A Near-Reality Approach to Improve the e-Learning Open Courseware

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ABSTRACT
The open courseware proposed by MIT with single streaming video has been widely accepted by most of the universities as their supplementary learning contents. In this streaming video, a digital video camera is used to capture the speaker’s gesture and his/her PowerPoint presentation at the same time. However, the blurry content of PowerPoint slice in this recorded video isn’t rich enough for students’ further learning. This motivates us to find a novel approach to integrate the details of teacher’s gesture and presentation with digital video camera and screen catcher, respectively. Due to the integration technologies of multimedia applied in this paper, this proposed method can significantly improve the quality of streaming video especially the content of PowerPoint and moving data on PC screen. In addition, the variety of scenes occurred inside a classroom can be easily directed and then recorded for future learning. A utilized experimental design was applied to check the degree of clarity and validate the learning effectiveness. The results showed that the proposed method was much better than the conventional method that with only one single digital video camera.

Keywords
E-Learning, Open courseware, Situated learning, Recorded video, MOOCs

Introduction

The media/video sharing data recorded with streaming format have been widely accepted by most of the people, including the information in YouTube and the open courseware proposed by MIT (Abelson & Long, 2008; Carson & Forward, 2010; Lerman & Potts, 2006; Tovar, 2010). Currently, a lot of universities develop the program of open courseware as part of their distant learning activities including University of Tokyo OCW, Tufts Open Courseware, Utah State University Open Courseware, National Chiao Tung University OCW, etc (Carson & Forward, 2010; MIT OCW; University of Tokyo OCW; Tufts OpenCourseWare; Utah State University OpenCourseWare; National Chiao Tung University of Taiwan OCW). Teaching and learning are no longer restricted to classroom learning (Marold, Larsen, & Moreno, 2000; McAllister & McAllister, 1996; Papanikolau, Mabott, Bull, & Grigoriadou, 2006; Zhang & Nunamaker, 2003). As we know, most of the contents from open coursewares are recorded in classroom and then translated into web site for online self-learning purpose. Even students can read the same data from the classroom recorded by themselves, they actually cannot endure the poor quality media if the recording procedure inside the classroom is not well-controlled. Up to now, a number of studies have demonstrated how e-Learning technology influences today’s education (Davies & Graff, 2005; Naeve, Lytras, Nejdll, Blacheff, & Hardin, 2006). Wentling et al. suggested that “e-Learning is the acquisition and use of knowledge distributed and facilitated primarily by electronic means” (Wentling, Waight, Gallaher, La Fleur, Wang, & Kanfer, 2000, p. 5). Hence, in this paper, the advantage of e-Learning technology will be taken to improve the recording quantity and quality of open courseware such that students can read everywhere and anytime with enough amount of high quality streaming data.

Inside a classroom or studio room, several streaming data from computer screen, digital camera, and document camera are recorded to preserve the details. The best way to keep all data together is to apply the integration technology to fuse those streaming data into a single streaming media (Boer, Kommers, & Brock, 2011; Liu, Chen, Wang, & Zhang, 2010; Reisslein, Seeling, & Reisslein, 2005). Two technical issues have to be considered. One is to decide what kinds of catching devices including digital camera, document camera, and VGA grabber are used. Another is the integration software to fuse those caught streaming data into the single streaming. The VGA grabber is a hardware device which can catch the screen of another computer with fine quality. The software system receives raw signals from grabber and then to process, analyze, integrate, and compress images (Diaz, Pelayo, Ortizosa, & Mota, 2006; Will, 2001). As shown in Figure 1, the VGA grabber is embedded in a PC which can catch teacher’s gesture and notebook screen. This technique has been widely used to catch the computer screen with dynamic
content, for instance, the moving particle run on teacher’s notebook and shown in front of students in the physics lecture can be recorded by this skill (Diaz, Ros, Carrillo, & Prieto, 2007; Kim, Lee, Jeon, & Song, 2010).

