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Cover Page Footnote

I would like to thank my supervisor, Prof. Jens Kaasbøll, from Department of Informatics, University of Oslo for his valuable comments throughout this paper. I am also grateful to the two anonymous reviewers for their comments to improve the quality of the paper.



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Factors Impacting the Use of Videoconferencing for Training: A Case Study in the Public Health Sector of Ethiopia

Research Paper

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Abstract

Videoconferencing was used for training in dispersed settings, in which lectures were broadcast and trainees were able to ask questions and discuss issues with instructors and other participants. The aims of this study are, first, to discover how to properly align videoconferencing with specific training approaches and, second, to learn which technological solutions are appropriate for use in countries with poorly developed technical infrastructures. The trainees appreciated the opportunity to establish close contact with high-ranking officials, despite encountering various technical problems and their having a low level of skills in using the new instructional technology. Moreover, the technology enabled instructors to conduct the training and interact with participants much more efficiently than had they been limited to face-to-face lectures and meetings. However, the use of videoconferencing technology mainly for instruction delivery limited the interactive and reflexive qualities of the technology. Poor training design, resulting from the influence of traditional training practices and a general lack of knowledge of instructional technology, was identified as hindering the full exploitation of this technology. While synchronous video transfer is appropriate in countries with well functioning infrastructure, distribution of lectures in developing countries should be supplemented by pre-recorded CDs and files that can be downloaded on the web.

Keywords

Technology-Mediated Learning, Healthcare, Developing Countries, Training, Videoconferencing, Extension Health Workers.

Factors Impacting the Use of Videoconferencing for Training: A Case Study in the Public Health Sector of Ethiopia

INTRODUCTION

Pre-service education cannot cover all that will be required for a career in healthcare. Healthcare workers have to frequently update their skills and knowledge due to continuous changes in the field. Providing health care workers with access to training and information is limited by factors of time and place, and further complicated by the inadequate training of instructors, as was the case in this study, as well as in many other developing countries (Kimaro, 2006; Lagebo & Mekonnen, 2005; Mengiste, 2010; Ngoma, Kaasbøll, & Aanestad, 2008; Williamson, 2001). Currently, many business and government organizations are exploring the use of satellite technology as a method for disseminating information or delivering education and training (Andrews & Klease, 1998; Freeman, 1998; Gill, Parker, & Richardson, 2005; Mitchell, Hawkshaw, Naylor, Soewido, & Sanders, 2008; Whetzel, Felker, & Williams, 1996; Wotton, 2001; Wright & Cordeaux, 1996). For example, this study focuses on the approximately 4,000 community health workers, locally known as “Health Extension Workers” (HEWs), who are dispersed across rural Ethiopia and were trained with the help of technology-mediated learning (TML).

Most researchers agree on the significance of the role that training methods play in learning outcomes (Clark, 1994). They have found that effective applications of technology in training are those that are well-aligned with the teaching/learning model that structures the course (Gupta & Bostrom, 2009; Leidner & Jarvenpaa, 1995) and the spatial and temporal boundaries of the communication process (Benbunan-Fich, 2002).

Some researchers have focused on the role that information technology (IT) infrastructures play in training effectiveness (North, Strain, & Abbott, 2000; Welsh, Wanberg, Brown, & Simmering, 2003). Others have emphasized the general lack of empirical research on these topics, especially in countries of the global south, such as in Africa (Abate, 2008). Still others highlight the need for research to determine the appropriateness of applying specific technologies to particular training situations (Rossett, 2002; Welsh, et al., 2003). The present study investigates the application of videoconferencing technology for training in the public health sector of a developing country. The results will provide much needed information for the effective implementation of TML, and, it is hoped, make a valuable contribution to the literature and practice.

Three research questions were addressed for the study: First, is the technology aligned with the training method that structures the training and with the temporal and spatial communication barriers? Second, which factors enhance or constrain the application of this technology in the training? Third, are there alternative technologies aligned with the training method and the temporal and spatial communication barriers for this training context?

This article describes how videoconferencing technology was chosen, used and complemented with other information and communication technologies (ICT) and non-ICT media, in a developing country where ICT and electricity infrastructures are poor. It identifies the importance of the training context in determining which technology is appropriate for particular training methods and temporal and spatial communication barriers. The socio-technical factors that enhance and constrain videoconferencing training are discussed, and alternative technologies that are also appropriate to the context are suggested. The study's findings should encourage practitioners and researchers to consider the training context when determining the appropriateness of applying specific IT applications to particular training methods and temporal spatial barriers.

The article is organized as follows. The next section describes the relevant technologies and discusses the role of training methods and the benefits of technology-mediated training. An Integration Model is presented as a theoretical framework to explain the application of ICT using two widely known pedagogical approaches. The research setting and approach, and describes how the research was conducted is followed by the case study. The case study describes how the training was conducted followed by findings. Finally, a conclusion is presented.

