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Learning with E-lectures: The Meaning of Learning Strategies

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ABSTRACT

Video-based e-lectures offer interactive learning and more vivid and personalized forms of self-regulated learning. Participants (N = 28) learned from either a video-based e-lecture with synchronized written transcript of oral presentation (multimodal) or an e-lecture without the transcript (unimodal presentation). Learners could be classified as "repeaters", whose primary focus was on the lectured material, or as "surfers," who spent less time on the lecture itself and instead used the optional links. Results showed that the learning outcomes were significantly influenced by learner strategy (with repeaters outperforming surfers), but not by presentation modality (with or without written text).

Keywords

E-learning, Multimedia learning, Interactive video, Redundancy principle, Learning strategies

Introduction

From various perspectives, learning with new media raises many hopes and expectations. Different solutions for learning with new media have been developed, e.g., web-based learning, videoconference systems, social software. Nowadays many educational institutions offer e-lectures to their students. An e-lecture can be defined as a media based lecture including an audio or video recording, synchronized slides, table of contents and optional complementary information (e.g., external links). An e-lecture can be presented with all relevant learning materials in one integrated learning environment. It can be distributed and viewed live or selected from an archive. However, they can look very different. Some of them include a video of the lecturer. Other e-lectures provide only audio recording. Most of all, an e-lecture consists of slides with relevant points mentioned by the lecturer. In only few e-lectures one can find a written transcript of the oral presentation. This article will present two kinds of a video-based e-lecture, one with synchronized text and one without text within the e-lecture. We will present the design of those two e-lectures considering instructional design principles and results of an experiment. The question will be answered whether learning results are affected by the different design of the e-lecture or the learning strategies used by students. Based on these results relevant aspects for learning with e-lectures are discussed.

Learning with interactive e-lectures

There are several advantages for learning with a video-based e-lecture but also some challenges. Within a video-based e-lecture verbal and nonverbal signals given by the lecturer can be transmitted.

An oral lecture presented in a lecture hall can be recorded and made available over the Internet. The learners have access to its content "on demand", independent of time or location. E-Lectures can be used very flexibly. Students can easily access learning material and reuse it at any time (Demetriadis & Pombortsis, 2007). The lecture can be divided into sections and displayed in a table of content. Therefore user can select or repeat a specific topic of the presentation according to their individual motivation, interest or prior knowledge. Navigation buttons like play and pause offer learners interactivity. E-lectures are characterised by dynamic presentation and different presentation modes. Therefore, an e-lecture is a more vivid and personalized form of self-regulated learning than a hypertext learning environment. The disadvantage of this kind of learning is the lack of immediate teacher-student communication (Demetriadis & Pombortsis, 2007), and no interaction with other students or the teacher to clarify questions is possible. The lack of feedback and higher degree of intrinsic motivation and self-regulated learning are also relevant aspects for learning with e-lectures.

Demetriadis and Pombortsis (2007) propose that e-lectures "can be safely used as students` introductory learning material to increase flexibility of learning, but only within a pedagogically limited perspective of learning as knowledge acquisition (as opposed to construction)" (p.156). Interactivity is the salient factor of a video-based e-lecture. The learner can adapt the representation to his or her individual needs. Interactive videos with navigation buttons give learners the opportunity to stop, pause, play and rewind the lecture. In this case, basic navigation options and natural mapping devices are required (Clark & Mayer, 2003; Norman, 1988). Common navigation options can avoid cognitive load. The learners recognize buttons like "play" and "stop" from regular media players (e.g., Windows Media, Real Player). Previous research has confirmed that these interactive possibilities are helpful for learners (Schwan & Riempp, 2004). In an experimental study from Schwan and Riempp (2004), subjects had to learn to tie nautical knots. They watched either non-interactive or interactive videos. In the condition of non-interactive video viewing, the subjects needed more time to learn. The learners in the interactive conditions made heavy use of the interactive features. The interactive behaviour increased with the difficulty of the learning material (Schwan & Riempp, 2004). Therefore, interactive possibilities for learners are necessary – especially for difficult topics. Learners can repeat relevant information for a better understanding and thus for effective knowledge acquisition.

Another study focused on the influence of an interactive video on learning outcomes and learner satisfaction (Zhang, Zhou, Briggs & Nunamaker, 2006). The authors compared four groups. One group learned with an interactive video, one with a non-interactive video, one group watched no video and one group learned in a traditional classroom setting. Learners had random content access through control buttons in the condition with the interactive video. The results confirmed previous findings; learners with the interactive video outperformed learners in the two other conditions and they also reported a higher level of satisfaction with the learning environment.

