

Teaching Real-Time, Multi-Site, Collaborative Course Using Videoconferencing System: From the Experiences of GECE

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Abstract

In the increasingly globalizing world, it has become essential for engineers to acquire the skills and knowledge necessary to perform specialized tasks within diverse social contexts, and with peers coming from disparate cultural backgrounds. However, there are many constraints to educate every student to acquire global capabilities. The evolution of information and communication technologies has changed the educational landscape, as well as the perception toward online learning. Online teaching has the potential to serve as a vehicle for training global engineers with a broad perspective in a cost-effective manner. Videoconferencing technology allows instructors and students from several different locations to have face-to-face interactions. However, it requires the diverse types of interactions among students and instructors in order to achieve effective teaching and learning using videoconferencing system. This paper aims to detail real-time, multi-site, collaborative videoconferencing lecture developed by Global Education Center for Engineers (GECE) hosted by Seoul National University. These schemes have been developed to exploit synergies among partner universities. It is believed that the paper presents a useful model for those seeking to implement similar collaborative education programs.

Keywords: Real-time, Multi-site education, Videoconferencing lecture, Collaborative course

1. Introduction

In recent years, training engineers with global capabilities has been of high interest to engineering educators around the world. Global capabilities or called global competency for engineering students is possession of the knowledge, ability and predisposition to work effectively with people who define and solve problems differently than they do. [1] In the previous research [1]-[2], ability is described as, which can be achieved through the acquisition of knowledge and the achievement of 'ability' requires practice. Predisposition refers to learnable tendencies or patterned actions. One of the greatest challenges facing many engineering programs is how to offer opportunities that can build global capabilities/competencies to as many students as possible.

The drastic development of technical platforms, internet and videoconferencing technology, has allowed the change in the educational landscape. With the recent internet technologies, online instruction has become an alternative model of teaching and learning. [3] And, videoconferencing technology have significantly raised the potential of online teaching to achieve what traditional offline(face-to-face) teaching process could not hope to achieve.

Since its origin, online education has been regarded within the higher education community as second rate. Indeed, online education was something that would be best avoided, if alternatives are available. Nevertheless, with the emergence of videoconferencing technology, online teaching becomes to have the potential to serve as a vehicle for training global engineers with a broad perspective in a cost-effective manner.

This paper introduces real-time, multi-site, collaborative videoconferencing lectures developed by Global Education Center for Engineers (GECE), and what instructional strategies applied in order to increase the effectiveness of our videoconferencing lectures.

2. Videoconferencing in Education: The Case of Global Education Center for Engineers

Videoconferencing technology, as a synchronous audio and video technology in which people are able to see and talk to others from two or more separate locations [4], has been used in education for a number of years. One of the main benefits of videoconferencing is to be able to closely approximate the face-to-face instructional experience. Since instructors and students can interact with each other in real time using videoconferencing system, it brings the same effect as attending classes in another part of the world.

Due to the effect, higher educations have steadily increased its usage of videoconferencing in recent years. [5]-[7] Global Education Center for Engineers (GECE), hosted by Seoul National University (SNU), also has been offering videoconferencing lectures since 2010 in order to provide access to universities around the country to high quality educational content. There are currently about 10 universities participating in GECE videoconferencing courses. Students from different universities enrol and attend class at their own universities. Each class has 10 to 50 students per university and the total number of students from participating universities for one class, when put together, reaches more than 100.

The GECE curriculum includes a wide range of courses, from liberal education and professional education for engineers, and engineering major courses. The majority of the courses are jointly offered to other domestic universities. There is big difference between GECE videoconferencing lectures and conventional videoconferencing lectures. There are several instructors and students from the number of participating universities in one course. The participating universities are also required to designate faculty members who are responsible for the operation of the course throughout the semester. The level of faculty participation depends on the specific design of the course. In some courses which include several team projects and/or practical works in small groups, such as Engineering English Communications, Technology and Entrepreneurship, and Engineering Project Management, the faculty members in participating universities are encouraged to provide special lectures based on their expertise, as well as lead class discussions. It is to ease the difference in students. Meanwhile, in other courses, such as Global Engineering Leadership, Engineering Ethics, Technology and Society, and Engineering Economy, one main instructor operates the course and faculty members at participating universities perform minimal supervision for students in their universities. The Table 1 shows the educational methods used for current GECE course offerings. [8]

Table 1. Educational Methods of Current GECE Course Offerings.

Classification	Course Title	Pre-Recorded Lectures	Real-time Joint Lecture w/Dom	Real-Time Joint Lecture w/Int'l	Special Lecture by Domestic Professional	Special Lecture by Int'l Professional	Domestic Joint Team Projects	Int'l Joint Team Projects
Liberal Education Courses	Global Engineering Leadership		0					
	Global Engineering Ethics		0			0		
	Engineering Economy		0		0			

	Engineering English Communications	O	O		O	O	O
	Technology & Entrepreneurship	O	O		O		O
Professional Education Courses	Engineering Project Management	O	O		O		O
	Technology and Society		O		O		
Engineering Major Courses	Capstone Design		O	O			O

We encountered several unexpected problems with videoconferencing lectures when we first started to offer the program. We didn't realize that different instructional methods should be applied for videoconferencing teaching and that the differences between participating universities, such as number of participating students, students' capabilities, and participating instructors' ownership, are quite critical factors in deciding instructional methods.