THEORETICAL BACKGROUND

Technology and Training Methods in Technology-Mediated Instruction

Many organizations currently use ICT to train employees who are dispersed across a wide geographical area (Whetzel, et al., 1996) without guidance (Rossett, 2002). Some of these organizations have reported success, while others report failure (Welsh, et al., 2003). This technology and its associated training methods have been recognized for the significant role they play in surmounting temporal and spatial challenges and in learning outcomes (Clark, 1994). Using ICT, trainees are able to access a course, course materials, their peers, and experts regardless of their physical locations. ICT offers two different modes of interaction: synchronous and asynchronous. Synchronous training refers to the delivery of a course at a set time for all participants regardless of their location. Asynchronous training refers to the delivery of pre-recorded course materials at a time determined by each individual trainee. The efficiency of ICT is self-evident: amongst other things, instructors are able to quickly transmit information to large numbers of people. However, technical difficulties and other problems can result in negative experiences when using TML, and organizations are advised to avoid technical problems and interruptions to maximize the effectiveness of TML applications (North, et al., 2000; Rossett, 2002; Welsh, et al., 2003).

As mentioned above, the technology used in this study is videoconferencing, which relies on synchronous interaction allowing both video and audio communication at a set time to all training locations (Andrews & Klease, 1998; Freeman, 1998; Martin, 2005; Toman & Bassler, 2000; Whetzel, et al., 1996). Despite the technological potential to handle different modes of interaction, it has been shown that most technology-mediated learning is asynchronous rather than synchronous (Welsh, et al., 2003); this underutilizing of the interactive aspects of the technology is a waste of resources (Govindasamy, 2002). Instructional design has been identified as a core reason for the presence or absence of interaction during training (North, et al., 2000;

Welsh, et al., 2003). In other words, implementing interactive communication technology does not guarantee that interaction will occur.

The effective application of technology in training requires proper alignment with the teaching/learning model that structures the course (Govindasamy, 2002; Gupta & Bostrom, 2009; Leidner & Jarvenpaa, 1995; Mitchell, et al., 2008) and the spatial and temporal boundaries of the communication (Benbunan-Fich, 2002). Technologies offer significant benefits when used for the tasks for which they were designed (Deborah, 1999).

There are two broad learning pedagogies that guide the design of training methods, the objectivist and constructivist approaches. The objectivist approach emphasizes one-way transmission of concepts, whereas the constructivist approach emphasizes interaction. Each approach suggests a different approach to implementing ICT in education and training settings. The objectivist approach tends to focus on improving the delivery of instruction through increasing the efficiency of transmission, whereas the constructive or collaborative learning approach focuses on improving systems that enhance group learning. Leidner and Jarvenpaa argue that different learning approaches will be appropriate according to the circumstances and the course (Leidner & Jarvenpaa, 1995). Frequently, organizations use both instruction delivery and group learning methods to conduct training, as was the case in this study.

The Integration Model

In order to serve both the objectivist and constructivist perspectives, the Integration Model was developed by Benbunan-Fich to guide the application of IT in training based on dimensions of time, place and pedagogy (Benbunan-Fich, 2002). The model was developed by adding the pedagogy dimension to the time-place dispersion typology developed by (Johansen, 1992). The Integration Model contains two dispersion typologies, one for the constructivist perspective and the other for the objectivist perspective (Figure 1). The model categorizes the educational application of IT in relation to pedagogy, mode and location. In this context, “pedagogy” refers to the learning model that structures the training. Location refers to the physical location of the training participants. The mode may be synchronous or asynchronous, depending on whether the communication occurs in real time or delayed time. Technologies are suggested for each cell.

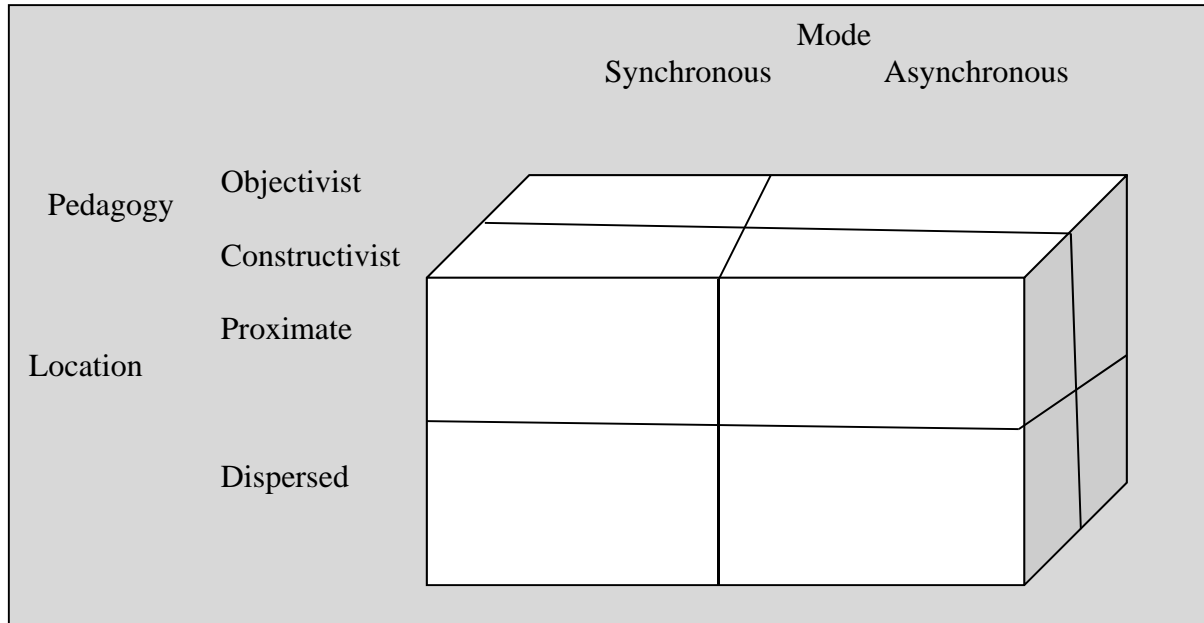


Figure 1. The Integration Model

	Synchronous	Asynchronous
Proximate	Presentation technology and computerized tutorials	Course Web page as a repository of lecture notes and class materials
Dispersed	Real-time networked classrooms with video and data links	Prerecorded lectures distributed via video streaming