An e-lecture can offer additional links with additional information and learning materials for learners. But additional information like external links is not always helpful for learners. Niederhauser, Reynolds, Salmen, and Skolmoski (2000) found that a frequent use of links in reading hypertext has a negative influence on the learning outcome. Especially if links show no direct connection to the content of the lecture but rather are added interesting material, hyperlinks may inhibit learning. In the Study of Zhu (1999), students learned with a hypermedia system. The results showed that in a "fewer-links" condition (3-7 links), learners performed significantly better than learners in the "more-links" condition (8-14 links). Zahn, Barquero and Schwan (2004) varied the number and integration of links in a hypervideo system. Groups 1 and 2 had to learn with a hypervideo including 15 or 30 links which where sequentially integrated in the video. For another two groups, the links (15 vs. 30) were presented as a cluster at the end of the video. A control group received the learning material without links. The results showed no significant effect of the groups. Participants of the experiment learned comparably well, and no differences in knowledge acquisition could be found. The number and position of hyperlinks did not influence learners' performance. But learners evaluated the learning material with 15 links more positively than participants whose learning material had included 30 links. Zahn et al. (2004) correlated the exploration activities and rewind-actions with the use of hyperlinks and the use of video recorder functions. The analyses showed that as interactive behaviour increases, comprehension and acquired knowledge increase as well. These studies clearly demonstrate the benefits of interactive videos.

E-lectures can be seen as a new possibility for knowledge distribution and as a complement to learning from hypertexts. But how should an e-lecture be designed? Do any design factors affect knowledge acquisition? The next sections will take a look at some relevant aspects.

Instructional design principles and learning strategies

The principles for multimedia learning are based on the theory of limited cognitive capacities (Mayer, 2001). There is evidence of two processing systems in the working memory, namely visual and auditory processing (Baddeley, 1997; Mayer & Moreno, 1998). In order to avoid cognitive load during knowledge acquisition, it is better to tap the full potential of the working memory by addressing both systems (Baddeley, 1997, Mayer, 2001, Mayer & Moreno, 2003). A combination of different presentation forms leads to better learning outcomes (Clark & Mayer, 2003; Mayer, 2001). The modality principle relies on the assumption, that it is better to use spoken text than printed text within an animation. (Clark & Mayer, 2003, Mousavi, Low & Sweller, 1995). But this principle is limited to audio recordings. What about e-lecture? Within a video, the audio channel and visual channel are equally stressed. If slides

and additional synchronously presented on-screen text are included, these also tax the visual channel. When spoken and on-screen text synchronously explain graphics, the on-screen text becomes redundant. This is known as the so called "redundancy principle" (Clark & Mayer, 2003, Mayer, 2001). Clark & Mayer (2003) recommend that on-screen text should remain only to describe complex knowledge domains. On the assumption that learning content presented in a foreign language is complex, on-screen text could be helpful for learners. In this case, Clark and Mayer (2003) recommend offering redundant on-screen text.

Another relevant aspect of effective knowledge acquisition is the use of learning strategies (Schmeck, 1988, Mayer, 1988, Weinstein & Mayer, 1986). "Learning strategies can be defined as behaviours of a learner that are intended to influence how the learner processes information" (Mayer, 1988, p. 11). Weinstein and Mayer (1986) describe these strategies as rehearsal, elaboration, organizational and monitoring strategies. Further they differentiate between basic and complex strategies. According to the active-processing assumption, humans are active processors who pay attention, select and organised information. The cognitive theory of multimedia learning (Mayer, 2001) includes these aspects. But what about active strategies to learn through e-lectures? Can different strategies be identified and do they have an impact on learning outcomes?

The principles identified by Mayer (2001) are based on learning in the fields of science and mechanics; multimedia presentations are primary linear computer animations. What about other tasks like learning a foreign language or learning with an e-lecture? Clark and Mayer (2003) argue that additional on-screen text can sometimes be indicated and not redundant, for example when "the audience has language differences" (Clark & Mayer, 2003, p.108).
In sum, this paper addresses the following research questions:

- In which way do learners use an e-lecture?
- Do different strategies have an impact on learning outcomes?
- How important are instructional design principles like additional printed text with spoken text for learning within an e-lecture?

Learning strategies are helpful for effective knowledge acquisition (Schmeck, 1988, Mayer, 1988, Weinstein & Mayer, 1986). Therefore our assumption for learning with an e-lecture is:

Hypotheses 1: Learners who use learning strategies have significant better knowledge test results than learners who do not use such learning strategies.

Learning a foreign language can be difficult. New words, grammar, pronunciation, conversation and writing must be learned. As postulated by Clark and Mayer (2003), additional written text with spoken text can help learners with knowledge acquisition. Thus the additional written text is not redundant, it is perhaps even necessary.