3. Collaborative Videoconferencing Teaching

A broad range of studies on the effectiveness of collaborative videoconferencing was conducted during the last couple of decades. [9]-[14] They conducted studies on interaction, motivation, relationship and collaborative learning. While videoconferencing technology has the capability for synchronous communication with participating members, interaction is still not as effective as in the offline (face-to-face) education settings. [15] This technology may restrict or alter interaction between instructors and students. [16] First, physical aspects of videoconferencing such as transmission quality, acoustics, lighting, and room configuration may either complement or detract from the distance learning experience. [14] And, instructional aspects of videoconferencing plays very important role in order to achieve effective videoconferencing learning. The key to success of videoconferencing is to engage learners and instructors as well as to develop the instructional designs and learning activities that are comparable to videoconferencing environment and the specific design of the course. [17] The instructional design models should be adapted to integrate various types of interactions, each with a specific purpose and intended outcome. Previous studies [18] [19] extended the meaning of an interaction, which is commonly understood as actions among individuals, to include individual interactions with curricular content: (1) student-instructor interaction, (2) student-student interaction, and (3) student-content interaction. It is confirmed that each type of interaction has important influence on student learning. [20]

There is one difference about GECE's videoconferencing lectures and that difference demands one more interaction during videoconferencing. Several universities offer the course simultaneously using videoconferencing system and the faculty members from each participating universities have to participate and collaborate with each other to conduct the class. Under the circumstance, the interaction among instructors has become to play an important role as well.

The study was conducted upon the development of instructional design model with the team of videoconferencing education experts and participating instructors. Since the purpose of the study was to achieve the quality interactions among instructors and students in order to increase the efficiency of the collaborative videoconferencing lecture, the study emphasized the interactions between various actors. In addition to previously suggested three types of interactions, the interaction has been extended to include the interaction between instructor and instructor. The suggested instructional design model classified interactions into four types: (1) the interaction between students and content, (2) the interaction between instructor and instructor, (3) the interaction between instructor and students, and (4) the interaction

between students and students. For efficient videoconferencing teaching, necessary interactions should be facilitated on every stage of course operation, that is, namely, ‘before class’, ‘during class’, and ‘after class’ interaction activities. The Table 2 shows the interactive activities of each stage for collaborative videoconferencing. The different interactive activities are necessary for each step. Those interactive activities are also based on evidence-based approaches [18]: (1) theories of self-regulation, (2) collaborative and cooperative learning principles and (3) motivational design principles. Self-regulation principles means that learners will be self-regulated by setting their goals and developing strategies for achieving those goals. Collaborative and cooperative learning principles seek to capture the benefits of interactivity by let learners work together to help each other learn. Motivational design principles, which are also important as well as self-regulation, are applied to insure the active and directed engagement of learners.

Table 2. Interactive activities for collaborative videoconferencing.

Interaction	Before class	During class	After Class
	Self-regulation principles	Collaborative and cooperative learning principles	Motivational design principles
Learner - Content	<ul style="list-style-type: none"> • Provide learning resources • Provide pre-training in the characteristics of key component 	<ul style="list-style-type: none"> • Provide the goals of learning content clearly 	<ul style="list-style-type: none"> • Provide opportunities to review & learning resources
Instructor - Instructor	<ul style="list-style-type: none"> • Consider learner's interest • Plan together and share information 	<ul style="list-style-type: none"> • Lecture based on instructors' collaboration 	<ul style="list-style-type: none"> • Share feedback (Monitoring)
Instructor - Learner	<ul style="list-style-type: none"> • Create sense of intimacy between instructor and learners 	<ul style="list-style-type: none"> • Check learners' understanding • Facilitate learners to participate actively 	<ul style="list-style-type: none"> • Provide participating path to individual learners • Check feedback
Learner - Learner	<ul style="list-style-type: none"> • Create sense of intimacy among learners 	<ul style="list-style-type: none"> • Provide the opportunities for cooperative learning 	<ul style="list-style-type: none"> • Provide the opportunities for cooperative learning • Share peer feedback

For the interaction among instructors, ‘before class’ and ‘after class’ activities especially play an important role for videoconferencing teaching. Moreover, the collaborative learning process and outcomes can be improved greatly when appropriate additional support is provided. [13] Learning Management system (LMS) was developed and adopted as a supporting tool for supporting collaboration and interaction among actors for ‘before class’ and ‘after class’ step. Since remote students have less access to the instructor before and after class, LMS can acts as a supplementary communication channel and helps to provide necessary functions for instructors. Instructors use the system to plan the class with other participating instructors, to share information and to collect feedbacks. In addition, students use the LMS to collaborate with instructors and students in remote locations.

4. Conclusion

This paper introduced the real-time, multi-site and collaborative videoconferencing programs and appropriate instructional strategies for effective videoconferencing teaching. These videoconferencing programs have been developed to exploit synergies among partner universities.

At first videoconferencing education was thought to be potential for cost savings, but there are also important issues to do with the quality of learning experience from the student’s perspective. For example, keynote lectures within a lecture course were delivered remotely by external experts in the field to give extra information. And, inter-university project teams were organized to carry out projects with students from other universities. It provides opportunities to embrace global competencies as well since the ability to communicate and work with people of diverse backgrounds are important attributes in a

globalized world. Of course, enabling to run classes even when there are too few students opting for that subject or no suitable instructors are available at any one university are one of main advantages of videoconferencing.

It is harder for students to concentrate, particularly those at the remote site, and instructors tend to rely heavily on student nonverbal communication to gauge engagement and comprehension as well as to adjust pacing presentation. Thus, videoconferencing teaching requires that instructors, in general, have to work much harder to promote student interaction and to develop a good 'classroom' atmosphere. In addition, this study found a greater importance on the interactions among instructors. Multi-site videoconferencing course involving several instructors has to be well-prepared with course materials and activities in advance. And the consensus should be made among participating instructors. Frequent use of small-group activity or project is one of the features of GECE videoconferencing programs. This strategy promotes student-to-student interaction and collaborative learning. It is believed that the paper presents a useful model for those seeking to implement similar collaborative videoconferencing education programs.

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