Figure 2. Objectivist Matrix

	Synchronous	Asynchronous
Proximate	Synchronous GSS in labs or decision room	Web-based interactive case studies
Dispersed	Networked GSS across locations, chat rooms and desktop videoconferences	Asynchronous Learning Networks and Computer Conferences

Figure 3. Constructivist Matrix

Figures 2 and 3 classify the different types of IT applications in the objectivist and constructivist perspectives based on the meta-analysis framework for improving the efficiency of instruction delivery and group learning, respectively, along with time and place dimensions. However, the meta-analysis framework largely omits the developing countries' context, demonstrating a lack of empirical research in this area. This paper uses the model to analyze the empirical case from the developing country context and incorporate suggestions to appropriate the model for the context.

RESEARCH METHODOLOGY

Research Setting

Public Healthcare in the Oromia Region of Ethiopia

The study was conducted in Oromia, the largest region of Ethiopia, covering 284,537 sq km. The region suffers from poor transportation and unreliable electricity supply and communication infrastructures. The Oromia Regional Health Bureau is divided into 17 zonal health offices which are further divided into 198 district health offices, with a total of 2,748 public health facilities in the region (FDRE, 2007). It is primarily the regional bureau that organizes and provides in-service training for its employees, who are deployed in a wide range of settings, from urban to remote rural areas.

After one year of education, the HEWs who were the trainees in this study were deployed in rural areas to provide basic health education and services to the local communities. The HEWs' work was characterized by a lack of proper guidelines or access to adequate reference material, and was far removed from any transport and communication facilities (Teklehaimanot et al., 2007). Instructing HEWs so that they understand the country's health policy, which is not a topic currently covered in their formal training, is considered to be a key factor in improving community health services. The shortage of instructors, the time required for training, and the lack of appropriate facilities have made the target of training 1000–1500 HEWs every year a significant challenge.

Established ICT infrastructure at wereda (district) level

WeredaNet is a terrestrial and satellite-based network that connects all 641 weredas (districts) to 11 regional capitals through Internet telephone and videoconferencing. It was deployed by the Federal Information Communication Technology Agency to provide ICT services such as videoconferencing, directory services, mail services, voice services, and Internet connectivity to federal, regional, and the lowest wereda levels of government bodies.

The use of videoconferencing for training the HEWs was initiated by some of the regional health bureau management bodies who had experience with the new technology. This study describes the use of the technology by highlighting factors promoting and constraining the use of videoconferencing. Participants in this study were the HEWs, trainers, training organizers, and IT people.

Research Approach

The study employed an interpretative case method to understand how videoconferencing was implemented to train a large number of HEWs dispersed across the region. The interpretative approach is used to understand human thought and action in a social and organizational context (Klein & Myers, 1999). The people who participated in the training organization, provision of the instruction, and support were my informants. The study aimed at understanding their thoughts and actions regarding the use of videoconferencing for training. Walsham suggests that

gaining and maintaining good access to the research setting is crucial to conducting the study (Walsham, 2006). My previous experience as a trainer in the region (implementing computer-based health information systems) facilitated access to the research setting.

Data collection was accomplished through face-to-face and telephone interviews, document analysis, and observation. The data collection began with interviewing key informants from the health and ICT fields in Addis Ababa. The national and regional ICT development documents were analyzed from October 15 to November 10, 2008, in order to understand the WeredaNet infrastructure. This was followed by direct observations for six days out of the two weeks of training at the Oromia Information Communication Technology Development Agency office, located in Addis Ababa, hereafter referred to as the Center. Immediately after the training, telephone interviews were conducted with eight trainees from three training sites, Jimma (3), Assela (2), and Chiro (3). The facilitators from the sites randomly selected trainees for the study. Training organizers, trainers, and IT staff were interviewed after the training. Informal conversations were also conducted during break-times with training organizers, trainers, and IT staff in order to ascertain their reactions to the technology. A semi-structured interview guide was employed and included questions raised through discussions and observations of the training. The informants were asked to comment on their feelings about the importance of the technology for the training, the training content, how they chose the technology, and problems associated with the technology and the training. To address any questions after the training, appointments were fixed with the training organizers and IT staff. The final data collection took place from July 24 to August 2, 2009. Five trainees from one of the study sites, around eastern Shoa zone, were interviewed at their workplace six months after completing the training, in order to assess the benefits. Interview duration varied from 20 minutes to 1 hour. Table 1 lists the summarized information about the informants of the study.

