---|---|---|
| Average number of pause and rewind buttons clicked | Standard deviation | Average number of pause and rewind buttons clicked | Standard deviation |
| 1.63 | 1.16 | 0.23 | 0.50 |

Table 4 shows the number of pause and rewind buttons participants clicked both in regular e-learning system (A session) and our proposed system, which is e-learning system with the automatic speed control of multimedia materials (B session). In the A session, total number of pause button which participants clicked is twenty eight times and total number of rewind button which participants clicked is nineteen times. In other word, they clicked both pause and rewind buttons forty nine times in regular e-learning system. In the B session, total number of a pause button which participants clicked is four and total number of a rewind button which participants clicked is three. It means they used both pause and rewind buttons seven times in e-learning system with the automatic speed control of multimedia materials. In the B session, as comparisons with the A session, total number of pause and rewind buttons clicked has decreased forty two times.

**Table 4. Comparisons between Regular e-learning System (A session) and e-learning System with the Automatic Speed Control of Multimedia Materials (B session)**

| | Manual speed control (A session) | | | Automatic speed control (B session) | | |
|---|---|---|---|---|---|---|
| | No. of pause button clicked | No. of rewind button clicked | Total no. of buttons clicked | No. of pause button clicked | No. of rewind button clicked | Total no. of buttons clicked |
| Participant 1 (23, male) | 1 | 0 | 1 | 0 | 0 | 0 |
| Participant 2 (25, female) | 0 | 0 | 0 | 0 | 0 | 0 |
| Participant 3 (28, female) | 1 | 0 | 1 | 0 | 0 | 0 |
| Participant 4 (28, female) | 0 | 0 | 0 | 0 | 0 | 0 |
| Participant 5 (25, male) | 2 | 0 | 2 | 0 | 0 | 0 |
| Participant 6 (25, male) | 0 | 0 | 0 | 0 | 0 | 0 |
| Participant 7 (26, male) | 2 | 0 | 2 | 0 | 0 | 0 |
| Participant 8 (26, female) | 0 | 3 | 3 | 0 | 0 | 0 |
| Participant 9 (28, male) | 0 | 2 | 2 | 0 | 0 | 0 |
| Participant 10 (28, male) | 1 | 0 | 1 | 1 | 0 | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Participant 11 (27, male) | 1 | 3 | 4 | 0 | 0 | 0 |
| Participant 12 (28, male) | 2 | 1 | 3 | 0 | 0 | 0 |
| Participant 13 (30, male) | 1 | 0 | 1 | 0 | 0 | 0 |
| Participant 14 (25. female) | 2 | 0 | 2 | 0 | 0 | 0 |
| Participant 15 (32, male) | 0 | 1 | 1 | 0 | 0 | 0 |
| Participant 16 (28, male) | 0 | 0 | 0 | 0 | 0 | 0 |
| Participant 17 (30, male) | 1 | 0 | 1 | 0 | 0 | 0 |
| Participant 18 (22, female) | 2 | 1 | 3 | 0 | 1 | 1 |
| Participant 19 (28, male) | 1 | 0 | 1 | 0 | 0 | 0 |
| Participant 20 (26, female) | 2 | 0 | 2 | 0 | 0 | 0 |
| Participant 21 (24, female) | 0 | 1 | 1 | 0 | 0 | 0 |
| Participant 22 (23, female) | 0 | 2 | 2 | 1 | 0 | 1 |
| Participant 23 (28, female) | 2 | 0 | 2 | 0 | 0 | 0 |
| Participant 24 (26, male) | 0 | 0 | 0 | 0 | 0 | 0 |
| Participant 25 (28, male) | 1 | 2 | 3 | 0 | 0 | 0 |
| Participant 26 (25, female) | 1 | 2 | 3 | 2 | 0 | 2 |
| Participant 27 (27, male) | 2 | 0 | 2 | 0 | 1 | 1 |
| Participant 28 (28, male) | 1 | 0 | 1 | 0 | 0 | 0 |
| Participant 29 (24, male) | 3 | 1 | 4 | 0 | 1 | 1 |
| Participant 30 (25, female) | 1 | 0 | 1 | 0 | 0 | 0 |
| Total | 28 | 19 | 49 | 4 | 3 | 7 |
| Average | 1 | 0.63 | 1.63 | 0.13 | 0.1 | 0.23 |

### 4.3. Interview Results

We conducted the interview after experiment 2. The interview was consisted of three categories: usual study habits, the automatic speed control of multimedia materials, note taking. The analysis results are compiled as two categories the automatic speed control of multimedia materials and note taking. As a result, the automatic speed control of multimedia materials and note taking influence participant's satisfaction positively.

