Potential Pedagogical Benefits and Limitations of Multimedia Integrated Desktop Video Conferencing Technology for Synchronous Learning

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Abstract—**As multimedia gradually becomes more and more an integrated part of video conferencing systems, the use of multimedia integrated desktop video conferencing technology (MIDVCT) will open up new educational possibilities for synchronous learning. However, the possibilities and limitations of this technology must be clearly understood so that it can be used to maximize possible pedagogical benefits and reduce possible pedagogical limitations. This paper analyses the process of integrating MIDVCT in a first-year English language course, and offers insights into theoretical underpinnings of multimedia learning from two perspectives: the generative theory of multimedia learning and the cognitive overload theory. The data discussed in this paper have been drawn from a study which took place in a cross institutional setting at Fontys University of Applied Sciences, The Netherlands. The data were collected and analyzed according to a qualitative approach.**

Index Terms—**multimedia learning, desktop video conferencing, synchronous learning, pedagogical issues**

I. INTRODUCTION

Many universities, colleges and other educational institutions continually strive to improve and provide first class educational opportunities to their students. However, over the last decades many of these institutions have experienced profound changes in their external environment which have affected both their primary and secondary processes of education; research and organization [1]. One result of these changes that these factors have brought about is that higher educational institutions such as Fontys University of Applied Sciences must operate in a far more competitive world than heretofore. In other words, these higher educational institutions must deal with greater market forces due to a decline in public funding and rising expenses. Moreover, the increasingly diverse nature of student bodies, the ever-changing needs and expectations of students as well as the heightened demand for innovative educational programs, forces institutions to move towards more demand focused and economic solutions so as to provide educational opportunities for the remote learner.

At the end of the twentieth century several developments in information technologies and network connections enhanced communication and information transmission capabilities between educational institutions. Since then the use of video conferencing technology has increased as the costs of providing the required technology has decreased significantly. Such videoconferencing technologies provide learning opportunities for students who have no physical access to a local college, allowing them to share perspectives and materials with their instructors and peers.

In addition to regular video conferencing technology, the availability of multipoint desktop video conferencing systems (MDVCS) enables students and instructors to conference simultaneously from multiple sites with each other. Additionally, most of these MDVCS have integrated multimedia tools such as electronic whiteboards and live presentations.

However, research has shown that multimedia representations do not always enhance learning [2]. Some researchers claim that multimedia information can have deleterious effects, under certain circumstances [3].

In this paper, I will therefore draw upon the body of research in order to analyze and discuss the pedagogical benefits of multimedia integrated desktop video conferencing technology (MIDVCT) such as the open source video conferencing tool Dimdim™. This conferencing tool enables instructors to deliver synchronized live presentations, whiteboard and web pages while sharing voice and video on the Internet − with no download of software required.

The data to be discussed in this study has been drawn from a cross institutional study of the potential pedagogical benefits and potential limitations of multimedia integrated desktop video conferencing on student learning. The following research questions were the main focus of this study:

1. What theoretical insights can be derived from secondary literature with regard to multimedia learning?
2. What are the pedagogical benefits and limitations of using MIDVCT as perceived by the learners participating in this study?

II. MULTIMEDIA LEARNING THEORIES

Before analyzing and discussing the potential pedagogical benefits of multimedia integrated video conferencing technology, it is important to understand what is meant with *multimedia* and *multimedia learning*. In this paper multimedia is defined as the use of computer tech-

nology to present video, audio text, graphics and animations in an integrated manner. According to [4], "multimedia environments" include "online instructional presentations, interactive lessons, e-courses, simulation games, virtual reality, and computer-supported in-class presentations".