Field	Institutions	Position	No
ICT	Ethiopian Information Communication and Technology Development Agency (EICTDA)	Head	1
		Expert	1
	Oromia Information Communication and Technology Development Agency (OICTDA)	Head	1
		Experts	3
Health	Oromia Regional Health Bureau (ORHB)	Trainers	2
		Training organizers	2
	Jimma, Assela, Chiro, and Eastern Shoa Zone health offices	Trainees	13
Total			23

Table 1: Interviewed informants

Extensive notes were taken during the interviews, and transcriptions were made immediately afterwards. Initially, a document about the technology, trainers, trainees, and training method themes was prepared in order to understand their role and how they influenced each other. An interpretative approach was followed in order to analyze the data (Walsham, 2006). The documents, the views of the informants, and their actions were analyzed in order to understand their meanings in context, their interrelationships, and the impact of videoconferencing on their

training. The Integration Model and the TML literature guided analysis of the data. Some of the initial themes were discarded or modified, and new themes emerged through the analysis process. Training designs, practice, and IT infrastructure are themes that emerged during the process.

VIDEOCONFERENCE TRAINING FOR HEALTH EXTENSION WORKERS

Training Initiation

Two training organizers with Bachelor of Science (BSc) degrees in health science were responsible for organizing the videoconference training based on their experience in organizing face-to-face training. Training organizers were responsible for selecting WeredaNet training sites and facilitators and for preparing training schedules, which contained training topics, the agenda, and the trainer's name. They were also responsible for making sure everything was in order during the training period. WeredaNet site visits and discussions with IT staff were carried out to help select the training sites and set the training schedule. The specific days and times for training topics were selected based on previous face-to-face training experiences. Potential trainers were chosen for each topic with the involvement of a few management bodies from the regional health bureau.

Trainers were high-level government officials from the Health Bureau's capacity-building office, and the Federal Parliament office. Both are located in Addis Ababa, where the training course was broadcasted from. The trainers were given the training topics along with a specific date and time in advance so they could prepare the training course content for delivery. The trainers broadcasted by video from the Center at pre-scheduled times. They delivered lectures, led discussions, and gave feedback to trainees without being displaced from their demanding jobs.

Based on their experience as face-to-face trainers and their knowledge of national health policy, facilitators for the local sites were chosen from the Wereda health offices, zonal health departments and Wereda capacity-building offices. These facilitators were mainly responsible for chairing the site discussions, summarizing trainees' views, impressions, questions, and comments, and faxing these to the Center. In addition, together with the site IT person, they handled onsite problems by communicating with the Center's training organizer and IT staff.

The Videoconferencing Training Sites

The training was delivered from the Oromia Information Communication Technology Development Agency office (the Center), located in Addis Ababa, to 4421 HEWs who were organized in five WeredaNet sites (Assela, Jimma, Shasemene, Nekemte, and Chiro) from November 11 to 27, 2008. The Center and training sites were equipped with PCs for recording pictures and audio, cameras, microphones, receivers, recorders, plasma screens, mixers, routers, 500 GB external hard disks, label printer machines and DVD players. The Center accommodated around 30 people, and the training site halls varied in size, accommodating from between 200 to 1500 people. Each training hall was set up with a plasma screen at the front of the room so that all the participants were able to follow the instruction. Microphones and cameras were used as input devices and the plasma screen as an output device for the training course. All the lectures and discussions transferred by the videoconferencing system were recorded using audio and video facilities at all the training sites. The training sites were chosen based on their functionality,

availability of IT staff, and size of the viewing halls. The HEWs were assigned to the training sites according to the size of the videoconferencing hall and its relative closeness to their workplaces (see Table 1).

No	Sites	Trainees/ HEWs	Distance to the Center	Schedule
1	Shashemene	1400	250	November 11– 27, 2008
2	Nekemte	1300	335	
3	Jimma	820	331	
4	Chiro	666	326	
5	Assela	235	175	
	Total	4421		

Table 2: Trainees distribution in WeredaNet sites

Each training site has one dedicated IT staff member with computer skills at diploma level and the Center has one at the BSc level; they had all received special training so they were able to operate the WeredaNet services. The IT staff was responsible for setting up the videoconferencing on a specified training schedule, controlling the flow of the training, and handling any technical problems that arose.

The videoconferencing technology enabled the trainer at the Center to hold a lecture and lead discussions at all the sites simultaneously. Videoconferencing enabled remote trainees to ask and respond to questions, making this an interactive training session. When directed by the Center, trainees were able to walk up to the front (where the videoconferencing tool was set with a microphone) and make comments and / or ask questions. The trainees and trainers were only required to learn how to operate the microphone, which was demonstrated by the IT person when needed. The plasma screen display and input access were changed by the IT staff based on the flow of the training, and trainer's instructions during the training period.

Training

The Head of the Regional Health Bureau officially launched the integrated health policy training on November 11, 2008, with videoconferencing broadcast from the Center to five training sites. The lecture was transmitted from the Center to a satellite, and then down-linked to the preselected five training sites located across the country. Trainers, training organizers, and a few other Bureau staff attended the first day of the training at the Center. The training courses continued for two weeks; in the mornings, there were face-to-face discussions at the sites chaired by facilitators, and in the afternoons trainers delivered instruction by videoconferencing with all of the sites. A few minutes ahead of the scheduled time, IT staff would set up the videoconferencing to enable the broadcasting to the predefined training sites. Videoconferencing training typically consisted of a lecture combined with a few minutes of live discussion between trainers and trainees.

