

Assessment of video lectures

BACHELOR THESIS

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Abstract

This study focuses on the improvement of video lectures. The aim was to investigate if in-video questions could increase the concentration and motivation of students and therefore yield a significant positive effect on the learning outcome. The 40 participants were randomly assigned to two conditions. Participants in the experimental group got four in-video questions while watching a video lecture with an approximate length of 30 minutes. It was about brain development through the use of technology. The control group watched the same video lecture without in-video questions. All participants had to answer the same knowledge test and evaluation questionnaire at the end of the study. The research questions were if participants of the experimental group got higher scores on the knowledge test and the evaluation questionnaire than the participants of the control group. All participants were students of universities and between 18 and 28 years old. There is no significant difference found in the evaluation questionnaire between the two conditions, but all participants scored high on it. This indicated that they liked the study and the material. For the knowledge test, there is a significant difference found between the two conditions. The experimental group remembered significantly more information than the control group. Throughout the discussion of this study the importance of this research is lined out as well as its novelty in comparison to previous studies. At the end of the discussion there are suggestions provided for further research.

1. Introduction

Flipped classrooms, also called inverted classrooms, are becoming increasingly more popular. It is an instructional strategy to improve education (Milman, 2012), which was used for the first time by the lecturers Jonathan Bergmann and Aaron Sams to give absent students the chance to watch lectures online. The unexpected outcome was that even the students that were present in the lectures watched the lectures online again for better understanding. This was the beginning of flipping classrooms. The students have to watch the video lectures before class and practice in class what they saw in the video lectures. The common instructional approach is “flipped”: the theory is done at home and the practice at school, instead of the other way around (Tucker, 2012). Valuable time in class can be used for practicing together (Milman, 2012). When students need help they can ask their peers or their teacher. In the common instructional approach students cannot ask for help while doing their homework. There are many more advantages of flipped classrooms but in this research the focus is on the possible improvement of video lectures.

Besides the advantages, the flipped classroom approach also has its limitations as for example the quality of the video lectures (Milman, 2012). The lecturers have to produce a high quality video to have a good basis for adequate understanding. Another problem is that the students cannot ask the lecturer questions if they do not understand the video lectures content (Milman, 2012). The lecturer does not know whether or not the students understand, therefore the students cannot receive additional help (Cummins, Beresford & Rice, 2016).

Furthermore, all students need to have accessibility to a computer to have the opportunity to watch the video lecture (Milman, 2012). If this is not the case, then the students miss the explanation of the topic from the lecturer and cannot work on the study matter as they should. Also students may not retain any of the information because they are distracted by more entertaining things (Milman, 2012). More entertaining things such as watching TV or talking to friends rather than focusing on the content of the video lecture. Hence, they would also come to class without being prepared and would not be able to participate in an appropriate way. Students themselves stated that they can focus better on the lesson taught in class rather than by watching it on a screen (Schultz, Duffield, Rasmussen, & Wageman, 2014). Besides that, students mentioned that video lectures were often too long to stay focused (Schultz et al., 2014). It is shown that the human concentration decreases considerably after 10-15 minutes (Stuart & Rutherford, 1978). Moreover, students criticized that they miss interacting with others while watching the video lectures (Schultz et al., 2014).

These limitations raise the question: how could learning through video lectures be improved? It would be difficult to require all teachers to produce their video lectures in high quality or to give computers to all students. An attempt needs to be made which improves the focus of the students and therefore improve their understanding and ability to retain information. This could be achieved by making the process of learning through video lectures more interactive. Active learning is shown to be significantly more successful than passive learning (Chi, 2009). Therefore, the focus of this research will cover how to make learning through video lectures more active.

1.1 Theoretical framework

One suggestion for better understanding of the video lectures is to use in-video questions. This means to use adjunct questions within electronically recorded lectures. Adjunct questions are questions that are inserted into the text to increase the attention of the reader for particular parts of the text (Dornisch, 2012). It is supposed to be effective as in-video questions make the process of watching video lectures more interactive (Cummins et al., 2016).

What has been known for many years is that texts are better understood if adjunct questions are inserted. A forward and a backward effect can be found by using adjunct questions. When adjunct questions are inserted before the relevant information in the text, students are likely to pay more attention to certain information, which would cause a forward effect. A backward effect occurs when adjunct questions are asked after the relevant passage so that the students have to look back into the text to get the answer (Dornisch, 2012). The focus here lies on the fact that students have to review the passage before they can continue reading. Questions that cause a backward effect are called adjunct post-questions. Generally, students spend more time on analysing the text when post-questions are used. Thus, when there is a time limit given, adjunct pre-questions are more useful, but if there is no time limit, post-questions have a greater facilitative effect on learning (Hamaker, 1986).

Research on cognitive processing of information showed that the more a person analyses a text, the more information will be remembered from the text. This effect relates to the different level of processing. Information can be processed at different levels of depth. To remember the information best, it has to be processed on a deeper level of processing (Craik & Lockhart, 1972). There are two different types of questions that are usually used: factual and conceptual questions. Factual questions lead to shallow processing. The probability that the information is forgotten is lower for conceptual questions because conceptual questions lead to deeper processing (Peverly & Wood, 2001).

Adjunct questions did not only have a positive effect when they were used in texts but also in lectures. One example is the use of clickers. Clickers are usually multiple choice questions that are asked by the teacher in class and the students have to answer it by using a clicker. Immediately after the voting the teacher can display the results on a screen (Shapiro & Gordon, 2013). In the study of Shapiro & Gordon (2013) it is shown that the use of clickers was more effective than the repetition of important information. The participants got feedback and did consequently know the correct answer right away (Shapiro & Grodon, 2013). In other studies about clickers, it was further investigated that a quizzing procedure with feedback as clickers can improve the learning effect of students (McDaniel, Thomas, McDermott, & Roediger, 2013; Hunsu, Adesope & Bayly, 2016). It would not be possible to use clickers in video lectures because the students would not watch the video lecture at the same time and therefore it would not be possible to show the results of the other participants immediately after responding to the questions.

There is also research done on in-video questions. In the study of Valdez (2013), the participants of the experimental condition watched a recorded lecture and got a question after every second slide. The participants of the experimental condition scored higher on the retention/comprehension measure than those of the control condition. Likewise, in another study it is shown that in-video questions improve the amount of remembered information by students (Lawson, Bodle, Houlette & Haubner, 2006). In both studies the participants had to answer open questions and they just had some seconds to answer.

