ON THE REALIZATION OF RESTRICTIONS-FREE ACTIVE CLASSROOMS IN THE POST-COVID ERA

Achyut Sapkota, Natsu Kitagawa

National Institute of Technology, Kisarazu College, Japan

Hiromasa Ogawa

Keio University, Japan

Kanane Tsuchiya

Prane.jpn General Incorporated Association, Kisarazu, Japan

ABSTRACT

Due to the global COVID-19 pandemic, various ICT-based platforms are being used to conduct remote classes. Although most institutions have returned to normal, preparation is needed for future events, including unforeseen natural disasters. Most practical implementations of remote classes are the same as traditional classroom settings, except for the physical presence of students and teachers in different locations. This has caused considerable discomfort among stakeholders, as the ideal situation would always involve teachers and students being in the same location. In this study, we designed and evaluated a ”remote classroom model” that attempts to replicate the best aspects of traditional classrooms and make use of the wider potential of ICT technology. The aim is to create an unrestricted environment for the proper implementation of the CDIO framework. The model was tested with engineering course modules, and feedback was collected from participating students. Our classroom model enables the delivery of overall lectures, one-to-one consultations, and parallel group discussions in the same time slot among the same target group.

KEYWORDS

ICT-based Learning, Technological Limitations, Behavioral Issues, Active Learning,
CDIO Standards: 6, 7, 8

BACKGROUND

Following the global COVID-19 pandemic, there has been a general trend towards online classes and seminars. However, at our college, Kisarazu KOSEN (National Institute of Technology, Kisarazu College), we had already been focusing on promoting active remote collaboration between young engineering students prior to this trend. In 2018, we established a virtual laboratory called Kisarazu International Collaborative Station (KICS) that enables students to

work with their international peers and develop their working skills in a non-native environment. This facility, in addition to providing an active learning environment (CDIO standard 8), is also an engineering workspace and digital learning environment for students (CDIO standard 6), where students can conceive and design a product while considering various professional issues (CDIO standard 7). Although various laboratories in Kisarazu KOSEN address all these CDIO Standards, KICS is particularly focused on international collaboration (CDIO Syllabus: Communication in Foreign Language). We are developing this facility as a prototype of a hybrid learning environment that can also serve as a digital equivalent of traditional classrooms, where students can participate in classes conducted by an instructor located in a remote location without any technical difficulties. Although this facility has multiple purposes, the work reported here focuses on addressing the technical and behavioral issues of remote classrooms from the perspective of international collaboration.

CONCEPT OF RESTRICTION-FREE CLASS ROOMS

From the perspective of international collaborations, we consider ”restriction-free” from both a technical and behavioral perspective. In this study, we focus on the limitations of network technology in resource-limited settings to ensure that students feel as if they are in a face-to-face setting even in an online environment. Additionally, we seek to address the attention issue of students in online classes by studying different levels of interest in the lecture content due to different levels of understanding.

Real-time video call services are ideal for conducting classes almost in the same style as face-to-face classes. However, video calls require a large amount of data traffic and a stable communication environment. Limitations on data transmission and an unstable communication environment make it difficult to conduct classes via video conference, leading to an unfair learning environment for students. To ensure equal access, consideration should be taken to ensure all students have equal access to the lectures. Conducting several classes in an on-demand format restricts the real-time interactions between teachers and students. Therefore, we seek to develop a remote classroom model that imitates the smoothness of the lectures and real-time interaction between the students as in a face-to-face physical classroom.

In face-to-face physical classrooms, lectures tend to be targeted at average students, while slower students may be overlooked. This issue is more pronounced in online settings if left unaddressed. However, it is possible to track the progress or understanding of the students in a quantitative way in an online setting. By addressing these issues, a classroom model can be developed that addresses the limitations of both physical and virtual classrooms, providing a platform that can be used anytime, irrespective of the physical locations of the students and teachers. This can be helpful not only in international collaboration but also during epidemics, disasters, or restrictions specific to individual personal circumstances.

SYSTEM DESIGN AND IMPLEMENTATION

In the present study, we designed two systems that address the technical and pedagogical challenges of remote learning. The first system leverages audio-visual media and minimizes data traffic to facilitate real-time interactive lectures. The second system enables real-time

monitoring of students' progress as they navigate through digital handouts, thereby promoting greater engagement and participation. A detailed description of these systems is presented below.

Delivering High-Quality E-Learning Experiences with Minimal Data Traffic

To overcome delays in loading media files from a central location, we opted to provide students with video files in advance instead of real-time video streaming. To accomplish this, we developed a web application that operates independently of the usage environment. This web application acts as an interface for playing audio-visual media and allows students to load distributed video files from their local drives during lectures. Only the teacher has control over the playback and stopping of the video, which distinguishes it from conventional E-learning. The educational materials were structured in such a way that the teacher could stop the video at any time and administer quizzes through static web pages. Depending on the student's response, the teacher can provide additional explanations and proceed only when satisfied that the students understood as expected.