The outcome of the morning training sites' face-to-face discussions on a topic or a lecture delivered from the Center was summarized in a report and sent via fax to the Center by the facilitators. The training coordinators at the Center received all of the sites' summarized reports

and sorted out questions to hand over to the trainers when they came in for discussion. Trainers provided answers to the questions from all the sites through videoconferencing. The training organizer replied to a question why the discussion was not on videoconference:

It would have been a mess if we had used the videoconferencing for discussion with such a large number of trainees. Trainees' questions and thoughts would have been limited due to the shortage of time and the large number of trainees.

The HEWs gained experience from their fellows at other sites within the few minutes allocated for the trainees' reactions. All of my informants agreed on the importance of the training sessions, especially in terms of having access to the knowledge of high-level officials who were able to clarify issues regarding their work. One of the trainees commented on this positive aspect of the training session at her workplace after six months of the training conducted:

I worked for six months before the training. During that period I did not know with whom I had to cooperate with. I would go on my own to farmers' houses to teach them, but they were not as receptive as they are now. Now I work together with Kebele's administration workers. We now get communities acceptance when we were at the local communities for education or service together with Kebele's workers. Moreover, the Kebele people will arrange a time for us when they have a meeting with the community; we use this opportunity to teach the community.

However, the delivery was sometimes hindered by limitations of bandwidth or unreliable supply of electricity at the training sites. At other times, the quality of the picture was not always good, and the sound was sometimes poor quality, making it difficult to hear the trainer. Disconnections ranging from seconds to a few minutes were observed but were fixed immediately by IT staff. One trainee from Assela said, "It would have been better if the picture of the presenter was more clear." IT staff commented on this situation: "The capacity of the bandwidth, weather, and the geographical location of the site affect the quality of sound and picture. There is a plan to increase the bandwidth".

On the fourth day of the training, the Jimma site became disconnected 30 minutes after the lecture began due to an electricity failure. The following day, the lecture that should have been transmitted was burnt onto a CD and delivered to Jimma by a driver; and the trainees had access to it during one of the site's face-to-face discussion periods. All of my informants, including the training organizers and ICT staff, expressed how using the CD helped them to overcome the previous day's disruption to the transmitted training course. Furthermore, all of my informants expressed their enthusiasm for using videoconferencing. One of the trainers from the health bureau said:

I think with this technology, we can do much more. If the training was outside Addis, I would not be able to participate, because I have a lot of paper work, meetings, and inauguration events.

The training organizer remembered the challenge of getting trainers for the face-to-face training:

One of the problems that we had in face-to-face training was getting skilled trainers on the policy issue. The current facilitators mainly from zones and weredas were trainers in a face-to-face training. Even so, there were a number of times we had to cancel or re-schedule training due to the shortage of trainers.

Similarly another training organizer said:

We had to organize many sessions to accommodate all the HEWs, and this delayed the training. There were still the previous batches of HEWs working without this training – now we have been able to accommodate them.

The regional ICT Head gave his opinion on the technology as follows:

It is a very important tool particularly for (the) health (sector). The technology enables us to access knowledge and skills from wherever we want, and as a result the travelling time and cost are reduced.

One of the trainees explained the importance of having people of high-level authority rectify the absence of guidance at their workplace:

It is good to have high officials; we were working in a way we thought was right. (However) nobody here gives us clear answers to our questions – not even the wereda people.

These comments point to the importance of the videoconferencing for training. They provide clarity by discussing its merits in the context of the resource constraints and other limiting conditions that make conducting face-to-face training a considerable challenge.

Despite the benefits of the technology for this training, informants were skeptical and pointed out their assumption about the use of videoconferencing for other training courses in the future. Most of their comments are linked with training allowance associated with training. One of the health staff at the expert level said:

The health staff have a small salary. When they are given training, they are motivated by the training allowance that they receive. If they are given videoconferencing training at their work place, they might not receive a per diem, and as a result they could lose interest in the training as well as the job.

The department head of the bureau expressed a similar idea:

I can see the benefits of the e-learning technology but the health staff would not be happy about it. Currently the health staff sees training or workshops as one criterion to change their position from one health program to another; it is just to enjoy the economic benefits associated with training.

This saying was complemented by the training organizer: “The problem is that the health staff considers the training allowance as a motivator but it would be nice if we could use the

videoconferencing”. The above comments suggest that there might be resistance toward technology-mediated learning due to lost economic benefits. The ICT Head shared this view: “The wereda administration people do not want to invest resources to replace a simple adaptor for the WeredaNet sites to maintain the infrastructure. They are waiting for us. Frankly speaking, they do not like the infrastructure since they consider it a hindrance to go out in the name of a meeting”. These sayings depict the challenges of using TML in the context due to health staff emphasis on the economic benefits linked with the training rather than the training content.

FINDINGS: THE TECHNOLOGY USED TO TRAIN THE HEWS

Effective applications of technology for training are those properly aligned with the training method that drives the training and the spatial and temporal boundaries of the communication (Benbunan-Fich, 2002). The Integration Model suggests different technological alternatives in line with the training methods and physical and temporal communication boundaries based on previous literature, which originates mostly from developed countries. However, this does not reflect the reality of the training context researched in this study that is, in the context of a developing country, where ICT use for training and ICT development in general are. For instance, some of the technologies, desktop conferences, group support systems, and computer conferences suggested in the model are high tech and require computer skills that are not common in this training context. Trainees in this study had neither access to computers nor the computer skills required for training. This revealed the significance of the training context in determining the appropriateness of the technology for the training methods, and particularly physical and temporal communication barriers.