Another study about in-video questions showed that 83% of the students that participated in a study gave positive feedback about the usefulness of in-video questions. Students found it beneficial to see how much information they remembered of the video lecture (Cummins et al., 2016). Because of this rate it can be inferred that students like using in-video questions. The results of the study of Nast, Schafer-Hesterberg, Zielke, Sterry and Rzany (2009) fit with the findings of Cummins et al. (2016). Nast et al. (2009) measured the motivation and technical acceptance of students with regard to the use of video lectures and got positive results.

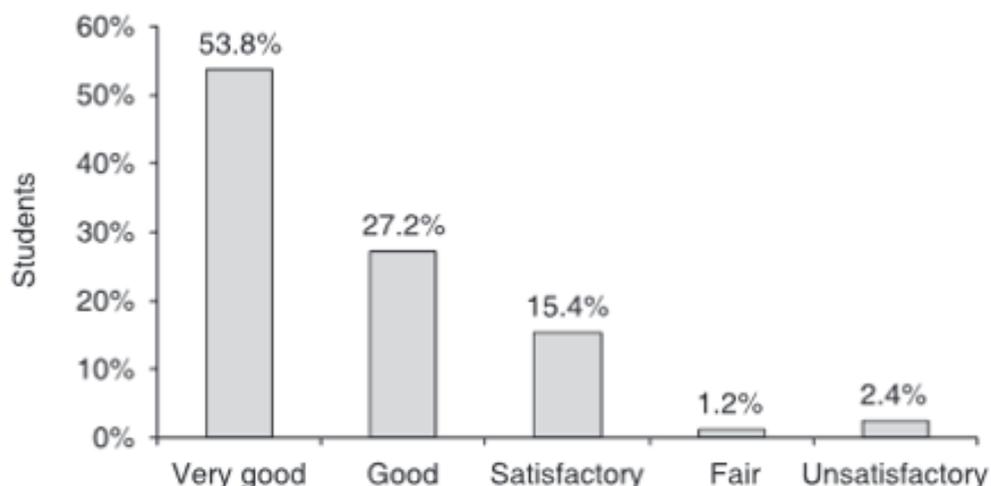


Figure 1. [Usefulness of video lectures according to participants.] Nast, Schafer-Hesterberg, Zielke, Sterry and Rzany (2009).

The participants showed a great motivation and technical acceptance of video lectures. More than 80% of the participants indicated that the video lectures had a good or very good impact on their learning. Besides that, students were still motivated to participate in face to face lectures. The use of online lectures in addition to traditional lectures had no negative effect on the amount of students that went to the traditional lectures (Nast et al., 2009). According to Brittain, Glowacki, Van Ittersum and Johnson (2006), 90% of the students used the opportunity of video lectures in addition to traditional lectures and only 9% completely replaced traditional lectures by video lectures. Therefore, it can be assumed that video lectures do have a positive effect on the learning of students. To improve the video lectures and to increase the amount of time students spend on the material for better understanding and remembering, one idea would be to use adjunct questions in video lectures.

1.2 Design

In this research the participants were randomly assigned to two conditions and they were not aware of it. In both conditions a video lecture was shown to the participants which was divided into four parts. They were told to try to remember as much as possible to get a high score on the knowledge test at the end of the study.

The only difference between the two conditions was that the experimental condition got one adjunct question at the end of every video, addressing the videos content. The participants were not asked to answer the questions but only to think about it. This was intended to increase their attention. With the help of adjunct questions the participants

probably notice that they actually missed some information of the video lecture. Hence, they can decide to go back to some information to be able to answer the in-video question.

To measure how much information the participants were able to remember a knowledge test is done at the end of the experiment. Furthermore, an evaluation questionnaire was used about how the participants did perceive this type of video lecture. This is done to find out whether the effects that are found in the previous studies, as mentioned in the introduction, can be found as well.

1.3 Research questions

To investigate whether the attention of students improve when adjunct questions are used in video lectures, this study is about the effect of in-video questions. Two research questions were constructed:

- Do students who get in-video questions score significantly higher on the knowledge test at the end of the study and therefore remember more information of the video lecture than students who watched the video lecture without in-video questions?
- Do students who get in-video questions score significantly higher on the evaluation questionnaire and therefore like the study and the material more than students without in-video questions?

Based on the literature review it is expected to find out that the students who are in the condition with in-video questions would score significantly higher on the knowledge test at the end of the experiment. The in-video questions could motivate the participants to go back to some missed information and therefore increase their knowledge of information about the video-lecture.

Besides that, it is assumed that the participants of the experimental condition would enjoy the experiment more than those of the control condition because of the positive feedback participants gave about in-video question according to the study of Cummins et al. (2016).

2 Methods

2.1 Participants

The participants were 40 students of the University of Twente in the Netherlands. They could sign up for the study via a website of the university. In several studies at the University of Twente, as for example psychology or communication science, students have to participate 15 hours in experiments of other students to pass the study year. It is controlled via a website where students earn points when they participated in a study. One point equals one hour. Consequently, participants earned one point for this study. Furthermore, they received 7.50€ to motivate them to participate in this study especially. They knew in advance that they will earn a study point and 7.50€.

Ten of the participants were men and 30 were women. They were all 18 to 28 years old (mean= 21.6 years) and fluent in German. This was one required criteria to participate in the study because it was done in German. Only two of them were British and Ukrainian but they were not at a disadvantage because they were raised in Germany and they had an equal level of German compared to the other participants.

2.2 Material

Due to the overwhelming offer of online video lectures, the sample chosen for this study needs to be explained in the following. There were several reasons for the choice to take this video lecture for the experiment. The objective was to choose a video that was similar to a real university lecture.

Therefore, first of all, one main criteria was a person standing in front of people while explaining a topic. In a lot of video lectures, especially in the newer ones, one cannot see anyone presenting the study matter, you can only hear a voice and follow the presentation.

Secondly, it was required that the speaker presents something meaningful. This is not always the case in video lectures. It should not only be entertaining but primarily serve the acquisition of knowledge.

Thirdly, a video was chosen, dealing with a simple theme that would be interesting for almost everyone. In real lectures students are usually interested in the study matter because it is the study course they elected. Therefore, it is not chosen for a video about physics, chemistry or law but about digitalization and its impact on our brains which is an issue that concerns to almost all people. It is a neurological issue about brain development of children and about the consequences, of a weak brain development, later in life.