Hypotheses 2: Learners in a condition with additional written text within an e-lecture have better test results than learners who learn from an e-lecture with no written text.

Method

Participants

Twenty-eight participants (14 male and 14 female students from the Johannes Kepler University Linz) took part in the study. Eighteen of the students were studying business administration and economics and four are studying education. In each of the case one student studied information management, sociology, mechatronics and chemical engineering.

Their mean age was 25.3 years (Standard Deviation = 2.4). Students received a small incentive for their participation. The e-lecture was in English, but the participants spoke German. The Austrian students had to complete the course "English Text Production I." This course was a prerequisite for participation in the study, to assure a common level of English knowledge and comprehension. The topic of the e-lecture was corporate success. To determine prior expertise, subjects were asked five questions about business administration and economic terms. In a questionnaire, they had to rate their previous knowledge about the learning topic (five-point scale: "I can apply

and work with it" = 1, "I can describe and explain it" = 2, "I understand what it is" = 3, "I have heard about it" = 4, "I have never heard about it" = 5, i.e., "competitive advantage", Mean = 2.50, Standard Deviation = .96). T-Test was used to analyze whether a difference regarding the mean could be found (Bortz, 2005). The result shows no significant differences between the experimental conditions on the five variables ($t(28) = 1{,}02$, $p > .05$).

Stimulus material and experimental setting

The e-lecture, which has been selected from the University of Warwick, was about business successes of the last century and industrial economics. The e-lecture was modified with Openworld Presenter Plus version 1.24. The modified lecture can be seen in Figure 1. It consisted of five chapters, 40 slides and 13 additional links. The duration of the lecture was roughly 25 minutes. The e-lecture consisted of a video, slides, table of contents, external links and video control buttons. The slides showed pictures of mentioned persons, display diagrams and tables, along with keywords mentioned in the speech. The slides were also synchronized with the lecturer. The transitions from one chapter to the next proceeded automatically, but a table of contents allowed participants to navigate between the chapters. Therefore they had the possibility to replay chapters. Furthermore, another section in the e-lecture provided a selection of relevant external web links, which appeared throughout the lecture and offered the viewer additional resources. Participants could use the links if they wanted.