Multimedia tools enjoy increasing popularity at all levels of education. Recent studies [5] [6] have shown that multiple representations of information can indeed lead to improved learning outcomes, although multimedia materials can potentially have detrimental effects on the learning process [7]. The effectiveness of multimedia in class depends on the learning conditions and the differences in how learners acquire and process information. In several studies, the cause for such deleterious effects is based on cognitive load. Reference [8] theory focuses on the cognitive processing of verbal and visual material and is based on three assumptions: a) the dual channels assumption suggests that humans posses two separate systems for processing visual and verbal information; b) the capacity assumption suggests that each channel can only process a limited amount of information; c) the active-processing assumption suggests that for meaningful learning several cognitive processes need to take place in the verbal and visual channels such as in the selecting, organizing and integrating of new information.

References [8] [9] make clear that meaningful learning requires that the learner engages in substantial cognitive processing during the learning process. In other words, Mayer [8] and Moreno's [9] findings show that presented learning material is only advantageous to learners who actively process information. However, the learners' cognitive capacity remains limited which can have a negative effect on the learning process of some learners [10] [11] [12]. Essentially, the cognitive processing of verbal and visual information is based on the generative theory of multimedia learning [13] [5]. According to this theory, meaningful learning takes place when the learner selects relevant verbal information from e.g. either a text or from visual information such as a picture and then constructs an image or text base. In order to create coherent mental representations the learner must organize the information in the text base and the image base. Thereafter, the learner must integrate the verbal and visual representations by connecting the newly constructed verbal and visual representations together. In other words, when the two processes of connecting and integrating occur between the visual and verbal representations, enhancement of learning takes place. Figure 1 illustrates these processes.

Reference [3] who also investigated what role cognitive load plays in multimedia learning, reached similar findings. In their research they focused on how cognitive load affects the way in which foreign language learners possessing different cognitive abilities process verbal and visual representations. The multimedia environment which was used in their study was a second-language multimedia program for reading texts in a foreign language. The task was to comprehend the foreign text, which involved two levels of learning: understanding vocabulary items and overall text comprehension. The vocabulary items in the text were annotated with visual and verbal information. Their research findings make clear that the recall of word translations was worse for students possessing low-verbal and low-spatial ability than for high-verbal
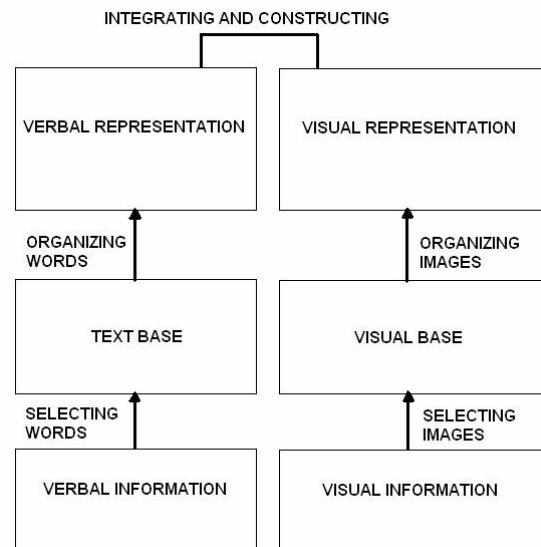

Figure 1. Generative theory of multimedia learning [13]

and high spatial ability students respectively, when they received visual annotations for vocabulary items in the given text.

III. METHOD

A. Participants

67 freshmen participated in the study that were enrolled in a first-year English language course. None of the enrolled students were native speakers of the English language. All students were following one of the three main study tracks at Fontys University of Applied Sciences: International Business and Management Studies, International Business Economics, and International Marketing.

B. Setting and Procedure

This investigation involved the use of MIDVCT in the teaching of English to first year students. To better understand the pedagogical benefits of MIDVCT, several video conferencing sessions were studied during a period of three months. Each session was established by making use of a local site on the university campus (instructor's room) and several off campus sites (students' apartments). The instructor hosted each video conferencing session, while video and audio was transmitted via a webcam to the students at the remote sites. Additionally, all students saw the same slides, text and graphics which were presented by the instructor. Moreover, for the purpose of extemporaneous writing, e.g. providing students with written comments or feedback, the integrated electronic whiteboard was used; the whiteboard display was shared with all students synchronously.