Fourthly, the presenter in this video is a good speaker. Unlike other videos he has no distracting accent and he talks neither too fast nor too slow. Furthermore, he presents the subject in different ways like using slides to support his talk. He does the presentation to inform people instead of presenting himself which is often the case in speeches. People are telling jokes, singing or playing guitar to make the speech more interesting. The speaker of this video is Manfred Spitzer (*1958), a man who studied psychology, philosophy and medicine. Manfred Spitzer became popular in Germany because of his speeches.

Fifthly, a video was chosen that lasts about 30 minutes. Many videos take only some minutes to explain something concise. The video should neither be too short, because it would be too easy to remember all information, nor too long because it should not be boring for the participants. Therefore, a video is chosen that takes 27:50 minutes.

After choosing this video lecture, it was divided into four parts. The goal was to get four equal parts with each part lasting seven minutes. This was not possible because the speaker should not be interrupted during a sentence or topic. Otherwise, the video lecture itself would no longer be clear due to the starting and stopping between sentences. Therefore, the seven minutes were just used as a guideline but the parts finally were divided by topic.

When the participants watched the video lecture, they had to decide when they wanted to move to the next part of the video lecture. As outlined above the participants could stop the video at any time and go back to previous sequences. If they decided to move to the next video they could not go back to the previous video. When they were ready to go on, they had to click autonomous on the next part. On the top of the screen, on the left side the participants could see which part they were actually watching. To get an idea of what the program looked like Figure 2 provides an example.

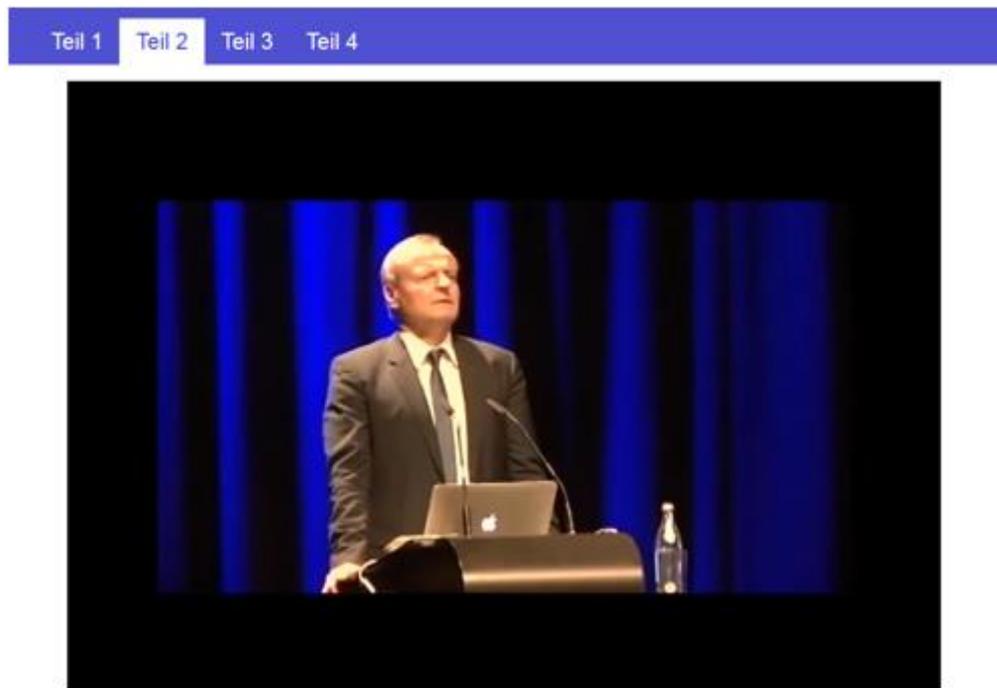


Figure 2. Design of the program. The speaker is Manfred Spitzer.

After each video part the experimental group got one in-video question. The participants were not obligated to answer these questions but they were used to increase their attention. The questions stayed on the screen until the participant decided to start the next video. An example of an in-video question is given in Figure 3.

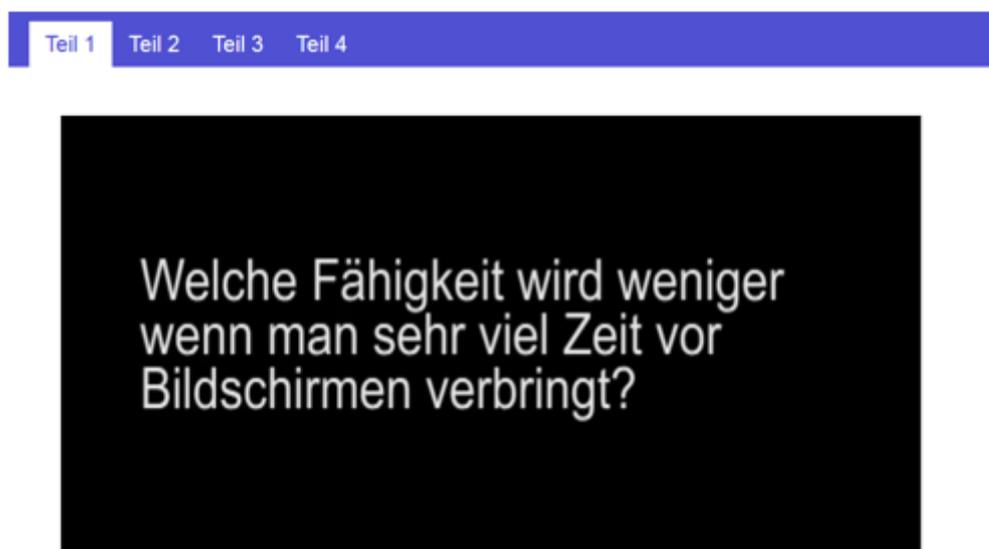


Figure 3. Example of one of the four in-video questions of the experimental condition. English: "Which capability decreases through spending much time in front of screens?"

The most important slide of the video lecture was a figure about brain development over time. This slide is shown in Figure 4. The slide shows the brain development of people who used a lot of technology in comparison to people who did not. If they did not use a lot of technology and additionally are able to speak two or more languages, their brain is vastly better developed. Other factors that improve the brain development are music, sport, family, healthy food, work or to help others.

