Using Mobile Video Conferencing for Coteaching in High School Science Classes

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Abstract

This study proposes a type of video conferencing coteaching model that applies mobile communication networks and video conferencing for coteaching middle and elementary school science classes called Mobile Video Conferencing Coteaching (MVCC). Coteaching science classes originally involved two or more teachers instructing the same classroom. Scheduling suitable instruction times and locations for this type of coteaching is difficult, and students do not have much opportunity to receive knowledge from outside the classroom. Mobile communication networks enable coteaching sites to be moved from the classroom or laboratory to outdoor locations. Coteaching instructors can adopt MVCC to teach at any location enabling a connection to a mobile communication network. Therefore, the proposed model enables students to be instructed outside the classroom or laboratory and acquire real-life knowledge beyond the scope of their coursework, which can broaden their horizons and add diversity to science courses.

Keywords: Coteaching, video conferencing, mobile learning, Mobile Video Conferencing Coteaching (MVCC)

Introduction

The traditional method of science coteaching involves two or more teachers instructing a class together in the same classroom or laboratory. Every participating instructor must be present at the time of instruction in this teaching method. Consequently, most coteaching is performed by instructors who work at the same school. If coteaching is performed by instructors working at different schools, they must arrange an instruction time that conforms to their schedules and consider the time and cost of commuting to the teaching location. Research is currently being conducted on how to use the Internet for coteaching (Jang, 2006). The teaching method is performing coteaching on e-learning web sites. One teacher instructs the class in a conventional manner, and another teacher provides teaching assistance and supplementary instructional materials over the Internet, but all of the participating instructors are from the same school.

To solve the aforementioned coteaching problems, this research proposes incorporating mobile technology and video conferencing technology for coteaching science courses. Mobile technology provides new options for instructors and students so that instruction and study are no longer limited to the campus or classroom. Video conferencing can overcome distance limitations and provides two-way real-time interaction. This method offers substantial flexibility when selecting a teaching location, promotes coteaching programs among schools, and facilitates sharing and combining faculties and teaching resources among different schools so that the goals of Coteaching can be effectively reflected in instruction and study. This teaching method is called Mobile Video Conferencing Coteaching (MVCC).
The research revealed the following five results:

1. Using mobile video conferencing helps realize the curriculum integration goals of science courses for students to acquire a comprehensive knowledge of science.

2. Science courses need not be instructed in a classroom or laboratory. Coteaching may be performed wherever a mobile Internet signal can be received. Students can be exposed to knowledge outside their normal coursework, which can help increase the scope of their knowledge.

3. Mobile video conferencing enables coteaching to be used beyond the limits of instructors and students in a single school so that students can receive instruction from instructors from other schools and gain educational experiences from diverse sources.

4. Cooperation among instructors with different professional backgrounds can be enhanced. The sharing of teaching resources between schools, specifically teaching resource exchanges among schools in remote and urban areas, is encouraged.

5. Mobile video conferencing provides more professional development benefits to instructors at remote schools compared with those at schools in urban areas. Instructors at remote schools do not have much opportunity to participate in professional development activities. This research provides an opportunity and platform for instructors to actively participate in these activities.

Mobile Learning

Currently, 3G and 4G mobile networks are already widely adopted for accessing the Internet. In theory, a 4G Long-Term Evolution network can support download speeds of up to 100 Mbps and upload speeds of up to 50 Mbps (Emad et al., 2013). Using video conferencing coteaching over a 4G network would not present any problems. Video conferencing coteaching applying a 3G/4G mobile network has two major advantages: portability and mobility. Because of the rapid development of mobile communication technology, the next generation of mobile technology can bring learning directly to learners, representing a drastic change from the traditional learning environment in schools (Kossen, 2001). The limited teaching and learning environments (e.g., classrooms and campuses) have become learning sites (e.g., zoos and farms) with experiences suited to the learners. Therefore, the instructional activities planned by instructors can closely meet the requirements of learners. Chang et al. (2005) indicated that mobile technology can provide a wealth of information from the learning site. Furthermore, mobile technology can provide a broader and more flexible range of learning compared with ordinary school courses. Kukulska-Hulme (2005) mentioned that mobile learning is a study method produced by combining e-learning and mobile communication, which enables learners to have educational experiences anywhere by using mobile equipment and instruction to move outside the classroom and into the real world.
Video Conferencing

Distance teaching and learning has already become a major trend in teaching. Traditional distance learning was mainly one-way learning for both early broadcasting and e-learning over the Internet. Many courses taught over the Internet consist of instructional materials and video or audio teaching files placed on a website that learners browse and study on their own. Although this method provides a flexible method of study, interaction between the instructor and learners is lacking. Anderson and Garrison (1998) stated that an effective learning process should provide interaction between the instructor and learner and not merely have the learner study the course material independently. Thus, distance learning activities would provide more effective online study if real-time interaction video conferencing were incorporated into the study.