C. Materials and Apparatus

The instructor and participants were not provided with any special equipment but they did all have access to on campus networked Hewlett Packard PCs running Windows™ Xp. However, most students used their own desktop PC or laptop when video conferencing off campus. Students were provided with an email in which they received information how to join the video conferencing sessions. In this study Dimdim™ was used as the

MIDVCT platform for the reason that it is an open source tool and that it does not require any software download.

D. Data Analysis Method

In this study qualitative research methods were used. Data were gathered from a focus group interview and individual interviews.

The focus group interview was conducted with nine participants in order to inventorize the thoughts and feelings of participants regarding the use of MIDVCT as a means to enhance synchronous learning. The interview lasted 38 minutes and was attended by all participants. The interview was recorded using a laptop with an integrated microphone and subsequently transcribed verbatim by the researcher.

Additionally, nine individual interviews were conducted based on the *interview guide approach*. All interviews lasted 30 minutes and were recorded using a laptop with an integrated microphone. Each interview was transcribed verbatim by the researcher.

IV. PEDAGOGICAL BENEFITS

A. Learner Motivation and Engagement

The research data show that the participants in the study highly valued the use of multimedia during the video conference sessions. One of the participants emphasized the fact that showing a video clip about how to use a wiki for report writing made it less abstract and fostered engagement[1]:

S[2]: The instructor showed us … a short mp3 file how we can use a wiki for … report writing. Sometimes he stopped the video and … gave us some tips and advice. In this way I found it more interesting to listen to what the instructor had to say.

One student mentioned that the use of MIDVCT was more interesting than a regular lecture or tutorial:

S: The video conference sessions made me do something … because they were interesting. I think … that regular classes are not that interesting … I mean some are … boring. Now I have the feeling that there is more … going on such as … video and whiteboard use… I mean in the video conference sessions … or … there is more interaction … and I learn English.

This student appreciated the variety of multimedia resources that were used during the video conference sessions and which raised her motivation to learn English.

B. Accommodation for Different Learning Styles

During the focus group interview, participants were asked to comment on the benefits of using MIDVCT in learning. Several participants felt that the use of multimedia during the video conferencing sessions helped them to better understand the learning material:

S: During the sessions the teacher added written comments in my report … he used the whiteboard … and he explained in words … when he wrote the comments … why something should be written differently. He corrected … some grammar mistakes and explained why … it should be written in that way. He also changed … replaced some of the words and explained the meaning of these words. I had the feeling that I … learned something from it.

Another student emphasized the remedial aspect of the record button in Dimdim™:

S: After the session the teacher send an email with an Internet link to all students. When you clicked on the link you could listen to and watch … a recording of the session. This helped me to (…) watch and listen to it over and over again … where and when I wanted.

The data with regard to the individual interviews confirmed the findings of the focus group interviews. Several students emphasized that MIDVCT enhanced their learning:

I: So it does improve your learning. Could you be more specific about this?
S: The teacher used the whiteboard and drew five boxes … squares and … in each square he wrote a few words. While listening to him and watching the whiteboard … it became easier … I could understand … the basic parts of a letter of application.
I: So, the teacher used words and pictures?
S: Yes … and listening to him and watching him via the webcam made it all easier. I think in this way … he was … not so … theoretical.

C. Fostering Synchronous Collaboration

Several participants stated that the MIDVCT fostered collaboration within the group because it provided them with multimedia resources which helped them to work together more effectively. One of the students pointed out that uploading her material for peer review enhanced her learning as she was able to receive feedback on her work from her peers.

S: I could upload the part that I had to write … and ask … ask the other group members to have a look at it.
I: So you received feedback on your work?
S: Yes … sometimes it was not clear to me … but … and I could ask them what they suggest to change. So … I … we could work together at the same time on the report and this was … much easier … than sending it via email.