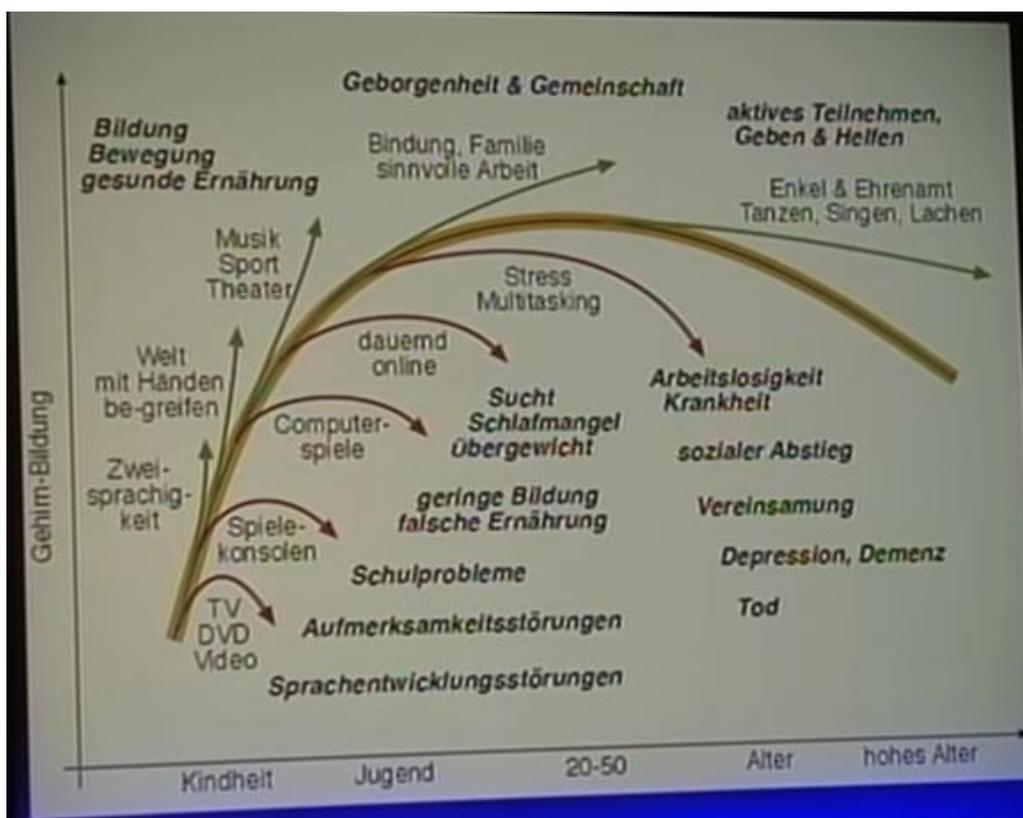


Figure 4. Most important slide of the video lecture. The slide shows the brain development over time with and without the use of technical devices.

After watching the video lecture, the participants had to fill out a questionnaire about how they perceived this type of video lecture. The TAM questionnaire was used as template. The abbreviation TAM stands for the technical acceptance model and is about technical acceptance and ease of use new technology (Davis, 1993). In this study additionally to the two basic components, user satisfaction and self-efficacy were tested. Therefore, the questionnaire covered four different concepts. Each concept consisted of six items. The items that are part of the concept “ease of use” are the items 5, 7, 15, 19, 25, 30. An example of an item of this concept is “I quickly lost the overview of this video lecture”. Items 1, 8, 11, 18, 22, 27 are part of the concept “usefulness” and an example is: “Video lectures are useful for

students”. The third concept was “user satisfaction” and the items 4, 9, 14, 16, 20, 24 belong to it. “I liked to watch the video lecture”, is an example of this concept. The fourth concept that was measured was “self-efficacy” with the items 3, 10, 13, 21, 26, 29 and an example is: ” I am able to write a good summary of the video lecture”. For more details the questionnaire is added in Appendix B. Additionally, six filler items were used to make it more difficult for the participants to understand the intention of the questionnaire. Overall, the questionnaire consisted of 30 items. A 7-point Likert scale is used, where participants indicated if they did totally agree to totally disagree. The questionnaire was printed and filled in with pen and paper because it would be easier than on the computer. The questionnaire can be found in Appendix B.

After the questionnaire the participants had to answer the knowledge test. This was done on the computer to ensure to be able to read every answer of the participants. It consisted of six questions about information the participants saw in the video to get to know how much information they remembered. There were two types of questions used, namely four concept questions and two fact questions. The fact questions required the participants to mention the exact amount or term used in the video lecture. For answering a concept questions, it was required to not only remember but also understand and reproduce the information. For concept questions it was also accepted if own words were used to describe the required answer. The knowledge test was scored with one point per answer. A codebook was used to ensure a correct marking. The knowledge test can be found in Appendix A.

2.3 Procedure

The study is done in one room of the university where four participants could be tested at the same time. Every student got one laptop provided by the university.

In total the study lasted maximum one hour which was composed of different parts. The first part was the introduction. It lasted five minutes. The participants were told how the study will proceed and what they are allowed to do and what not. Everyone had the possibility to stop the video and go back to a missed information, but when the participants decided to proceed to the next video they were not allowed to go back to the previous video. It was prohibited to make notes or take a break while doing the study. Following, the participants had to sign the informed consent and indicate their age, nationality and gender. This took also five minutes. Thirdly, when all four participants were ready, they started to watch the video lecture for 27:50 minutes. When they stopped the video lecture and watched some passages again it took some minutes more. Fourthly, the participants had to fill out the evaluation

questionnaire which took maximum five minutes. Fifthly, they answered the question of the knowledge test as accurate as they could. This took maximum 15 minutes. Afterwards, they got the money and had to sign a payment confirmation which took two minutes. Before leaving, the participants had the possibility to ask questions to the researcher about the study. During the experiment the researcher was also in the room to answer questions of the participants if needed or to help if there were any problems with the computer.

2.4 Data analysis

There were two important datasets in this study, the data of the questionnaire and the data of the knowledge test. All scores were first put into excel and afterwards analysed with SPSS. First of all, the internal consistency of the four concepts of the evaluation questionnaire was determined with Cronbach's alpha. The internal consistency of the items of "usefulness" is high with Cronbach's alpha = .81. Cronbach's alpha of "ease of use" was .58. To improve the internal consistency of this concept, one item that showed negative values was removed from the scale and thereby, Cronbach's alpha increased to .66. The removed item was V15 "using video lectures means less effort for me" (see Appendix B). The highest internal consistency had the concept "user satisfaction" Cronbach's alpha=.93. The internal consistency of the last concept was satisfying too. The concept was "self-efficacy" and Cronbach's alpha 80.