Lin (2009) investigated two universities using video conferencing and an e-learning system for two-way synchronization of coteaching for distance learning between Taiwan and Japan, which can help improve student motivation and encourage students and instructors to understand cross-cultural learning. Researchers in the United States have investigated the effectiveness of science experiments in real-time online teaching. The research subjects were 35 science instructors dispersed in 15 U.S. states. The results showed that, in an online experimental course, the collaborative learning of students and inquiry teaching degree of instructors significantly increased (Crippen, Archambault, & Kern, 2013).

In promoting Project ASK in the United States, Shymansky (2008) indicated that video conferencing fostered the professional development of science instructors at township elementary schools in two major U.S. states. Annetta and Shymansky (2008) revealed that video conferencing significantly affects the professional development of instructors. In promoting a virtual learning environment in the United Kingdom, Murphy and Beggs (2010) employed video conferencing to assist practice teachers and mentor teachers in jointly conducting teaching planning and discussions.

Coteaching

Buckley (2000) defined coteaching as a team of instructors collaborating toward a certain objective in designing a course, syllabus, and courseware, jointly instructing students, evaluating results, sharing viewpoints, and engaging in joint discussions. Abell (2000) observed that, when science instructors of elementary schools and college researchers perform coteaching, consensus among the science instructors is easier to achieve for teaching improvement. Roth and Tobin (2004) fostered coteaching between preservice instructors and in-service instructors. When teaching, preservice instructors are not required to emulate in-service instructors in teaching. Instead, more emphasis is placed on the personal experience of the preservice instructors, sharing the science teaching experience and learning process of the in-service instructors, and forming the theme of professional dialogue in instruction, thereby constituting a cogenerative dialogue related to teaching practice. Eick and Dias (2005) determined that, when instructors begin to implement exploratory teaching in the preliminary period, developing professional knowledge in exploratory teaching is easy if they engage in coteaching with other instructors implementing exploratory teaching. Murphy and Beggs (2010) stated that students who accept coteaching may have an obvious enhancement in science-learning attitude compared with those who accept conventional teaching.
Bacharah, Heck, and Dahlberg (2010) applied science coteaching at 14 elementary schools. The research showed that students who received coteaching demonstrated superior learning performance to their classmates who did not receive coteaching, particularly in reading and mathematics. Upadhyay and Gifford (2010) used science coteaching between an Asian instructor and science instructor to instruct Asian minority students in the United States. The students who joined this course reported that the coteaching performed by the Asian instructor and science instructor made them happier learning science. Jang (2007) used network technology to facilitate coteaching. The findings showed that such a method promotes the collaborative relationship among instructors and enhances the teaching capabilities of instructors.

However, coteaching requires two or more instructors jointly teaching in a classroom or laboratory. Such a method requires that all instructors participate in teaching. Instructors from different schools who intend to coteach must ensure that they can teach at the same time. Hence, conventional coteaching is often restricted by the schedule of instructors and administrative procedures.

System Architecture

In this study, the current video conferencing system was used at the Center for Teacher Education, National Changhua University of Education (NCUE) as an instruction and research platform. The current system connects five distant learning partner schools in Central and Southern Taiwan. Each of these five schools has video conferencing classrooms or laboratories equipped with fixed video cameras (Fig 1). This type of camera uses a local area network or wide area network and a control center to connect to partner schools. Web page remote control is used to operate the camera lens and view the video of the classroom. This remote control function can be used to move the camera direction, zoom in and out, and record sound and video during screen viewing. Each partner school can use the camera to connect to the NCUE or other partner schools and add other digital teaching equipment, such as projectors or electronic whiteboards, for video conferencing teaching activities.

Figure 1 Video conferencing Fixed video cameras
The other type is portable cameras that can connect to 3G/4G mobile networks. This type of camera provides greater flexibility when selecting teaching locations. Video conferencing connections can be made at any location, including parks, farms, or zoos, where a 3G/4G mobile communication network signal can be received (Figure 2).

Figure 2 Mobile Video conferencing video cameras

In addition to this video conferencing equipment, multipoint play and control software that can simultaneously display the screens of up to nine video conferencing cameras was used in this study. In other words, the researcher or instructors at partner schools could simultaneously view the video from up to nine cameras or switch to any camera and have two-way conversations with another research or instructor. The content of the conversations were recorded as audio or video files for subsequent examination and analysis. Figure 3 shows the multipoint play and control software.