As we know, most of the contents of open courseware just provide students with more opportunities to review the lecture after they go back home for self-learning. Currently, a lot of universities try to improve the quality of open courseware to be suitable for regular distant lectures. Hence, how to record teaching lectures and retouch those recorded materials to be high quality materials such that students can have better learning outcomes is a critical issue (Leijen, Lam, Wildschut, Simons, & Admiraal, 2009; Ochoa & Duval, 2009; Wilson & Harris, 2003).

In contrast to advertisement program which just consists of short messages or illustrations, the teaching program needs to present the detailed knowledge with more verbal illustration. In order to provide a suitable learning content instead of just a short message, a stable and easy solution operated inside the classroom by teachers, teaching assistant-assistants or students has to be considered such that a variety of situations occurred among teachers and students during a long period lecture can be directed and recorded. Huang, Lubin and Ge (2011) found that the students in the situated learning environment could demonstrate more sophisticated problem-solving skills, exhibit metacognitive awareness, produce coherent artifacts, and show high levels of motivation.

The digital video cameras are usually used to capture speaker’s gesture and his/her PowerPoint content projected on screen simultaneously. However, these recorded videos can only preserve teacher’s gesture in details instead of his/her PowerPoint content which is always with blurry quality.

In Figure 2, the content of video includes both teacher’s gesture and the content of PowerPoint. The text and figure inside the PowerPoint slice is not clear enough to let students concentrate on their study. In this paper, one of the contributions is to solve above questions and requirements. Thus, a near reality approach is proposed to preserve the recording style of situated learning including teacher’s gesture, body language, interaction, and the content of PowerPoint. Then, the design overhead is lower than in other systems which are usually used in professional studio room or micro-teaching classroom and the users can integrate the system by themselves with primitive devices (Casakin, 2011; Eddings, Stephenson, & Harvey, 2009; Ginns, Norton, & Gupta, 2005; Wahba, 1999).
In this paper, an integration technology is proposed to integrate the streaming from VGA grabbers and digital cameras such that the near reality from classroom can be easily obtained by using our self-design recording instrument. We believe that the quality of the recorded video with quality guarantee of near reality can give online readers more real situation like inside classroom.

**Situated learning**

Anthropologists Schon, Suchman, Lave and Wenger collated and analyzed the people in the learning process (Lave, 1988; Lave & Wenger, 1991; Schön, 1987; Suchman, 1987). Schön (1987) proposed two concepts about learning, the knowledge in action and reflection in action, after he studied the learning about professional model. Suchman (1987) issued a situational action argument after he observed people in learning how to operate a copy machine. He emphasized that if the people learned knowledge without combining with the operating situation of this real copy machine, he just played a game of abstract symbols without physical impact. Learners must construct their concepts and rules of knowledge through practical experience and through practical action to understand its true meaning. Lave and Wenger (1991) found that people who engaged in the butcher, midwives, tailors, and helmsman did not receive a complete education or formal training, but they learned their techniques from observing their masters or from their own inventions in daily activities and practices under the real working situation. They could use their skills and knowledge intuitively to solve problems around the real resources. Furthermore, when they faced the complex professional issues, their performance was still satisfactory. Also, Brown, Collins and Duguid (1989) and other cognitive psychologists used the anthropological perspective to define “situational learning” as people continue to interact with the actual situation during a long period of time and then they can use effective strategies to solve the problem in a specific situation. Therefore, learning and practice under the real situation has its effect on the construction of knowledge. In this paper, the real recording in classroom which can give students more vivid situation for future study to construct their deep knowledge is emphasized.

McLellan (1996) considered that situated learning should include eight factors: stories, reflection, cognitive apprenticeship, collaboration, coaching, multiple practices, articulation of learning skills and technology. Therefore, these factors can derive eight recording actions to record the corresponding situation into video during the lecture hour.