To analyse the knowledge test data, a one-way ANOVA is done to find out if there were significant differences between the experimental and the control condition. With the aid of an effect size calculator Cohen's d is calculated. Cohen's d is the difference between the means of the conditions divided by the standard deviation. It is used to get to know if the difference found between the two conditions was meaningful. $D=5$ would be a medium effect size and $d=8$ would be a large and therefore meaningful effect size.

3 Results

3.1 Results knowledge test

A one-way ANOVA is done in SPSS to get to know if there is a significant effect in the amount of information the participants remembered. Between the two conditions a significant effect was found $F(1,38)=4.46$ $p=.41$.

Table 1

Mean (percentage of correct answers of the maximum score) and standard deviation of the knowledge test score per condition

	N	M	Std. Deviation
experimental (questions)	20	.51	.16
control (no questions)	20	.41	.12
Total	40	.46	.15

Furthermore, Cohen's d is calculated. The means and standard deviations can be seen in Table 1. In this study the Cohen's $d=0.67$ which is in-between of a medium and a large effect size.

Figure 5 is added to show the difference in means of the knowledge test between the two conditions. The participants in condition 1 got in-video questions, participants in condition 2 did not.

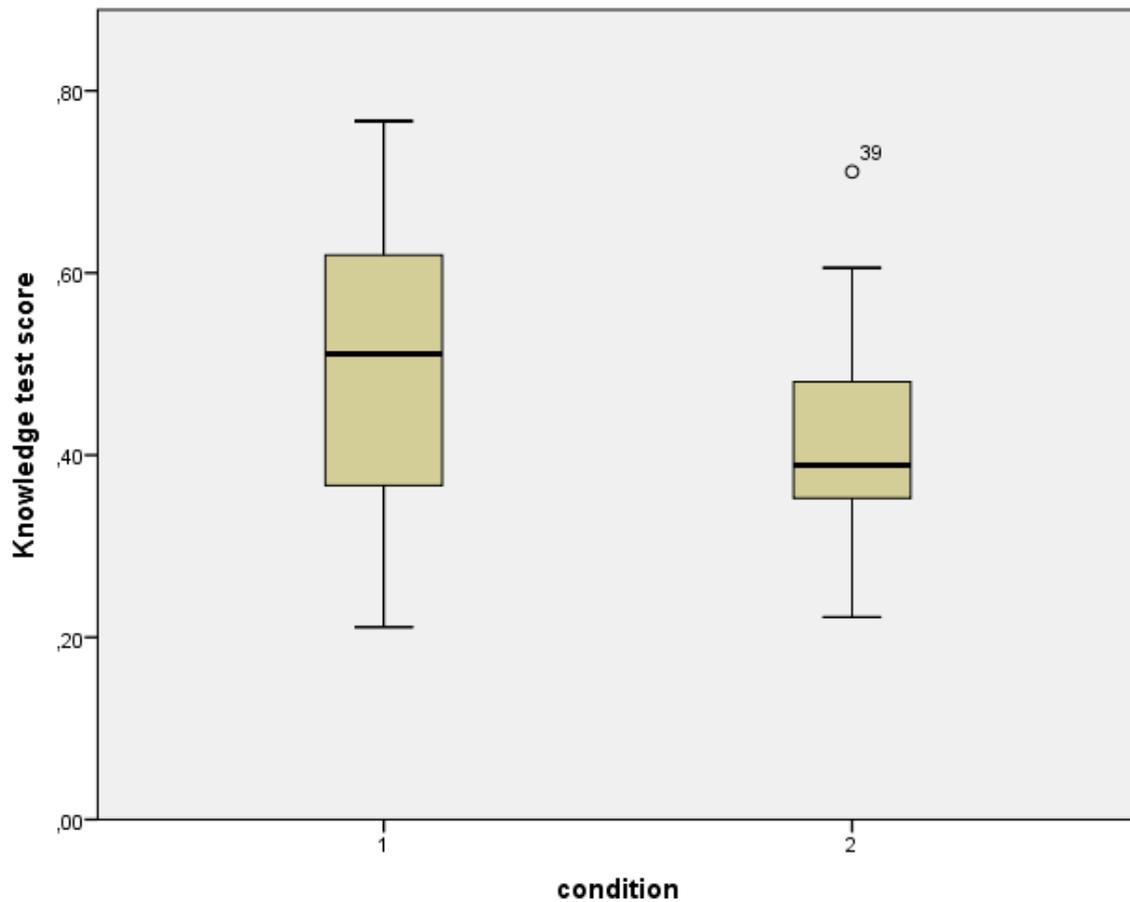


Figure 5. Means score of the knowledge test per condition (in percentage)

3.2 Evaluation questionnaire

As already said the reliability of the four concepts of the questionnaire was tested to ensure a reliable instrument. Furthermore, it was tested if there was a significant difference between the two conditions for the questionnaire. The means of condition 1 and condition 2 are compared regarding to the four different concepts: Usefulness (UM1= 5.45, UM2=5.5), Ease of use (EM1= 5.47, EM2= 5.45), Satisfaction (SM1=5.56, SM2=5.46) and Self-efficacy (SEM1=5.46, SEM2=5.51) (see Table 2).

Table 2

Mean and standard deviation of the four concepts

		Usefulness	Ease of use	Satisfaction	Self-efficacy
Control	N=20				
(no questions)					
	Mean	5.51	5.45	5.46	5.5
	Std. Deviation	.97	.82	1.2	.85
Experimental	N=20				
(questions)					
	Mean	5.45	5.47	5.56	5.46
	Std. Deviation	.79	.65	.69	.63
Total	N=40				
	Mean	5.48	5.46	5.51	5.48
	Std. Deviation	.87	.73	.97	.74

There is no significant difference found between the two conditions for none of the four concepts Usefulness $F(1,38)=0.043$ $p=0.836>0.05$, Ease of use $F(1,38)=0.007$ $p=0.93>0.05$, Satisfaction $F(1,38)=0.099$ $p=0.75>0.05$, Self-efficacy $F(1,38)=0.045$ $p=0.83>0.05$.

Even if there is no significant effect found it is noticeable that the participants scored high on the different concepts. As can be seen in table 2 all means were between 5.45 and 5.57 on the 7-point Likert scale. In Figure 6 a boxplot can be seen which displays the mean score of the participants for the evaluation questionnaire. 75% of the participants scored in average higher than 5. This indicates that 75% of the participants gave positive feedback about the video lecture.