Figure 3 Multipoint play and control software
Subjects

The subjects of this research were two classes at a junior high school in Southern Taiwan. Each of the two classes comprised 36 students. The instructor who taught the classes was the school’s science instructor (referred to as Teacher A). Another science instructor from a junior high school in Central Taiwan (referred to as Teacher B) was the video conferencing coteaching instructor. Teacher A specializes in chemistry, and Teacher B’s field of expertise is in biology.

Implementation

Interdisciplinary coteaching was adopted in this study to implement the following steps:

Step 1: Teaching planning stage

First, two coteaching instructors and researchers meet for brainstorming sessions to determine the teaching content and objectives as well as develop a coteaching strategy and model. The instructors and researchers then create a teaching plan and schedule. First, the course contents and teaching times are decided. The coteaching times for the two instructors are then established. A study course is set up on the school’s digital teaching web site to provide students and instructors with a platform for asynchronous online discussion and interaction after class.

This study proposes a type of distant coteaching method. By using a method that is similar to the “call out” model used for television shows, instructors and students can use video conferencing to achieve the highest interaction level and course integration objectives. For instance, the initial concept for the course design was to conduct coteaching of animal subjects in a science class. Teacher B, who specializes in biology, is highly knowledgeable about wild animals, and thus, the zoo can be used as a coteaching site by Teacher B. When Teacher A introduces the biology portions of the science class, supplementary materials for the course can be used. Using a video conferencing connection to Teacher B, Teacher B can introduce animal knowledge from the zoo and interact using video with the students and instructor.

Step 2: Teaching stage

Before the class begins, Teacher B uses a portable mobile camera at the zoo to establish a connection with Teacher A over a 3G/4G mobile network and performs system testing to evaluate the quality of the connection. After the class begins, Teacher A establishes a connection with Teacher B, who instructs the class according to the class schedule. For example, if buffaloes are being introduced in class, Teacher A connects by mobile video to Teacher B who is at the zoo. Teacher B first introduces information on buffaloes and then Teacher A turns the camera by using a remote control to the buffalo screen. Teacher A then explains some additional characteristics of the buffalo. Finally, Teacher B makes some final comments from the zoo and interacts through the camera with the students and instructor in the classroom. The students can ask Teacher B about further knowledge of the buffaloes and respond to the questions asked by the instructors. The video conferencing control software records the entire teaching process in real time for future study and data analysis.
During the course of instruction, the two instructors do not have clearly defined teaching missions and interact with all students in the class to encourage thought and discussion. Teacher A is like a host of a television show, and Teacher B is like a special guest to whom the program connects. The crucial part is that Teacher B must become immediately involved in the instruction and interact with Teacher A and the students. Merely providing a noninteractive introduction of the course material is insufficient. The aforementioned connection method can be used to establish a highly flexible video conferencing coteaching network. Figure 4 presents a diagram of the video conferencing coteaching framework.

![Diagram of video conferencing coteaching framework](image)

**Figure 4 Video conferencing co-teaching framework**

**Step 3: Postteaching stage**

After the class is completed, Teacher A divides the class into nine groups of four students and presents the students with two assignments. The first assignment requests each student to write an after-class report. After finishing the assignment, they send the report over the Internet to the teaching site. The second assignment involves searching for information on buffaloes on the Internet. Teacher A creates a discussion board on the Web site and students post the information that they have collected on the discussion site. First, an interactive discussion is held on the discussion site and then the final results are organized. Finally, the team leaders upload the assignment to the teaching web site. At the same time, Teacher B opens a discussion board on the teaching web site to interact with Teacher A and the students as well as to answer student questions and provide supplementary information. The students’ study information on the teaching web site becomes information for future research.
Conclusions

The MVCC model for science coteaching proposed in this study applies mobile communication networks and video conferencing technology to enable science instruction to be conducted outside classrooms and laboratories such as at zoos, museums, farms, on beaches, or in forests. Through this type of instruction, students can be exposed to a diverse range of knowledge that can increase the scope of their knowledge and provide a more extensive science education. In addition, mobile video conferencing provides new opportunities for coteaching so that this instruction method is not limited to instructors and students at the same school. Students can receive instruction from instructors from other schools and have new study experiences. This study revealed more interschool cooperation among instructors with different specializations and more teaching resource sharing among schools, which positively benefits the professional development of instructors from remote school districts.

References


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