- **Story Action**: The digital devices can take the teacher’s presentation with his/her body language as a story about the lecture content.
- **Reflection**: The students’ reflection with respect to teacher’s story can also be recorded to let other students who read this recorded data online understand why their peers ask this kind of questions.
- **Cognitive apprenticeship**: A sequence of interactions between teacher and students can also be recorded to let other students who read this recorded data online understand how the teacher leads their peers to correct their wrong concepts and skills.
- **Collaboration**: When a group of students is working on an experiment, this situation can be recorded to let other students who read this recorded data online feel how cooperative tasks can be achieved by a group.
- **Coaching**: This kind of videos can refer to the teaching activity about teacher’s coaching procedure which has detailed steps to show how a teacher coaches a pupil to learn some concepts and skills.
- **Multiple practices**: The integration technology can be applied to fuse the videos from each practice into a situation of multiple practices such that students can easily read several practice experiences with a single streaming data.
- **Articulation of learning skills**: The recorded video can preserve the details of each learning skill. Students can repeatedly read this video to find out the micro skills from each step.
- **Articulation of technology**: The recorded video can preserve the details of technology. Students can repeatedly read this video to find out the inside concepts about the interesting technology.

Inside the classroom, the teacher can lead students with his/her eye contact, body language, and other teaching strategies. This kind of real activities can form a vivid situation for students’ learning. Hence, the best way to preserve the learning situation is to record the whole scenes inside the classroom.
Near reality approach

A near reality (NR) approach that can record video effectively to achieve the recording style of situated learning including speaker’s gesture, body language, interaction with students, and presentation with PowerPoint file is developed (Yu, Hwang, Liao, & Su, 2011). In this section, the near reality approach will be introduced in details.

Scenario

Near reality approach is grounded on the situated learning and the results of He, Grudin and Gupta (2000), Baecker (2003), and Zhang, Rui, Crawford, and He (2008). These design principles are described as follows:

- The system is friendly: Teacher can act or behave normally during his/her talk or lecture. That is, no restrictions are imposed on him or her. The only device which the teacher needs to wear is a wireless clip-on microphone.
- The system has no pre- or post-production: Teacher does not need to give his/her slides/transparencies in advance for pre-processing. After the presentation, no post-production such as slide integration is needed. The lecture is immediately available for on-demand viewing.
- The system captures synchronized high resolution visual aids: Such synchronization is done on-the-fly during the lecture. Both the live and the on-demand viewers can watch them synchronously with the audio/video stream of the lecture.
- The system allows the remote clients to view the lecture at their own pace: Students can view the lecture at home or in any place.

In order to realize above requirements, a specific system including hardware and software is designed to let the teaching assistant easily handle it. The design of this system will be specified in the following subsection. Due to the recording procedure operated by the teaching assistant instead of by the teacher, this kind of recording is called as other-record skill. On the contrary, the recording procedure operated by the teacher is called as self-record skill, that is, the teacher needs to teach and record simultaneously during the lecture.

While the other-record procedure is in progressing, the teachers can concentrate on their teaching without worrying about the recording business. An example of teaching situation translated to an integrated form with the proposed method is shown in Figure 3.

First, the teaching assistant creates a display board based on NR system. On this display screen, there are two DV cards, one VGA grabber card, two text cards, and one timer card. Second, the teaching assistant operates all the devices including two DV cameras and one VGA grabber with a control software installed in NR system. Hence, the teacher’s image, students’ image, and the teacher’s notebook screen can be captured by these three cards, respectively. Finally, the teaching assistant applies another VGA grabber to capture the integrated screen corresponding to the content of display board. Then, the vivid video including almost all the teaching situations
inside the classroom can be obtained. In addition, this recorded video can be uploaded immediately to the media server for students’ instant or further learning.

Method

The function of NR system is to integrate multiple signals mainly obtained from the devices of DV cameras and VGA grabbers. Moreover, in order to collect the details inside a classroom, some extra components have to be concerned. All the devices used to design NR system are listed as follows:

- **VGA grabbers**: There are two VGA grabbers, one for capturing the signals from VGA mixer and another for capturing the integrated signal from the display board.
- **Audio mixer**: It can mix different sounds from five microphones used by different users into a signal.
- **VGA mixer**: This device can translate digital videos from digital camera into VGA signals and then mix above signals with usual VGA signals into regular VGA signals.
- **VGA/Audio matrix with RS232 controller**: There is a 2x3 VGA/Audio matrix which can provide $2^3$ possible output combinations. The control configuration can be selected from the software installed inside the PC to realize the possible project situation.