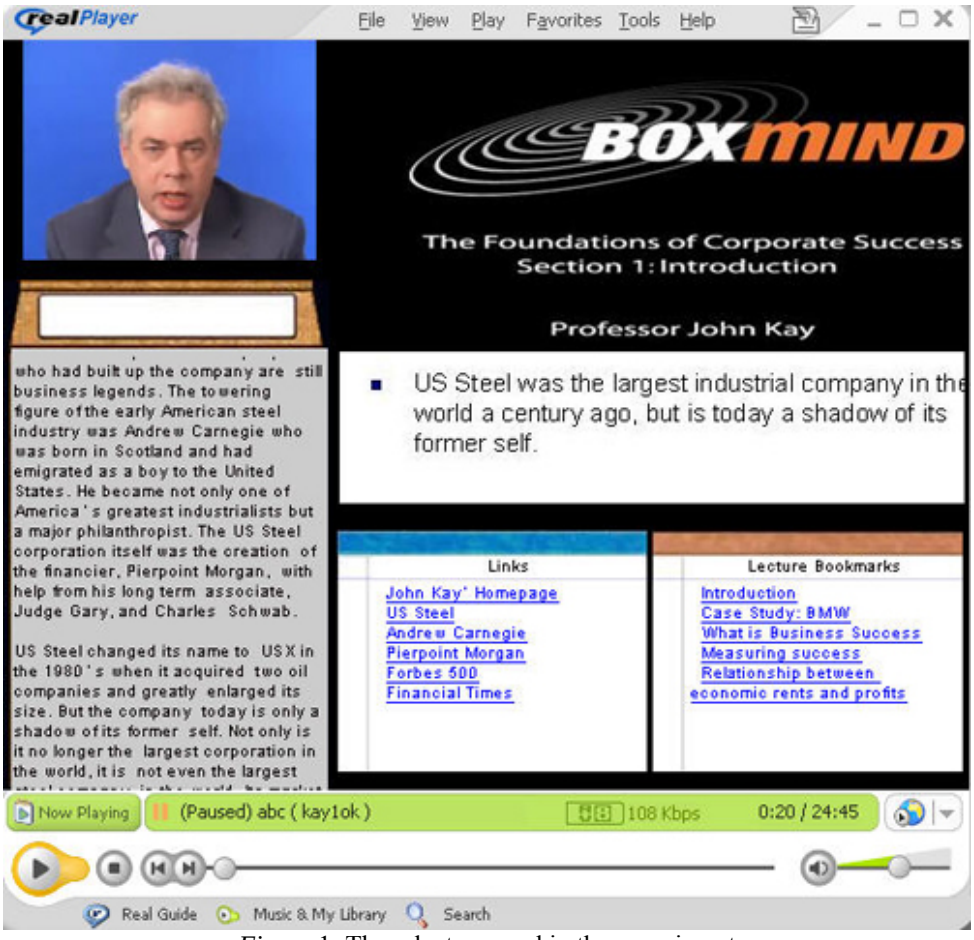

Figure 1: The e-lecture used in the experiment

The e-lecture covered five subtopics: It started with a short introduction to the topic, followed by a case study of BMW as a successful company. Next, the definition of business success and how to measure that success, as well as the relationship between economic rents and profits, were explained. The video showed mainly the lecturer, with the exception of chapters two and three, where this setting was interrupted by a short video sequence of a BMW car and

a soccer team. The lecture could be paused and replayed with familiar video control buttons (real media player). It was also possible to navigate forward and backward with a timeline. Thus, the e-lecture was designed as an interactive video.

For the experimental setting, two kinds of lecture were designed. One e-lecture had a text transcript in addition to the spoken text. The text contained the same information, which the lecturer presented and was synchronized with the video. The other e-lecture had no synchronized text, so the space for the text was empty. The experiment was run as one factorial design with a unimodal presentation (spoken text) and a multimodal presentation (spoken & written text). The multimodal e-lecture included a synchronized written transcript of the oral presentation, whereas the text in the same window was missing for the unimodal presentation. The participants were randomly assigned to these two presentations. The experiment was run in individual sessions at the Johannes Kepler University. After a short welcome, the procedure of the experiment and the software functions were explained to the students. The participants were asked to imagine that they attended a management course where they had missed one meeting due to illness or other reasons and were now preparing themselves for an upcoming exam, which they knew might take place during the next class. Their task was to memorize the presented information and operate within the e-lecture as if they were studying for an upcoming exam. Although the duration of the e-lecture was roughly 25 minutes, the subjects had 40 minutes time to deal with the learning content. They could abandon the learning process as soon as they felt that they had acquired sufficient knowledge to pass the exam. During their learning phase, the participants were allowed to replay the e-lecture. They were not permitted to take notes.

After the learning phase, the participants were asked to take a ten minute test. The test consisted of ten multiple choice questions. The results of the test were used as the dependent variable. Afterwards, participants were asked to complete a questionnaire where they evaluated the e-lecture they had just worked with and reported what their focus had been.

Data analysis

Content analysis was used to identify the learning strategies. The actions of the participants were recorded with a screen recording program (Camtasia recorder http://www.techsmith.com/camtasia.asp). All mouse movements, navigation action and the use of links and table of contents were recorded. Based on these log-files, a detailed transcription of the learners` behavior was made. The following categories were used to analyze the transcript and thus to identify the learning strategies: segments of uninterrupted viewing, repetitions, interruption, use of table of contents and use of external links. The segments of uninterrupted viewing included the use of the buttons play, pause and stop and forward or backward. Repetitions were defined as the replay of chapters or sections. Also the use of table of contents and use of external links were analyzed in detail. Viewing a link for less than 20 seconds was disregarded, since it was impossible to read through the text in that time period. Sometimes the browser window took some time to open, so the action consisted merely of opening and closing the browser window. The transcripts were analyzed by two independent raters (Cohen`s κ: .94). Cohen`s Kappa coefficient was used to measure the inter-rater agreement. The value of .94 shows a very good agreement. The recorded data allowed a detailed description of how participants worked and studied using the e-lecture. It was possible to determine how often subjects paused, replayed or stopped the course and also how interactive elements like links were used.

After coding the transcript, the data were analysed by the following criteria: how often and which repetition strategies were used, how often and how long links were used and the interruption of the lecture through external links were analysed. With this method, two different learning strategies were identified, namely “repeater” and “surfer”. Repeaters were characterized by a primary focus on the given lecture material. They studied the lecture extensively through repeated cycles. Only three or fewer links were used for more than 20 seconds. Participants first watched the lecture with no or only short interruptions and then repeated some sections or chapters when they had finished their first run of the e-lecture. Other subjects reviewed part of the lecture right from the beginning of the learning phase. The second type of learner, namely the “surfers,” used bookmarks and links for accessing additional external information. Some participants paused the e-lecture to spend time focusing on the additional links. Others were distracted by the links and viewed the links without interrupting the e-lecture. Overall the focus was not primary on the e-lecture.