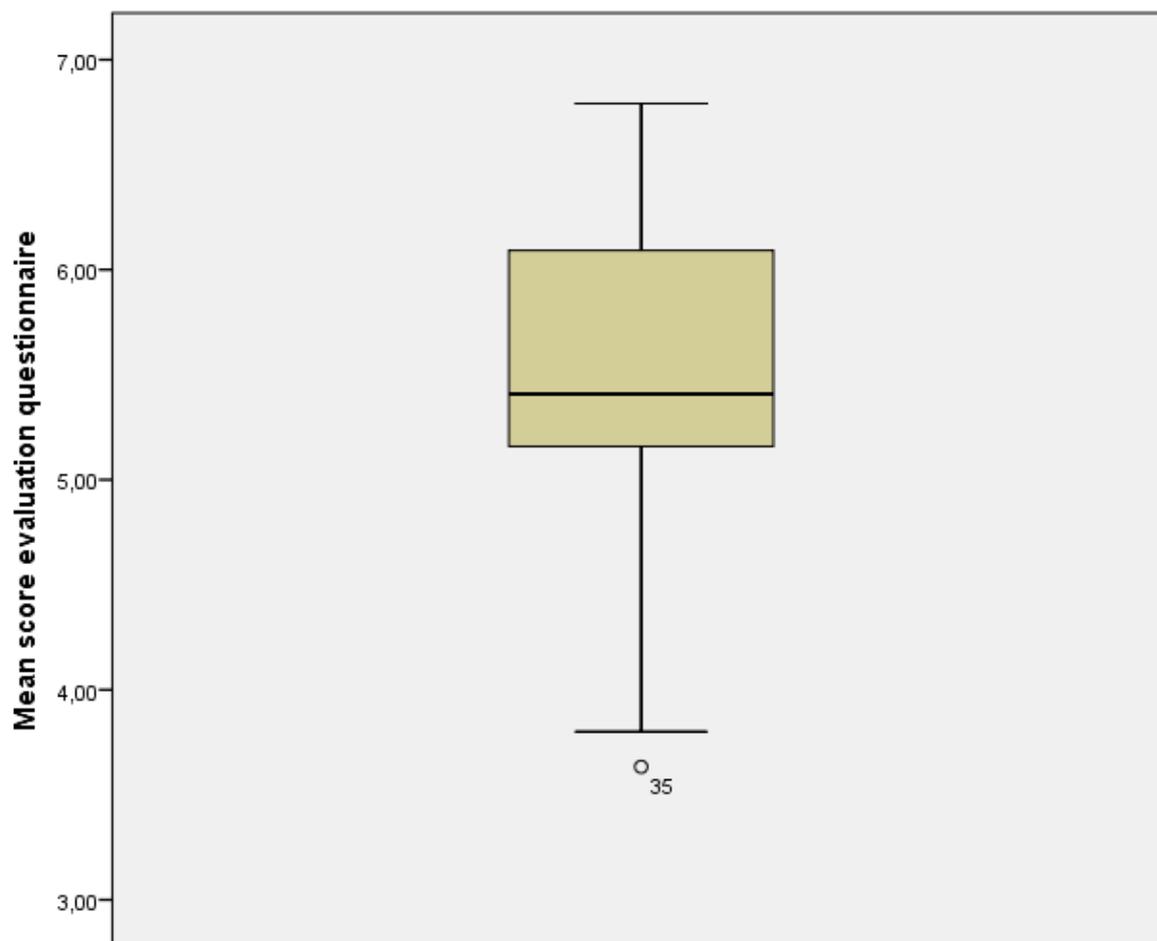


Figure 6. Mean score of the evaluation questionnaire.

4 Discussion and conclusion

The first objective of this research was to find a way to make students remember more information of a video lecture. In the introduction it is assumed that the more active a learning process is, the more successful students learn (Chi, 2009). The learning process in this study is more active because of the in-video questions what led to positive results. Furthermore, earlier research as done by Lawson et al. (2006) and Valdez (2013), showed that in-video questions were effective which led to the expectation that the in-video questions in this study would cause a positive effect on the learning outcome as well.

It was tested if in-video questions could improve the amount of information students remembered. As shown in the result section there is a significant difference found between the two conditions. It means that participants in the condition with in-video-questions remembered significantly more information than participants did without in-video-questions. These findings fit with the findings of previous studies mentioned in the introduction.

Besides the significant effect that was found between the two conditions regarding to the amount of information the participants remembered, there was also a meaningful effect size found. The Cohen's $d=0.67$ is a medium/large effect size. Both different measurements indicate that there is a meaningful difference between the two conditions. Therefore, it can be stated that there is evidence for the effect of in-video questions.

There are several renewals in this study in comparison to other previous studies. One difference was that this study was not about how information of a text or a normal lecture could be remembered better but about a video lecture. Other researchers as Craik and Lockhart (1972) did research on the cognitive processing of information of a text. They found out that participants remember information better when it is processed on a deeper level of processing. Additionally, Pevely and Wood (2001) suggested to use conceptual questions which would lead to deeper processing. Studies about clickers showed that learning in class could be improved by getting immediate feedback through clickers (Hunsu et al., 2016; McDaniel et al., 2013; Shapiro & Gordon, 2013). These findings were important but they did not add to the research field of information processing in video lectures.

The renewal in comparison to the studies that were done about in-video questions as Lawson et al. (2006) and Valdez (2013), was that in this study the participants got not only open questions but also fact questions. Furthermore, the participants were not asked to answer the questions just to think about it and they could think about it as long as they wanted to. There was no time limit given as it was in the two studies mentioned before.

Another renewal was that all participants had the possibility to watch parts of the lecture again to ensure to not have missed several information. This was possible because every participant worked on one laptop and the video lecture was not shown on a big screen to the whole class at the same time.

Besides that, this study is a high controlled study. Two conditions were used, namely an experimental group and a control group and it was done under laboratory conditions. Furthermore, in this study the participants got no feedback after answering the questions. This was different in comparison to the other studies as studies about clickers. It is shown that even if the students get not to now which answer was the correct one, there is still a positive significant effect of in-video questions.