The structure of NR system is shown in Figure 4 and it includes three components, the signal inputs, the process engine, and the signal outputs. The recording procedure with this system can be described as follows:

Step 1: The NR system captures the audio and video signals from microphones, notebook, and digital cameras.
Step 2: The video signals from DVs and notebook are translated to the VGA mixer, and then the mixer integrates the signals to create an integrated video signal.
Step 3: The machine for other-recording skill can receive an integrated video signal from VGA grabber which captures the signal from VGA mixer and a mixed audio signal from audio mixer. Then, this machine is continuous to process those signals with some assigned learning situations given by teachers or teaching assistants. Finally, the integrated content is obtained and ready to be delivered to VGA/Audio matrix for further processing.
Step 4: Based on the switching function of VGA/Audio matrix, signals from other-recording PC which creates the integrated content and from VGA grabber can be delivered to two projectors and the audio signal can be delivered to the loudspeaker. In order to record the high quality of integrated content, another VGA grabber is applied to capture the feedback signal instead of recording desktop content directly.
Step 5: The machine for other-record skill finally receives the integrated content from VGA grabber to create the video of situated learning where the machine only processes the recording task without worrying about the signal retrieval which is already shared by VGA grabber.

![Figure 4: The architecture of near reality system](image)

Implementation

The control panels of NR system are shown in Figure 5. There are five modules corresponding to those panels and the function of each module will be specified as follows.
In Figure 5, the panels can be divided into three parts. The left-hand side of the panels is used to control the audio-related devices as audio input port. The right-hand side of the panels is used to control the video-related devices such as the control ports of DV camera, and VGA grabbers. Moreover, the middle side is a 12-key control panel which can control DVI, VGA, and audio as parts of the system inputs and outputs. Also, the 12-key control panel can control the configurations of picture-in-picture, picture-aside-picture to display on a screen.

The content of this display screen is just the integrated content shown in Figure 6. First, the teaching assistant can select an appropriate picture as the background of this display screen. Second, the teaching assistant can select some available blocks offered by the NR system to direct a suitable learning situation for their students. Those blocks consist of images, pictures, text, scrolling text, marqueses, etc.

In this paper, three scenarios are applied to direct the situations occurring inside classroom. The details about these situations are specified as follows.

1. **Presentation situation**

   This situation consists of teacher’s body language and the content of PowerPoint. In addition, a text description is added into this situation to specify the lecture topic and teacher’s name as shown in Figure 6. Readers can feel the teacher’s charm and atmosphere during the presentation, just like teachers in front of them.
2. Interaction situation between teacher and students

This situation consists of the content of PowerPoint, teacher’s and students’ body language. According to the active around the teacher and students in the video, readers can feel their interaction like talking with teachers inside classroom as shown in Figure 7.

![Figure 7. Interaction situation between teacher and students](image)

3. Interaction situation among students

This situation consists of the content of PowerPoint and students’ body language as shown in Figure 8. According to the interaction among students in the video, readers can feel their participation like they really join in the classroom.

![Figure 8. Interaction situation among students](image)

We can find that key components in above three situations are the content of PowerPoint, teachers’ and students’ body language. Therefore, we can select the combination of key components to form a variety of situations. This combination can be shown in Figure 9.
Teaching strategies often utilized in situated learning environments include the stories, reflection, anchored instruction, cognitive apprenticeship, modeling, collaboration, competition, coaching, scaffolding and judging, multiple practice, exploration, articulation, science and technology (McLellan, 1986; Brown, et. al. 1989). In near real video, the all of the teaching strategies and interaction situation including teacher’s presentation, interaction situation between teacher and students, and interaction situation among students were recorded by the near reality approach. The content of near real video can enrich self-learning situation for readers who do not participate in the actual process of learning to feel their interaction like talking with teachers inside classroom and students who participate in class to practice and reflect learning content.