Using PDF handouts to track student progress

PDF-format digital handouts were distributed to students, and a web interface was developed to display them. Each student progresses through the handouts while also solving included quizzes. Teachers can monitor students' progress through the handouts and provide additional support to those who are slower to grasp the material. Students who complete all the content and quizzes in each section of the handouts can be assigned additional tasks.

EVALUATION RESULTS

The first system was tested in a few lectures of the "Industrial English" module where students were required to comprehend English communication through audio-visual media and respond to quizzes supplied while the media was paused. To examine the usefulness and effectiveness of the system, a comparison was made between the real-time lecture model and the on-demand lecture model. For the on-demand model, we provided an interface for students to learn and respond according to their convenience. Instructors provided explanations in the on-demand materials prepared for the next lecture. To test the second system, we distributed PDFs of class material and asked some students to go through them. The trial test was conducted to measure attentiveness among students.

Feedback questionnaire

Following the above two teaching methods, a questionnaire was distributed among the students to gather their feedback on various aspects.

General Performance of the First System

A single question, "Did the system work well?" was asked with a checkbox, and a text box was provided if there were any problems. Out of 38 students, only 2 reported problems with system performance. The problems were mainly related to security restrictions on the devices

they used and the media format used. This issue is not significant and can be easily addressed. Therefore, the system performed well, irrespective of the local user environment.

Easiness and effectiveness for audio-visual content

A question related to the ease and effectiveness of the class model for lectures involving audio-visual content in a data-traffic restricted environment was asked with multiple options along with a text box for free-form responses. Among the respondents, 44% of students indicated that the system can be effective for any lecture involving audio-visual content irrespective of data-traffic-restricted environments. 40% of the respondents agreed that the model is useful in lectures involving audio-visual content in a data-traffic-restricted environment. 16% of the students responded that the model can't be effective for either scenario. Although almost 84% find the system effective, the remaining 16% is still a significant number. The model was used only for a few lectures during the testing stage, and we believe that it was difficult to fully convey the intent and effectiveness of the system.

Use of audio-visual content in lecture

We surveyed students to determine their preference for audio-visual content in online lectures. Surprisingly, only 54% of students preferred audio-visual content. The remaining students were satisfied with the current form of the lecture, which included significant explanations in text format. We refer to this lecture model as the ”on-demand type” lecture. As mentioned earlier, it was challenging to convey the full effectiveness of the model during the testing phase.

Usability of the model in the other modules

As mentioned previously, we tested our model in the ”Industrial English” module and subsequently asked students which other modules could benefit from using this model. We did not provide any options, allowing students to freely suggest modules they thought would be appropriate. The majority of students suggested three modules they were currently taking: Mathematics, Physical Education, and Presentation Techniques. All of these modules require real-time, two-way communication and cannot be fully explained through text-based materials.

PDF Document review and progress

To test the second system, we did not inform the students of our objective. Instead, we randomly selected 16 students and conducted a survey to gather their perspectives on the system. The goal was to understand how they would perceive the system without any prior knowledge of its purpose. Of the students who responded, 87.5% agreed that the system could increase attentiveness and effectiveness in online learning.

DISCUSSIONS AND FUTURE WORKS

The purpose of this program was to investigate the possibility of creating a new kind of virtual classroom that combines the benefits of both online and face-to-face classes, without the restrictions of either. In this study, we developed interactive online classrooms with significantly low network bandwidth requirements. Based on the feedback from students in environments

with limited data traffic, we can conclude that the model is quite useful in such situations. However, there are many factors that can affect the effectiveness of these classrooms, especially technological factors. Network congestion, for example, can significantly hamper the effectiveness of online classes (Choi, Karamollahi, Williamson, & Arlitt, 2022; Kumar, Garg, Kumar, & Panwar, 2022; Rizvi & Nabi, 2021). Additionally, network congestion becomes a significant issue when lectures involve audio-visual content. However, the importance of audio-visual content for effective learning cannot be understated (Lapitan Jr, Tiangco, Sumalinog, Sabarillo, & Diaz, 2021; Pal & Patra, 2021; Sablić, Mirosavljević, & Škugor, 2021; Scagnoli, Choo, & Tian, 2019). While there may be various technical solutions at the network level, managing them across different institutions with limited resources can be challenging. Therefore, we are developing a classroom model that can address this technological limitation within the existing network infrastructure. Our initial trials have been positive in this regard, and we are making progress in this direction.