In general, 10 repeaters and 14 surfers were identified (Tab.1). The remaining four learners were excluded from further analysis because of their low level of learning activities and the low cell allocation. Only one of these four learned with the unimodal presentation style.

Table 1. Number of Participants

	Repeaters	Surfers
Multimodal presentation	5	6
Unimodal presentation	5	8

Results

A 2x2 (form of content x learner strategy) analysis of variance (ANOVA) was conducted (Bortz, 2005). These analyses revealed that the learning outcomes were significantly influenced by learner strategy ($F(1,24) = 5.16$, $p < .05$), but not by presentation modality ($F(1,24) = .54$, $p > .05$). In particular, "repeaters" outperformed "surfers" with regard to the knowledge test. No interaction between the two factors was found ($F(1,24) = .54$, $p > .05$). Participants in the unimodal condition did perform nearly as well as learners in the multimodal condition (Tab.2). These results support the first hypothesis, but the second hypothesis must be rejected. The additional text in the multimodal presentation did not hinder learning as postulated by cognitive load nor did it facilitate learning in terms of a multimedia effect. The learning strategies of the users played a major role for learning outcomes.

Does the learning environment have any significant influence on which strategy (repeating or surfing) participants choose? To answer this question, a Chi-Square test was carried out. The test result showed that there is no significant connection between learning environment and the chosen strategy ($\chi^2 = 5{,}43$, $df = 2$, $p > .05$). Thus the applied strategy was not influenced by the given learning environment. The results show that the learning environment in which the learning content was presented (multimodal vs. unimodal) did not substantially influence the learning strategies of the learners.

Table 2. Means (M) and Standard deviations (SD) of learning

	Unimodal		Multimodal	
	Repeater	Surfer	Repeater	Surfer
M	7.20	5.50	7.20	6.33
SD	0.84	1.60	1.64	1.03

Discussion

In an experimental setting, participants had to learn either with a multimodal presentation or with an unimodal presentation. The multimodal presentation included an additional synchronized written transcript of the speaker. The unimodal presentation did not include this text. The results show that the usage of the e-lecture varied from person to person. Learners made use of the interactive possibilities of video-based e-lectures. Their actions ranged from very low activity to high activity in navigation. Some focused primary on the lecture, while others used the given links. Two main types of learners were identified, namely "repeaters" and "surfers". "Repeaters" outperformed "surfers": they showed better test results. Therefore, learning strategy was an important determinant of learning outcomes. In contrast, mode of presentation did not have substantial impact on usage or learning outcome. These results are in line with previous findings (Zahn et al, 2004, Zhang et al, 2006). The results also show that the written transcript of the oral presentation had no effect on learning performance. It can be argued that especially for language acquisition the additional text is helpful, because the topic is not easy to learn. Being presented with learning material in a foreign language makes knowledge acquisition more difficult. Therefore, additional on-screen text may be helpful for learners. But subjects in the multimodal presentation with the on-screen text did not outperform participants who learned without the text. The on-screen text was synchronized with the slides and the lecturer. This means that the text ran at a default speed. Maybe it would be helpful for learners, that they can control the text speed. Another possibility is to make the text available as an additional document. Further research can clarify how an additional text should be presented to learners within an e-lecture presentation.

Another aspect is the usage of links. “Surfers” used more links, but links distracted learners from relevant learning content. The important information for learning was presented in the lecture itself, and this topic formed the basis of the test. It was not necessary to explore the additional links. This phenomenon could be responsible for non-effective learning outcomes like Niederhauser et al. (2000) also suggested. In further studies it will be interesting to determine how to deal with links in a learning environment. Is it necessary to differ between interesting but optional additional information and links with relevant learning material? Learners’ grasp of the information presented on other websites needs to be examined with a test as well. It is necessary to develop adequate strategies for learning with additional information. It is important that learners are not distracted from learning the relevant topics and avoid cognitive overload.

The results presented in this article are based on an experiment. Learners were confronted with a time limit for preparation. The e-lecture was presented on CD-Rom. The presentation was not web-based. But the usual way to learn with e-lectures is web-based and therefore learners need high-speed Internet. Technical problems were excluded in the experiment but may affect learning in real learning situations.

For further research it will be interesting to determine whether scaffolding students in using learning strategies has an impact on successful learning. Maybe some prompts in the e-lecture are helpful to enhance the usage of cognitive and metacognitive strategies. Another research focus can be the investigation of the relevance of self-assessment possibilities after an e-lecture presentation. E-lectures offer a lot of flexible learning possibilities, but there is little research about the design and adequate usage for effective learning.

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