The degree of clarity

A series of lectures of Computer Science in authors’ university were recorded with two methods, conventional method with only one digital camera and the proposed method with NR system, simultaneously. Those recorded videos were uploaded into a media server for further usage as shown in Figure 10. Those videos can be used in the regular lecture with teacher-led (c-Learning) or self-learning (e-Learning) approach. Also, they can be used by students for supplementary learning out of classroom. As we know, most of the videos taken by a single digital camera are blurry especially in content of texts. Consequently, it is hard to let teachers and students use them in teaching and learning. Therefore, in this paper, the degrees of clarity about conventional and the proposed methods are studied. Definitely, the higher degree of clarity is good for reading. In order to check the degree of clarity, the skill of optical character recognition (OCR) is applied. Note that the higher recognition rate is assumed to be the higher degree of clarity.
Objectively, two sets of experimental samples were got from the videos recorded by conventional and the proposed methods by an automatic detection algorithm, respectively. The Sobel mask which is a filter is applied in this algorithm to detect the contents of different pages inside the recorded videos (Yu, Liao, Su, & Tsai, 2010). Then, all the pages in the PowerPoint file presented by the teacher can be extracted out. That is, two series of images from videos recorded by conventional and the proposed methods can be obtained, respectively. Without loss of generality, the series of images obtained from the conventional method can let be $s_{11}, s_{12}, \ldots, s_{1N}$, and let the series of images obtained from the proposed method be $s_{21}, s_{22}, \ldots, s_{2N}$, where $N$ is the number of pages in the PowerPoint file presented by the teacher. The definition can be specified as follows.

the degree of clarity of the slice $i$

$$
\text{the degree of clarity of the slice}_i = c(slice_i)
$$

$$
= \text{the recognition rate of slice}_i \text{ about the words on this image}
$$

$$
= \frac{\text{the number of correct words extracted from slice}_i}{\text{the number of words on the ith page of the PPT file}} \times 100 \%
$$

If $\sum_{i=1}^{N} c(slice_{1i}) < \sum_{i=1}^{N} c(slice_{2i})$ or more strictly require $c(slice_{11}) < c(slice_{21}), c(slice_{12}) < c(slice_{22}), \ldots, c(slice_{1N}) < c(slice_{2N})$ occurs, then the proposed method is better than the conventional method with respect to the comparison of clarity.

The experimental procedure is shown in Figure 11. In order to speed up the experiment, the function of OCR available in Adobe Acrobat writer to extract the texts from each slice is applied.
The experimental samples are obtained from five lectures of Computer Science, Lecture 1 Arithmetic Operations, Lecture 2 Logical Operations, Lecture 3 Integer Representation, Lecture 4 Representing Data, and Lecture 5 Excess System. In Lecture 1, there are 15 pages, that is, $N = 15$. In Table 1, the detail experimental result about Lecture 1 is listed. The results of other 4 Lectures are briefly shown in Figures 13 to 16 with graphic style.