Similarly, another factor that affects the effectiveness of virtual classrooms is the attentiveness of students. There are few studies on addressing attentiveness in online settings (Deepa et al., 2022; Vignesh, Gupta, & Kumar, 2022). However, we want to approach this problem from a different perspective. The attention of an individual toward a particular lecture session is a behavioral issue that can be influenced by many factors. In this study, we consider this issue as a lack of attention due to a different level of understanding of the content. Additional explanations are necessary for students who can't easily grasp the content. However, the same additional explanation may be a "waste of time" for some students. Addressing the issues of both categories of students is quite challenging. With further implementation and testing of the second system, we aim to address the issue of attentiveness. The progress monitor system provides a way for teachers to monitor students' progress quantitatively, which is difficult to do in a face-to-face classroom. Such quantitative information can be helpful in grouping students based on their levels of understanding, allowing them to engage in active peer-support group study. Combining the audio-visual interaction system with this progress monitor system enables the implementation of overall lectures, one-to-one consultations, and parallel group discussions in the same time slot among the same target group.

FINANCIAL SUPPORT ACKNOWLEDGEMENTS

This project was funded by a research grant from Prane.JPN, a general incorporated association headquartered in Kisarazu, Chiba, Japan

REFERENCES

Choi, A., Karamollahi, M., Williamson, C., & Arlitt, M. (2022). Zoom session quality: A network-level view. In *23rd International Conference on Passive and Active Measurement* (pp. 555–572).

Deepa, D., Selvaraj, S., Lakshmi, D. V., Sarneshwar, S., VigneshBalaji, N., & Vikash, M. (2022). Web application to track student attentiveness during online class using cnn and eye aspect ratio. In *6th International Conference on Computing Methodologies and Communication (ICCMC)* (pp. 1696–1703).

Kumar, P., Garg, R. K., Kumar, P., & Panwar, M. (2022). Teachers' perceptions of student barriers to sustainable engagement in online education. *International Journal of Knowledge and Learning*, *15*(4), 373–408.

Lapitan Jr, L. D., Tiangco, C. E., Sumalinog, D. A. G., Sabarillo, N. S., & Diaz, J. M. (2021). An effective blended online teaching and learning strategy during the covid-19 pandemic. *Education for Chemical Engineers*, *35*, 116–131.

Pal, D., & Patra, S. (2021). University students' perception of video-based learning in times of covid-19: A tam/ttf perspective. *International Journal of Human–Computer Interaction*, *37*(10), 903–921.

Rizvi, Y. S., & Nabi, A. (2021). Transformation of learning from real to virtual: an exploratory-descriptive analysis of issues and challenges. *Journal of Research in Innovative Teaching & Learning*.

Sablić, M., Mirosavljević, A., & Škugor, A. (2021). Video-based learning (vbl)—past, present and future: An overview of the research published from 2008 to 2019. *Technology, Knowledge and Learning*, *26*(4), 1061–1077.

Scagnoli, N. I., Choo, J., & Tian, J. (2019). Students' insights on the use of video lectures in online classes. *British Journal of Educational Technology*, *50*(1), 399–414.

Vignesh, K., Gupta, V. D. N., & Kumar, H. (2022). Attentiveness recognition system for online classes using opencv. In *2nd International Conference on Intelligent Technologies (CONIT)* (pp. 1–6).

BIOGRAPHICAL INFORMATION

Achyut Sapkota,Dr. Eng. is a Professor of Information Computer Engineering and Director of the Center of International Exchange at National Institute of Technology, Kisarazu College, Japan. He received his doctoral and master's degrees in information systems engineering from Osaka Sangyo University, Japan in 2009 and 2006 respectively. His first engineering degree was in electrical engineering from Tribhuvan University, Nepal in 2002. His research interests include sensor development, IoT, bioinformatics, and biological data visualization. Currently, he is actively involved in enhancing engineering education by implementing the CDIO framework.

Natsu Kitagawais an advanced degree course student of KOSEN Education system (equivalent to Bachelor degree third year) at the National Institute of Technology, Kisarazu College. His areas of interest include ICT-based educational platforms, user-interface design, etc.

Hiromasa Ogawa is a graduate student at Keio University. He was involved in this work when he was a student at the National Institute of Technology, Kisarazu College. His areas of interest include ICT-based educational platforms, media design, information security, and entrepreneurship.

Tsuchiya Kanae is an advisor and proprietor of Prane.JPN. Her areas of interest include industry-academia collaboration in education, healthcare, and agriculture. She focuses on solving underlying issues in these areas through the use of ICT technology.

Corresponding author

Achyut Sapkota
National Institute of Technology,
Kisarazu College
Department of Info. and
Computer Engineering
2-11-1 Kiyomidai-Higashi, Kisarazu, Japan
sapkota@j.kisarazu.ac.jp