The second objective of this research was to find out how the participants perceive the study and what they think about video-lectures. It was expected to get a significant difference between the conditions regarding to the motivation and technical acceptance of video-lectures. But for the questionnaire there was no significant effect found which means that no condition liked it better to participate in the study than others did. But it is nevertheless noticeable that the overall scores were high what shows that the participants liked the material used and to participate in the study.

As already mentioned in the introduction, participants showed a great motivation and technical acceptance of video lectures in the study of Nast et al. (2009). Their results fit with the results found in this study. All means of the four concepts were between 5.45 and 5.57 on the 7-point Likert scale. This indicates that the participants found the video-lecture useful, easy to use, satisfying and efficacious. Nast et al. (2009) stated likewise that more than 80% of their participants indicated that video lectures have a positive impact on their learning. In figure 5 it can be seen with the aid of a boxplot that 75% of the participants in this study scored in average higher than 5. This means that 75% of the participants gave positive feedback about the video lecture.

What was different than expected is that the participants of the experimental condition did not like the study better than those of the control condition. Cummins et al. (2016) stated that students think in-video questions are useful and that they like to use them. That was the reason why it was expected to find a significant difference between the two conditions but all students liked online lectures and so there was no significant difference found between the conditions.

Even if everything worked as expected there are nonetheless some little improvements for further research. The study was conducted in a laboratory instead of a daily life

environment. Students should watch the video lecture at home where they usually watch video lectures too. That would prevent that students pay more attention in the study than they would do at home in their usual environment.

Moreover, the participants could be asked which study they were doing to get to know if there are any differences between the students of different study programs regarding the scores on the evaluation questionnaire and the knowledge test.

Furthermore, the participants in this research were all students of an university and they were all between 18 and 28 years old. To improve the representativeness of the sample students from other educational systems should be taken into account. Furthermore, it would be interesting to find out if the same effects of in-video-questions could be found for younger students. From six years on children go to primary school so it would be important to get to know if this concept of education could work for this age group too. If so, the educational system could be enriched by the implementation of digital and interactive learning offers.

Besides that, the participants were all tested within three days. If the researcher would have the possibility to test much more people and if he would have several weeks to carry out the research, it would be conceivable to do a comparative approach over time. Do students need to be more activated through questions on Mondays than on Fridays? Are they more concentrated in the morning, afternoon or evening? Is this the same for every age group or gender? When these questions could be answered it would deliver a better understanding of concentration of students. With this knowledge the educational system could be adapt to the students concentration.

Concluding it can be said that there is evidence for the effect of in-video questions. There is a significant effect found in learning outcome and 75% of the participants gave positive feedback about the study. Even if the participants of the experimental group did not like the study more than the others, they still remembered more information. Nevertheless, more research on this issue should be done to enable an improvement of the educational system and therefore the learning success of students.

References

- Brittain, S., Glowacki, P., Van Ittersum, J., & Johnson, L. (2006). Podcasting lectures. *Educause quarterly*, 3(24), 10. Retrieved from http://formamente.guideassociation.org/wp-content/uploads/2006_3_4_13_SaraBrittain.pdf
- Chi, M. T. (2009). Active-constructive-interactive: A conceptual framework for differentiating learning activities. *Topics in cognitive science*, 1(1), 73-105. <https://doi.org/10.1111/j.1756-8765.2008.01005.x>
- Cummins, S., Beresford, A. R., & Rice, A. (2016). Investigating engagement with in-video quiz questions in a programming course. *IEEE Transactions on Learning Technologies*, 9(1), 57-66. <https://doi.org/10.1109/TLT.2015.2444374>
- Craik, F. I., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of verbal learning and verbal behavior*, 11(6), 671-684. [https://doi.org/10.1016/S0022-5371\(72\)80001-X](https://doi.org/10.1016/S0022-5371(72)80001-X)
- Davis, F. D. (1993). User acceptance of information technology: system characteristics, user perceptions and behavioral impacts. *International journal of man-machine studies*, 38(3), 475-487. <https://doi.org/10.1006/imms.1993.1022>
- Dornisch, M. M. (2012). Adjunct questions: Effects on learning. In *Encyclopedia of the Sciences of Learning* (pp. 128-129). Springer US. https://doi.org/10.1007/978-1-4419-1428-6_1052
- Hamaker, C. (1986). The effects of adjunct questions on prose learning. *Review of educational research*, 56(2), 212-242. <https://doi.org/10.3102/00346543056002212>
- Hunsu, N. J., Adesope, O., & Bayly, D. J. (2016). A meta-analysis of the effects of audience response systems (clicker-based technologies) on cognition and affect. *Computers & Education*, 94, 102-119. <https://doi.org/10.1016/j.compedu.2015.11.013>
- Lawson, T. J., Bodle, J. H., Houlette, M. A., & Haubner, R. R. (2006). Guiding questions enhance student learning from educational videos. *Teaching of Psychology*, 33(1), 31-33. https://doi.org/10.1207/s15328023top3301_7
- McDaniel, M. A., Thomas, R. C., Agarwal, P. K., McDermott, K. B., & Roediger, H. L. (2013). Quizzing in middle-school science: Successful transfer performance on classroom exams. *Applied Cognitive Psychology*, 27(3), 360-372. <https://doi.org/10.1002/acp.2914>