<table>
<thead>
<tr>
<th>Lecture 1</th>
<th>No. of words</th>
<th>The proposed method</th>
<th>Conventional method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of correct words</td>
<td>Recognition rate</td>
<td>No. of correct words</td>
</tr>
<tr>
<td>slice 1</td>
<td>20</td>
<td>20</td>
<td>100.0%</td>
</tr>
<tr>
<td>slice 2</td>
<td>230</td>
<td>206</td>
<td>89.6%</td>
</tr>
<tr>
<td>slice 3</td>
<td>142</td>
<td>122</td>
<td>85.9%</td>
</tr>
<tr>
<td>slice 4</td>
<td>151</td>
<td>144</td>
<td>95.4%</td>
</tr>
<tr>
<td>slice 5</td>
<td>154</td>
<td>147</td>
<td>95.5%</td>
</tr>
<tr>
<td>slice 6</td>
<td>154</td>
<td>146</td>
<td>94.8%</td>
</tr>
<tr>
<td>slice 7</td>
<td>189</td>
<td>175</td>
<td>92.6%</td>
</tr>
<tr>
<td>slice 8</td>
<td>197</td>
<td>154</td>
<td>78.2%</td>
</tr>
<tr>
<td>slice 9</td>
<td>87</td>
<td>87</td>
<td>100.0%</td>
</tr>
<tr>
<td>slice 10</td>
<td>35</td>
<td>35</td>
<td>100.0%</td>
</tr>
<tr>
<td>slice 11</td>
<td>131</td>
<td>119</td>
<td>90.8%</td>
</tr>
<tr>
<td>slice 12</td>
<td>128</td>
<td>120</td>
<td>93.8%</td>
</tr>
<tr>
<td>slice 13</td>
<td>172</td>
<td>165</td>
<td>95.9%</td>
</tr>
<tr>
<td>slice 14</td>
<td>372</td>
<td>317</td>
<td>85.2%</td>
</tr>
<tr>
<td>slice 15</td>
<td>292</td>
<td>279</td>
<td>95.5%</td>
</tr>
<tr>
<td>Average</td>
<td>92.9%</td>
<td>34.1%</td>
<td></td>
</tr>
</tbody>
</table>

From Figure 12, the proposed method is definitely much better than the conventional method. The same experimental results also can be found in Figures 13 to 16. In Table 2 and Figure 17, the average recognition rates of Lectures 1 through 5 are listed. Lecture 1 has the lowest rate among five Lectures due to the small size of characters on each page in contract to other four Lectures. Therefore, to simplify the content with enlarging the character size on each page is an important factor to improve the recognition rate. In experimental results, the conventional method has the recognition rate less than 35% in difference characters size (Table 2). Significantly, our proposed method has the recognition rate more than 84% in large or small characters size. And, it can enhance recognition rate to 95% more if the characters size is large enough. But, the conventional method is only about 2% increasing in regardless of the characters size. Therefore, these effects cannot be reached by conventional method.

![Figure 12](image1.png)  ![Figure 13](image2.png)  ![Figure 14](image3.png)  ![Figure 15](image4.png)
The proposed method 92.9% 95.9% 93.4% 86.0% 91.4%

Conventional method 34.1% 34.9% 28.6% 33.1% 35.6%

In addition, the environment factors including the light inside the classroom will highly affect the quality of conventional method due to the conventional method taking the content on each page directly from displayed screen. The proposed method catches the content of each page from VGA grabber. Therefore, it can neglect the light factor.

Learning effectiveness analysis

Research design

This study designed to find the significant effects of learning computer knowledge in the situation video. The learners taking the Computer Science course were invited to participate in this experiment. The learning effectiveness of participants was collected after learning with the particular subjects of Computer Science. The research design of this study was described as follows in details.

Participants

Participants were sixty-four students in authors’ university for this study. Based on their ability distribution obtained from a pre-test which was the ability test given at the beginning of this lecture, both thirty-two groups were decided as control and experimental groups, respectively. The independent-samples t-test was involved to compute the values of the means on the learning scores to examine the differences in pre-test and post-test between the experiment and control groups.

Instructional Materials

The experimental and control groups watched the video courses recorded by the proposed and conventional methods, respectively. In order to make an accurate evaluation, both groups all watched a series of 12-week samples. There was a sample shown in Figure 10. After 12 weeks, all students had to take a learning achievement test. Students were required to watch two units each week which is equal to two 40-min regular lectures of Introduction to Computer Science in each week. Of course, during these 12 weeks, some home works and quizzes were given to them.