#### 4.3.1. The Automatic Speed Control of Multimedia Materials

Participants answered they did not feel comfortable with manual control that they directly clicked pause and rewind buttons. And they said proposed the automatic speed control of multimedia materials was more convenient than regular e-learning system with manual speed control. Moreover many participants answered they are satisfied when they use our proposed system with the automatic speed control of multimedia materials.

*"With the regular e-learning system, I needed to click a pause button when I didn't understand the material. But with the automatic control, I don't need to do it." – Participant 5 (age 25, male)*

*"The automatic speed control of multimedia materials is convenient. Usually, I clicked a rewind button repeatedly. But I didn't push pause and rewind buttons at all with system of the automatic speed control. It was very effective for studying. I didn't need to move my fingers. It feels easier." – Participant 18 (age 22, female)*

 

*"I was embarrassed at first, but I got used to the system in an instant. It was helpful to concentrate with the lecture when this system returned to normal speed." – Participant 23 (age 28, female)*

#### 4.3.2. Note Taking

Many participants answered that note taking was easy when using the automatic speed control of multimedia materials. Some of the participants indicated that they spent more time to take notes when using our system than they use the regular e-learning system. Other participants indicated that the automatic speed control is helpful and useful for learning. And most participants were aware that the automatic speed of the multimedia materials would be slow. So they said that they felt more relaxed and recognized they can gain more time for note taking.

*"It makes me easy to write notes. I usually don't take notes, because it is really fiddly job to control the multimedia materials." – Participant 8 (age 26, female)*

*"When I write down some sentences, I should control a pause button. But I find it is too annoying. So I think I need this system. I felt it is helpful and useful for taking long notes. I recognized I can have much time because of the system." – Participant 22 (age 23, female)*

*"I love to take notes. I'm not happy when I can't take notes. But with this system, I don't miss notes. It was easy to write down notes and understand the lecture. I feel at ease." – Participant 16 (age 28, male)*

*"I felt accustomed to studying and taking notes with this system... Yes, from the first time with experiment. Two seconds might be appropriate for note taking. I didn't feel it too fast or slow to study." – Participant 13 (age 30, male)*

Participants reported that their satisfaction with the automatic speed control of multimedia materials was generally positive because they believed that the automatic speed control of multimedia materials reduced inconvenience and helped with note taking. However, considering the adaptive degree of the automatic speed control of multimedia materials, the participants responded with opposite comments. Some participants commented that they were embarrassed initially, but they adapted to the system instantly. Overall, these results indicate that a short adaptation time increased the participants' satisfaction.

## 5. Conclusion

In this study, we analyzed the situation of a learner's lowered head when learners watch a lecture at e-learning environment. Especially we focused on the situation of note taking. Second, nodding within two seconds is not relevant to the situation of note taking. Third, for the situation of the e-learning system with the automatic speed control of multimedia materials, the number of pause and rewind buttons clicked decreases dramatically. Last, because the automatic speed control of multimedia materials secures hours to take notes, learners are able to concentrate more on the lecture and feel satisfied.

This research contributes the advancement of e-learning system for e-learning learners as this research shows the effects on natural user interface. And this research contributes to e-learning researchers and developers as this study provides substantive improvement points of the e-learning system.

However, our research has several limitations. First, most participants are twenties, despite e-learning users are varied age. Second, experiment materials do not contain a wide variety. Last, experiments are performed without an actual device.

In the future, we need to analyze data with more various learning materials and the diverse participants. And It is essential to use an actual device embedded in e-learning system. Now, the development of this device is nearly finished. Therefore, we will perform experiments on a device with the automatic speed control of multimedia materials in near future

## Acknowledgments

This research was supported by the city of Seoul (No. HA120016) and the Industrial Strategic Technology Development Program (No. 10043388), and it was funded by the Ministry of Knowledge Economy and the Ministry of Trade, Industry and Energy (MOTIE).