In the case studied, the lecture was broadcasted from the Center to five training sites, and there was some synchronous discussion between the Center and the training sites. Therefore, this case falls under the category of dispersed synchronous and asynchronous communications in both pedagogies as shown in Figures 4 and 5. In addition, one site conducted a CD-based training at a different time from the videoconferencing training due to a power failure. Moreover, fax was used for communication.

Technologies used in the HEWs’ training (based on the Integration Model)

	Synchronous	Asynchronous
Proximate		
Dispersed	Videoconferencing	CD when the power failed

Figure 4. Instruction delivery for the HEWs’ training

	Synchronous	Asynchronous
Proximate		
Dispersed	Videoconferencing	Fax

Figure 5. Group discussion: the HEWs’ training

The following sections detail this technology’s alignment with the training methods and physical-temporal boundaries of communication, and highlight factors that enhance or constrain the use of videoconferencing.

Using Videoconferencing and CDs for Instruction Delivery

This study confirms the importance of videoconferencing training for the Regional Health Bureau, which faces challenges related to remote locations, limited time, and a large number of trainees with few potential trainers. More than 4000 trainees located in eight training sites were able to access the health policy training from the Center located several hundred kilometers from their workplaces. The Bureau has not only reaped an economic advantage by investing a relatively small amount in a few high-level experts' time, but also delivered the training at the right time. Time was the most significant barrier for face-to-face trainings, as seen in Section 4.3. Besides accessing the training at the right time, trainees in this study were able to access the knowledge of high-level experts who were involved in policy development and able to respond to situation specific problems due to their authority. Other researchers have shown similar results by suggesting satellite training for large organizations to reduce cost and increase efficiency (Gill, et al., 2005). Research results also described the effectiveness of smoking-cessation training delivered via videoconferencing to more than 300 health workers located in 27 sites across rural Australia (Mitchell, et al., 2008). This revealed the alignment of the technology with the physical-temporal boundaries of communication.

Despite this achievement in terms of time and spatial challenges, the technology used in this study was not aligned with the training method and the training context. First, using videoconferencing, with its two-way audio and video communication features, for a one-way instruction delivery limited the communication potential of the technology. This is a waste of resources (Govindasamy, 2002), particularly in the context of a place where ICT is scarce. Second, the videoconferencing used for instruction delivery was not aligned with the training context, which was hindered by an unreliable electricity supply, low bandwidths, and poor training design. As a result, time was lost and distractions at the training site were identified. A similar finding regarding time lost during a short disconnection was identified in a satellite-based multi-campus university mass lecture (Freeman, 1998).

Regardless of these socio-technical problems, all of my informants were pleased that they had received the recorded lecture on a CD, and were not that concerned about the disruption to the training course and the time lost. For example, one of the trainees from the Jimma site said: "The [disconnection of the] electricity disturbed us but we did not miss anything – we followed the recorded training which was sent from the Center." This statement stands in contrast to previous research results regarding learners' frustration and negative experiences as a result of non-functional technology (North, et al., 2000; Rossett, 2002; Welsh, et al., 2003). Receiving the missed lecture on a CD later, and having access to the knowledge of high-level experts, engendered a positive attitude in the trainees towards the technology. Therefore, the trainees understated the problems associated with training distractions and the time lost. This revealed the importance of a CD for instruction delivery for the context.

However, the means of communication they used to send the pre-recorded lecture on a CD, namely, a driver, was expensive and time-consuming. This reveals the influence of traditional communication mediums used in the health sector. It also suggests a lack of effort on the part of the IT staff, or perhaps reluctance to explore other ICT solutions, such as a web server, e-mail, or even having the closest training site burn the missed lecture on a CD to send the missed lecture.

Based on the findings in this study, using videoconferencing for instruction delivery without assessing the appropriateness to local teaching methods and infrastructure might reduce its potential benefits. To achieve significant benefits from moving beyond spatial-temporal barriers, it may be necessary to look at other technologies (Gill, et al., 2005; Whetzel, et al., 1996) that are in line with local training methods and contexts.

Using Videoconferencing and Fax for Discussion

Hackman and Walker (1990) found that interactive systems that allow learners to comment during training positively influenced the learning situations. However, users mentioned their concern regarding the lack of interactivity in technology-mediated training (Dobbs, 2002). Similarly, in this study, despite videoconferencing's potential for two-way communication, the interaction between trainees and trainers was limited to providing responses to questions and comments generated at the sites and received by fax and rarely during a videoconference. Ideas that arose during the videoconference might not be communicated until later or not at all. This revealed that the potential of the technology for interactivity is not a guarantee of interaction. Interaction is much more than just establishing a connection (Whetzel, et al., 1996); it must be designed as part of the training.