Instruments

The instruments in this study were used to address the learning achievement. Zhang finds that interaction video enhances the learner’s understanding and improves learning effectiveness (Zhang, Zhou, Briggs, & Jr, 2006). In this
research, we designed an experiment to understand the improvement of students’ knowledge and skills on the subject of computer logic unit and its arithmetic computing. Mainly, we analyzed their test scores to understand whether their knowledge and skills were significantly improved or not. We designed a pre-test before experience of our study. The test of computer basic conceptions was divided into 20 multi-choice items. Depending on the test scores, we can understand participants’ level of prior knowledge. By randomly assigning participants, we divided the participants into two groups, the experimental and the control groups. There are 30 multi-choice items and 5 question items in the post-test.

Procedures

One teacher and 64 students in one class contributed to trial of the system. The class agreed to teach with the recording videos of NR system and convention to support teaching of their lecture in the Winter 2011 semester. The reading materials were uploaded to the learning management system (LMS) for students. Students were able to watch the audio-video materials produced. The procedure of the experiment, as shown in Figure 18, is described as follows.

![Figure 18. The procedure of experiment](image)

1. Before lecture: Teachers prepare and produce the instructional videos into the teaching materials by using recording system. In the preparation of teaching materials, teachers can record teaching situation into instructional videos according to the difficulty of teaching activity. Finally teachers upload the materials to the LMS.

2. During lecture: Students need to login the LMS system to watch the online materials. They can learn one concept from interaction situation of instructional video. Teachers can always amend teaching materials and understand the situation of students watch the materials.

3. After class: Students were tested for the learning result.

Data analysis

Research data were collected through the test of the Computer Ability Achievement Test. The experimental group watched the video courses recorded by the proposed methods, while the control group watched the video courses recorded by the conventional methods. Independent-samples t-test was involved to compute the values of the means on the learning scores to examine for differences in pre-test and post-test between the experiment group and control group. Here, the significant level was set at $p = 0.05$. As boys and girls were shown differences in performing learning ability, the reason could be the video information to acquire knowledge. (Karadeniz, 2011; Piccardi, Risetti, Nori, Tanzilli, Bernardi, & Guariglia, 2011) Therefore, we were testing the learning differences of student's gender and scores level in learning environment. The two-way ANOVA test with 2 (instructional method: NR and convention) × 2 (students’ gender: boys and girls) and 2 (instructional method: NR and convention) × 3 (score level:
higher, middle, and low) factorial designs were applied to investigate the differences between the NR and convention for students’ learning achievement.

Results

Table 3 shows the results that the differences in post-test of the experimental group with the control one and the significant difference between two groups can definitely be found, \( t(62) = 4.79, p < .01 \). Also, the students who studied with the recorded video by the proposed method, on average, can have a better result. The mean of scores which was 88.87 (\( SD = 6.42 \)) for the experimental group was higher than the 81.15 (\( SD = 5.64 \)) for the control one. The results showed that the experimental group was more effective than the control one.

Table 3. The number (\( n \)), means (\( M \)), standard deviations (\( SD \)), and \( t \) value on the pre- and post-test with the ability of open courseware

<table>
<thead>
<tr>
<th></th>
<th>The proposed method</th>
<th>Conventional</th>
<th>( t ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n )</td>
<td>( M )</td>
<td>( SD )</td>
</tr>
<tr>
<td>Pre-test</td>
<td>32</td>
<td>76.09</td>
<td>8.47</td>
</tr>
<tr>
<td>Final-test</td>
<td>32</td>
<td>88.87</td>
<td>6.42</td>
</tr>
</tbody>
</table>

\( * p < .05; ** p < .01; ns = \) not significant

A 2 (instructional method) \( \times 2 \) (students’ gender) ANOVA was performed and revealed that the scores of students trained by the proposed method were higher than those by conventional method, \( F = 26.945, p < .01, \eta^2=0.314 \) (Table 4, 5). According to Cohen (1988) defines large (.40), medium (.25), and low (.10), indicated that the gender differences in learning style with a medium effect. Also, another one 2 (instructional method) \( \times 3 \) (score level) ANOVA was performed and revealed that scores obtained by the proposed method were higher than those of conventional method, \( F = 19.803, p < .01, \eta^2=0.258 \) (Table 6, 7). According to Cohen (1988) indicated that the score level differences in learning style with a medium effect. Scheffe’s post-hoc test (\( p > .05 \)) indicates that all two students’ sex or three score level groups differed from one another. Therefore, our method will not be gender and scores of students of different to create learning difference.