## References

[1] T. Navio, "Global E-learning Market 2013-2016", Infiniti Research Limited, **(2013).**
[2] M. S. Knowles, "Self-directed Learning", Association Press, New York, **(1975).**
[3] V. Cantoni, M. Cellario and M. Porta, "Perspectives and Challenges in E-learning: Towards Natural Interaction Paradigms, J. Visual Languages and Computing, vol. 15, no. 5, **(2004)** pp. 333-345.
[4] C. J. Lim, N. H. Lee, Y. G. Jeong and S. I. Heo, "Gesture Based Natural User Interface for E-training", J. the Ergonomics Society of Korea, vol. 31, no. 4, **(2012),** pp. 577-583.
[5] J. N. Bassili and S. Joordens, "Media Player Tool Use", Satisfaction with Online Lectures and Examination Performance, J. Distance Education, vol. 22, no. 2, **(2008).**
[6] F. J. Di-Vesta and G. S. Gray, "Listening and Note Taking", J. Educational Psychology, vol. 64, no. 3, **(1973)** pp. 278-287.
[7] H. S. Kim Chung, "The Effects of Online Note-taking Forms and Metacognitive Awareness While Reading Online Text", UMI Dissertations Publishing, Ann Arbor, **(2006).**
[8] S. W. Chou and C. H. Liu, "Learning Effectiveness in a Web-based Virtual Learning Environment: a Learner Control Perspective, J. Computer Assisted Learning, vol. 21, no.1, **(2005),** pp.65-76.
[9] D. P. Hong and W. T. Woo, "Recent Research Trend of Gesture-based User Interfaces", Telecommunications Review, vol. 18, no. 3, **(2008),** pp. 403-413.
[10] M. J. Park, J. H. Kang, S. W. Park and K. S. Cho, "User Interface Design of E-learning: Focused on the Automatic Speed Control of Multimedia Material by Learner's Head Angle", Proceedings of the 3rd Games and Graphics **(2014),** April 16-18, Jeju, Korea, pp. 269-274.
[11] G. Kearsley and M. Moore, "Distance Education: a System View", Wadsworth, California, **(1996).**
[12] D. C. Hillman, D. J. Willis and C. N. Gunawardena, "Learner-interface Interaction in Distance Education: An Extension of Contemporary Models and Strategies for Practitioners", American J. Distance Education, vol. 8, no. 2, **(1994),** pp. 30-42.
[13] M. Williams, "Learner Control and Instructional Technologies", Handbook of Research on Educational Communications and Technology, Scholastic, New York **(1996),** pp. 957-983.
[14] R. J. Spiro, P. J. Feltovich, M. J. Jacobson and R. L. Coulson, "Cognitive Flexibility", Constructivism and Hypertext: Random Access Instruction for Advanced Knowledge Acquisition in Ill-structured Domains, Educational Technology, vol. 315 **(1992),** pp. 57-76.
[15] W. D. Milheim and B. L. Martin, "Theoretical Bases for the Use of Learner Control: Three Different Perspectives", J. Computer-Based Instruction, vol. 18, no. 3, **(1991),** pp.99-105.
[16] R. P. Niemiec, C. Sikorski and H. J. Walberg, "Learner-control Effects: A Review of Reviews and a Meta-Analysis", J. Educational Computing Research, vol. 15, no. 2, **(1996),** pp.157-174.
[17] D. Wigdor and D. Wixon, "Brave NUI World: Designing Natural User Interfaces for Touch and Gesture", Elsevier, USA, **(2011),**
[18] E. Vural, M. Cetin, A. Ercil, G. Littlewort, M. Bartlett and J. Movellan, "Drowsy Driver Detection through Facial Movement Analysis", Proceedings of the 12th International Conference on Human–Computer Interaction **(2007)** July 22-27, Beijing, China, pp. 6-18.
[19] E. LoPresti, D. M. Brienza, J. Angelo, L. Gilbertson and J. Sakai, "Neck Range of Motion and Use of Computer Head Controls, Proceedings of the 4th International ACM Conference on Assistive Technologies **(2000)** November 13-14, Virginia, USA, pp. 121-128.
[20] F. Girbacia and S. Butnariu, "Development of a Natural User Interface for Intuitive Presentations in Educational Process", Proceedings of the E Learning and Software for Education **(2012)** April 26-27, Bucharest, Romania, pp. 74-79.

 

# Authors

**Minjae Park**
• 2006 ~ 2013: BFA in Communication Design, Hongik University, Korea
• 2013 ~: Graduate Student, Department of Human ICT Convergence, Sungkyunkwan University, Korea

**Joohee Kang**
• 2008 ~: Undergraduate Student, Department of History, Sungkyunkwan University, Korea

**Seongwon Park**
• 2011: Ph.D. in Digital Cultural Content, Yonsei University, Korea
• 2011 ~ 2013: Policy Research Division, Korea Creative Content Agency
• 2013 ~ 2014: Design Science Institute, Sungkyunkwan University, Korea

**Kwangsu Cho**
• 2004: Ph.D. in Cognitive Psychology, University of Pittsburgh, USA.
• 2006 ~ 2010: The School of Information Science and Learning Technologies, University of Missouri, USA, Professor.
• 2009 ~ 2014: Department of Interaction Science, Sungkyunkwan University, Korea, Professor.
• 2014 ~: The School of Information, Yonsei University, Korea, Professor.