This study identified the training design as the root cause for the lack of interaction. The training design was based on the trainers and training organizers' face-to-face training experience, which consists of transferring knowledge from trainers to trainees. Similarly, a team of experts in computing, instructional technology, and academic content designed satellite-based training for multi-campus, large classes (Freeman, 1998). In this study, however, the IT staff members were not asked to participate in the design of the training, and they did not possess the instructional technology knowledge to advise the trainers and organizers either. This manifested itself in a lack of understanding on how to develop a learner-centered approach to learning, which is appropriate for videoconferencing technology (Andrews & Klease, 1998). Consequently, a large number of trainees were assigned to training sites based on the size of the hall, rather than on a consideration of the trainees' interactional needs. Most of the training time was dedicated to lectures designed to "transfer knowledge" from trainers to trainees. Training organizers cited the large number of trainees as a reason for limited interaction during videoconferencing. A large number of trainees was found to be a constraint to interaction among participants (Yarkin-Levin, 1983).

Despite the limited interaction revealed in this study, the HEWs benefited from trainers' responses to their questions and comments, which were sent by fax from their sites and other training sites. The following comments by the HEWs emphasize what they have gained from the limited interaction they have had with the trainers and other trainees.

It is good to get a response from high officials that resolves our doubts. For instance, regarding our careers, the Health Minister promised to arrange education for further development; that is a good thing, which nobody at the wereda level was able to answer.

I heard about different experiences of our colleagues from the other sites; some of them were sad stories like being raped by farmers, which I had not thought of...I will never go alone to teaching the (local) community the way I did before.

The comments above suggest the importance of the videoconferencing technology for interaction; in this case, presenting critical issues to high officials for action, as well as sharing experiences with other trainees. Similar results were found by Freeman (1998): getting access to experts was the primary goal achieved from a satellite-based, mass-lecture delivered to a multi-campus university.

Ultimately, “[J]ust because e-Learning is available, the old practices cannot be totally discarded” (Govindasamy, 2002). The face-to-face discussion chaired by the site facilitator was found to be valuable in this study. As mentioned by the training organizer, trainees might not have had a chance to voice their opinions during videoconferencing due to such a large number of trainees in attendance. There has been a great deal of discussion of blended learning advantages (Rossett, 2002; Welsh, et al., 2003). However, using faxes to submit questions and report the outcome of the sites’ discussions limited the interaction between the trainer and trainees, and made the communication expensive.

Proposed Technologies Appropriate to the Training Context

Videoconferencing was mostly used for delivering lectures from the Center to the training sites and was rarely used for interaction between the trainers and trainees or among trainees. Nevertheless, trainees appreciated the technology, because it enabled them to access the knowledge of high-level authorities, and to be able to ask questions and get solutions for the specific challenges they face at their workplaces, rather than rely exclusively on predefined training topics. This shows that trainees assigned higher value to interactions than to pre-defined training topics, such as, national health policy, healthcare strategies, their rights, and so on. The study also identified the challenge of using videoconferencing for instruction delivery to multiple training sites in the context of unreliable electricity supply. Furthermore, using a two-way communication technology such as videoconferencing for instruction delivery is a poor use of the limited ICT resources in the country (Govindasamy, 2002).

Rossett asserts the need for empirical research to assess the suitability of one technology over another in relation to the training contexts (Rossett, 2002). Based on this empirical research finding and the Integration Model, less-sophisticated and available technologies that are more suitable for the training context, when the technical infrastructure is poor, are suggested as shown in Figure 6. It is suggested that the sophisticated technologies that are shown in the Integration Model should not be used in the present-day situation, but perhaps at some point in the future, when the use of ICT has become more developed throughout the country. Accordingly, pre-recorded lectures on a CD and/or uploading on the organization’s website are suggested as more properly aligned with the training method as well as the specific temporal and spatial communication barriers specific to this context. These technologies alleviate some of the contextual problems caused by unreliable electricity supply and low bandwidths. The technologies can be used asynchronously without requiring setting a time schedule across other

training sites. Similarly, pre-recording lectures on CDs has been suggested for multi-campus university teaching (Freeman, 1998; North, et al., 2000). The effectiveness of CDs has also been identified in teachers’ training and child health immunization training in developing countries (North, et al., 2000; Tavrow et al., 2002).

This study suggests that it would be productive to enhance the use of videoconferencing for synchronous communication given that our findings revealed its importance in training. E-mail and instant messaging is also suggested as supplements to videoconferencing. The IT staff could deliver the trainees’ ideas during and after the discussion period in order to facilitate communication.