Table 5: Post-hoc test: recorded method and students’ gender

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>( Df )</th>
<th>Mean Square</th>
<th>( F )</th>
<th>Eta Squared</th>
<th>Observed Power(a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covariance</td>
<td>147.327</td>
<td>1</td>
<td>147.327</td>
<td>4.124</td>
<td>0.065</td>
<td>0.515</td>
</tr>
<tr>
<td>Gender</td>
<td>0.452</td>
<td>1</td>
<td>0.452</td>
<td>0.013</td>
<td>0.000002</td>
<td>0.051</td>
</tr>
<tr>
<td>Method</td>
<td>962.537</td>
<td>1</td>
<td>962.537</td>
<td>26.945**</td>
<td>0.314</td>
<td>0.999</td>
</tr>
<tr>
<td>Interaction</td>
<td>9.205</td>
<td>1</td>
<td>9.205</td>
<td>0.258</td>
<td>0.004</td>
<td>0.079</td>
</tr>
<tr>
<td>Error</td>
<td>2107.622</td>
<td>59</td>
<td>35.722</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\( * p < .05; ** p < .01; ns = \) not significant

Table 6. The test scores of learning achievement as a function of recorded method and score level

<table>
<thead>
<tr>
<th></th>
<th>The proposed method</th>
<th>Conventional</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n )</td>
<td>( M )</td>
<td>( SD )</td>
</tr>
<tr>
<td>High</td>
<td>8</td>
<td>89.5</td>
<td>7.051</td>
</tr>
<tr>
<td>Middle</td>
<td>16</td>
<td>89.25</td>
<td>5.639</td>
</tr>
<tr>
<td>Low</td>
<td>8</td>
<td>87.5</td>
<td>7.874</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
<td>88.88</td>
<td>6.424</td>
</tr>
</tbody>
</table>
Table 7. Post-hoc test: recorded method and score level

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Eta Squared</th>
<th>Observed Power(a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covariance</td>
<td>221.022</td>
<td>1</td>
<td>221.022</td>
<td>6.455</td>
<td>0.102</td>
<td>0.705</td>
</tr>
<tr>
<td>Score</td>
<td>99.084</td>
<td>2</td>
<td>49.542</td>
<td>1.447</td>
<td>0.048</td>
<td>0.297</td>
</tr>
<tr>
<td>Method</td>
<td>678.045</td>
<td>1</td>
<td>678.045</td>
<td>19.803**</td>
<td>0.258</td>
<td>0.992</td>
</tr>
<tr>
<td>Interaction</td>
<td>97.482</td>
<td>2</td>
<td>48.741</td>
<td>1.424</td>
<td>0.048</td>
<td>0.293</td>
</tr>
<tr>
<td>Error</td>
<td>1951.665</td>
<td>57</td>
<td>34.24</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05; ** p < .01; ns = not significant

Conclusions

The concepts of open courseware and MOOCs have been widely accepted by several universities to expand their learning scale among classroom and internet (Frank, 2012; McFedries, 2012). The use of information technology can enrich the teaching and learning activities to enhance the interaction and quality of teaching in classroom and internet. Therefore, the requirement of contents is getting urgent and then the recorded content from classroom is getting important to satisfy the requirement. However, the quality of recorded data by a digital camera is not good enough for students’ further learning. In this paper, a novel approach has been proposed to improve the quality of recorded data by applying the integration technology.

In order to specify the major contribution, two experimental designs have been developed. The clarity of streaming data by the technique of OCR was checked. The experimental results have demonstrated that the quality of recorded video from the proposed method has much better than that generated from conventional method. It also showed that the learning effectiveness of student by the presented method was more than that by conventional method. Therefore, the integration technology can play an important role to fulfill the effective learning situation both in c-Learning and e-Learning.

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