One student mentioned in the focus group interview that the use of multimedia created more possibilities with regard to synchronous learning:

I: What are the advantages of using MIDVCT?
S: I think that … how should I say it … using Dimdim makes it possible to work together at the same time also when you have no audio … I used the computers in the library.
I: Could you be more specific?

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[1] The following conventions were used in the transcripts: … pause; ( ) transcriber's comments; (…) inaudible utterance.
[2] All names of the participants have been deleted in order to protect students' anonymity.

S: I did not have … a headset but I could see my teacher and … communicate with him and the other students via … the whiteboard and chat.

V. PEDAGOGICAL LIMITATIONS

A. Overload of Information

The data show that a possible drawback of using MIDVCT is that learners experienced an overload of information during the sessions. Students indicated that they had problems processing the presented verbal and visual information shown in several screens simultaneously. The following focus group extract illustrates students' experiences:

I: Could you say something about the disadvantages of using MIDVCT?

S: One of the disadvantages is that … when the teacher uses more screens at the same time.

I: Can you explain this a bit more?

S: The teacher showed us an mp3 about how we could use a wiki … and … he did not want to disturb us … so … he wrote something … in the chat room. I had … how should I say it … really problems reading the text and … watching the mp3 file … at the same time.

The student's statement illustrates a situation known as a split-attention effect. This is due to the student's visual attention being split between watching the mp3 file and reading the text in the chat room. Due to the overload of visual information the student limits information processing since the visual working memory can only carry a limited amount of information.

B. Overkill of Multimedia Resources

Students mentioned that they were overwhelmed by the amount of multimedia resources which were used during the conferencing sessions. Some students really had problems processing the information which was presented via several multimedia at the same time. They felt that they did not have enough time to "consume" and "digest" the information:

I: Could you say something about the disadvantages of using MIDVCT?

S: For me it was really difficult to use all these … tools at the same time … I mean … when the teacher is using these tools at the same time. I did not have enough time … to think what was going on. It took some time to understand the tools … but then I was too late. My teacher was already busy with something else … I mean he already explained something … in another screen. I need some time … I think in a … normal class this would be easier … you do not use all these tools.

The extract shows that the student has problems keeping up the pace and understanding the information which was delivered to him via the available multimedia. Several other students mentioned:

S: Everything goes for me too fast.

S: I could not understand everything … I needed more time. There were too many texts … and video clips and the teacher was … moving quickly.

Learning requires substantial cognitive processing in the verbal and visual channels [5]. In fact this is the central assumption of the generative-learning theory which assumes that the selecting, organizing, and integrating of information are essential processes for meaningful learning. However, if cognitive processing is not taking place or is only partly taking place, students may be limited in constructing new information. Cognitive processing needs time since the capacity for mentally holding and manipulating images and words in the working memory is limited.

VI. SUMMARY AND CONCLUSION

In this paper the information obtained in the secondary literature has been combined with these research findings in order to better understand the potential pedagogical benefits and limitations of using MIDVCT. In fact, there appear to be meaningful ties between the theories used and the qualitative data from the participants in this study.

The research findings with regard to the potential pedagogical benefits have shown that students perceived the use of MIDVCT as enhancing their language learning. In particular, students mentioned that it raised their motivation and engagement. Students felt that the technology catered to various learning styles, and that it provided support for their language learning process.

However, data analysis with regard to the potential pedagogical limitations has shed light on the disadvantages such as: cognitive overload and overkill of multimedia resources which results in blocked cognitive processing. It seems reasonable to conclude that reducing a cognitive overload and limiting the use of multimedia will enable students to intellectually digest chunks of information sequentially rather than simultaneously [8] .

The data and literature discussed in this paper provide interesting insights into the use of MIDVCT within the context of an English language course. It is important to mention that due to the small scale research study, the research findings only reveal students' perceptions with regard to the use of MIDVCT. In other words, the research findings do not allow for the drawing of conclusions as to the students' learning outcomes which would be in itself an interesting topic for further research.

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