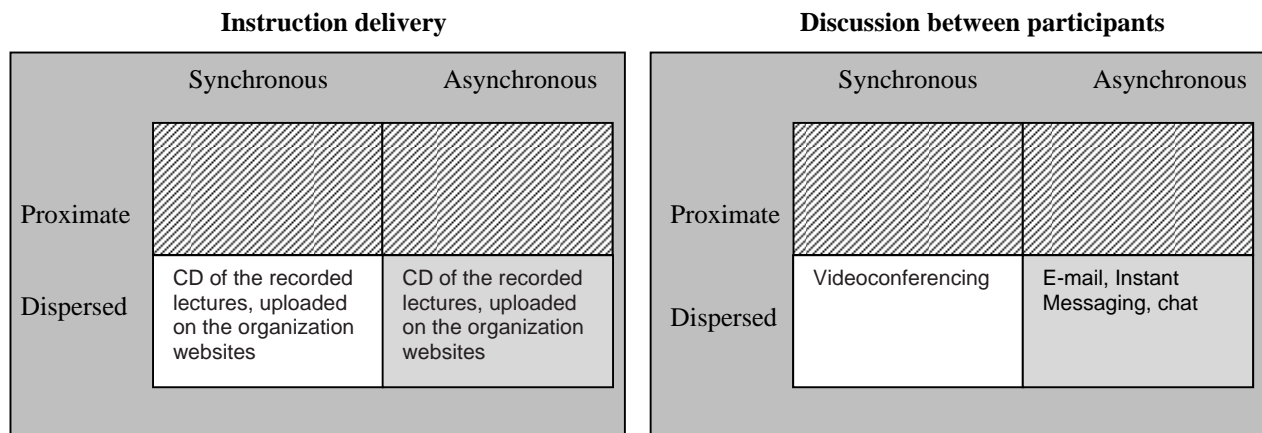


Figure 6. Proposed technologies for the HEWs’ training based on the Integration Model (Benbunan-Fich, 2002)

Work Practice Change Required

The training and communication practices identified as problematic must be addressed to ensure effective TML in the public sector. The dominance of objectivist perspectives in TML design may reduce the benefits we can gain from the technology. Technology-mediated learning design requires experts from the domain of training content (health), and computing and instructional design for its effectiveness. The IT staff should direct their knowledge and skills beyond setting up the system and providing technical support. They have the capacity to advance the application of technologies for training and communication.

Much research in the health sector of developing countries has cited the training allowance as an important motivator for health staff to attend trainings (Ngoma, et al., 2008, Lagebo, 2005). Similarly, this study documents the negative attitude of the health staff toward technology-mediated learning due to their fear that the HEWs might lose their training allowances. This kind of attitude is a danger for training in general, and it would probably be worse for technology-mediated learning. This issue must be addressed by either keeping the training allowance when the training is run by technology or changing the health staff’s attitude toward training.

CONCLUSION

This study aimed to identify the factors that enhance and constrain the effectiveness of technology-mediated learning in the public health sector of Ethiopia by examining how technologies are applied to training. The study posed three research questions in order to understand how videoconferencing technology is used in the public health sector of a developing country where ICT development is still in its infancy. First, is the technology properly aligned with the training method that drives the training and the spatial situation of the training? The Health Bureau has faced significant challenges due to limited time, large distances, and the lack of skilled trainers to instruct such a large number of trainees. Videoconferencing technology has enabled the Bureau to deliver training at the right time using high-level experts. This demonstrates the technology's alignment with the spatial and physical boundaries. However, the unique potential of the technology, specifically its potential for interactivity, remained unexplored due to a misalignment between the training method and technology. Videoconferencing, which is a two-way communication medium, was used to broadcast lectures from the Center to five training sites. The failure to exploit its two-way functionality wasted limited and scarce ICT resources. However, the study highlights the importance of the limited two-way interaction in terms of enabling trainees to describe problems to high-level experts and receive solutions, which would have been impossible in face-to-face training sessions with low-level officers.

Second, what are factors that enhance or constrain the application of this technology in this type of training? Poor training design informed by objectivist face-to-face delivery training practices, and influenced by the traditional communication medium, combined with the absence of instructional design knowledge appropriate to technology-mediated training contributed to the misalignment between training method and technology. In addition, the withdrawal of economic benefits, which have been viewed as incentives to participate in training would be a considerable threat to TML implementation; insufficient bandwidths and unreliable electricity supply were also identified as technological factors constraining the effective application of the technology to training. The establishment of the WeredaNet infrastructure for the public sector is a technological factor that has enhanced the possibility of using videoconferencing for training. The positive attitude of the health staff toward the technology and their relatively negative attitudes toward the benefits of previous face-to-face training sessions can be considered an enhancing social factor for the application of the technology. These socio-technical factors revealed the significance of the training context to determine the appropriateness of the technology in addition to the training methods, physical and temporal communication barriers.

Third, are there alternative technologies aligned with the training method for this training context? The study suggests simpler technologies appropriate for the context that do not require sophisticated skills and a well-developed information communication infrastructure. Pre-recorded lectures on CDs and web pages as repositories for lectures have been suggested for instruction delivery. These technical solutions, in addition to the training method and physical-temporal dimensions, align with the training context. The importance of interaction between trainers and trainees, as well as among the trainees, leads to the suggestion of enhancing the use of videoconferencing for synchronous communication. E-mail and instant messaging are suggested as supplements to be handled by the IT staff to communicate the trainees' ideas during and after the discussion period. Interaction between the trainers and trainees, as well as among

trainees, has been identified as vital for sharing knowledge gained through distinct experiences. Trainees used the technology to access high-level authorities to get answers and solutions for the challenges they faced at their workplaces. This study highlights the importance of the training context in addition to space, time and pedagogy which were used by Benbunan-Fich to suggest alternative technologies.

The contribution of this study is threefold: theoretical, practical, and methodological. Theoretically, the study contributes knowledge about technology-mediated training in a developing country context, where ICT development is still in its infancy. Practically, it advises practitioners to design training by considering the training context and method to increase the effectiveness of the technology both in transcending time and place barriers and in improving the learning outcome. Methodologically, it showed the importance of the Integration Model to analyze the application of IT in training. The Integration Model helps us investigate the effectiveness of technology by focusing on two broad training methods often used in training. More empirical research in developing countries is required to inform both practitioners and researchers about the influence of local contexts on technology-mediated training.

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