- Milman, N. B. (2012). The flipped classroom strategy: What is it and how can it best be used?. *Distance Learning*, 9(3), 85. Retrieved from https://s3.amazonaws.com/academia.edu.documents/49371733/milman-flipped-classroom.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1529920769&Signature=L%2Bil39tKar76ITSxlNuh7Qvlphc%3D&response-content-disposition=inline%3B%20filename%3DThe_Flipped_Classroom_Strategy_What_Is_I.pdf
- Nast, A., Schafer-Hesterberg, G., Zielke, H., Sterry, W., & Rzany, B. (2009). Online lectures for students in dermatology: A replacement for traditional teaching or a valuable addition?. *Journal of the European Academy of Dermatology and Venereology*, 23(9), 1039. <https://doi.org/10.1111/j.1468-3083.2009.03246.x>
- Peverly, S. T., & Wood, R. (2001). The effects of adjunct questions and feedback on improving the reading comprehension skills of learning-disabled adolescents. *Contemporary Educational Psychology*, 26(1), 25-43. <https://doi.org/10.1006/ceps.1999.1025>
- Schultz, D., Duffield, S., Rasmussen, S. C., & Wageman, J. (2014). Effects of the flipped classroom model on student performance for advanced placement high school chemistry students. *Journal of chemical education*, 91(9), 1334-1339. <https://doi.org/10.1021/ed400868x>
- Shapiro, A., & Gordon, L. (2013). Classroom clickers offer more than repetition: Converging evidence for the testing effect and confirmatory feedback in clicker-assisted learning. *Journal of Teaching and Learning with Technology*, 15-30. Retrieved from <https://scholarworks.iu.edu/journals/index.php/jotlt/article/view/3248>
- Stuart, J., & Rutherford, R. J. D. (1978). Medical student concentration during lectures. *The lancet*, 312(8088), 514-516. [https://doi.org/10.1016/S0140-6736\(78\)92233-X](https://doi.org/10.1016/S0140-6736(78)92233-X)
- Tucker, B. (2012). The flipped classroom. *Education next*, 12(1). Retrieved from <https://search-proquest.com.ezproxy2.utwente.nl/openview/7047b268f4106b18fd41c52f2db40867/1?pq-origsite=gscholar&cbl=1766362>
- Valdez, A. (2013). Multimedia learning from PowerPoint: Use of adjunct questions. *Psychology Journal*, 10(1), 35-44. Retrieved from https://www.researchgate.net/profile/Alfred_Valdez/publication/267624362_Multimedia_Learning_From_PowerPoint_Use_of_Adjunct_Questions/links/569ed90a08ae21a56424f038.pdf

Appendix A

The knowledge test (Wissenstest)

Teilnehmernummer:

Bitte beantworte die folgenden Fragen über das Video. Die Punktzahl hinter jeden Frage steht für die Anzahl der Hauptpunkte, die ich in deiner Antwort erwarte.

Testfragen

1) Wie viel Prozent weniger Stoff haben die Schüler in der Studie gelernt, in der an einer Schule W-lan eingerichtet wurde? (1 Punkt)

2) Welche beiden Beispiele werden genannt, um den Effekt eines Smombies auf den Charakter eines jungen Menschen zu zeigen? Und wie haben sich die Menschen in dem jeweiligen Beispiel verhalten? (4 Punkte)

Beispiel 1:

Verhalten:

Beispiel 2:

Verhalten:

3) Wie viel Prozent des Gehirns, die für Motorik zuständig sind, werden nicht mitbenutzt, wenn wir etwas auf einem Bildschirm sehen aber nicht anfassen? (1 Punkt)

4) Welche beiden Arten von “knowledge“ sollten getestet werden, um zu beweisen, dass Babys Dinge fühlen müssen, statt sie nur auf einem Bildschirm zu sehen? (2 Punkte)

--

5) Was sind die drei Hauptdimensionen, die dafür verantwortlich sind, wie gut unser Gehirn sich ausbildet? (3 Punkte)

--

6) Der Referent nennt eine beträchtliche Anzahl an negativen Konsequenzen (Entwicklungen und Erfahrungen), die durch extensive Nutzung technischer Geräte, wie zum Beispiel (1) Tv, dvd, video, (2) Spielekonsolen, (3) Computerspiele, (4) Dauernd online, (5) Stress Multitasking, verursacht werden. Nenne so viele Konsequenzen wie möglich (aus Abbildung 6). (15 Punkte)

1	8
2	9
3	10
4	11
5	12
6	13
7	14
	15

Appendix B

The evaluation questionnaire (Evaluationsbogen)

	Gar nicht einverstanden				Komplett einverstanden		
1. Video-Vorlesungen, wie diese, sind nützlich für das Studium	1	2	3	4	5	6	7
2. Ich hätte gern Video-Vorlesungen zur Verfügung	1	2	3	4	5	6	7
3. Ich habe eine klare Erinnerung an die Hauptidee des Videos	1	2	3	4	5	6	7
4. Mir hat es gefallen, das Video anzuschauen	1	2	3	4	5	6	7
5. Ich habe schnell den Überblick bei dem Video verloren	1	2	3	4	5	6	7
6. Video-Vorlesungen sollten Studenten mehr aktivieren als in dieser Video-Vorlesung	1	2	3	4	5	6	7
7. Eine Video-Vorlesung erleichtert einem, den Stoff zu lernen	1	2	3	4	5	6	7
8. Diese Art von Vorlesung ist praktisch für Studenten	1	2	3	4	5	6	7
9. Die Video-Vorlesung zu sehen, war eine wertvolle Erfahrung	1	2	3	4	5	6	7
10. Ich bin in der Lage, eine gute Zusammenfassung der Video- Vorlesung zu schreiben	1	2	3	4	5	6	7
	Gar nicht einverstanden				Komplett einverstanden		
11. Video-Vorlesungen sind wichtig für die Bildung	1	2	3	4	5	6	7
12. Normale Vorlesungen sollten durch Video-Vorlesungen ersetzt werden	1	2	3	4	5	6	7

13. Ich kann mich an die meisten Informationen erinnern	1	2	3	4	5	6	7
14. Es war eine Freude, die Video-Vorlesung anzusehen	1	2	3	4	5	6	7
15. Video-Vorlesungen bedeuten für mich weniger Aufwand	1	2	3	4	5	6	7
16. Ich habe es genossen, das Video anzusehen	1	2	3	4	5	6	7
17. Eine Video-Vorlesung, wie diese, sollte technisch verbessert werden	1	2	3	4	5	6	7
18. Studenten profitieren davon, Video-Vorlesungen zur Verfügung zu haben	1	2	3	4	5	6	7
19. Video-Vorlesungen sind einfach zu benutzen	1	2	3	4	5	6	7
20. Das Video war langweilig	1	2	3	4	5	6	7

	Gar nicht einverstanden			Komplett einverstanden			
21. Ich habe die Hauptidee des Videos verstanden	1	2	3	4	5	6	7
22. Video-Vorlesungen ergänzen Bücher sehr gut	1	2	3	4	5	6	7
23. Eine Video-Vorlesung ist eine schwache Alternative zu normalen Vorlesungen	1	2	3	4	5	6	7
24. Ich war froh darüber, was das Video mir zu bieten hatte	1	2	3	4	5	6	7
25. Die Länge des Videos war perfekt für mich	1	2	3	4	5	6	7

26. Ich bin zuversichtlich, dass ich den Wissenstest über das Video gut meistern werde	1	2	3	4	5	6	7
27. Video-Vorlesungen sind eine nützliche Methode	1	2	3	4	5	6	7
28. Video-Vorlesungen sollten visuell und auditiv gute Qualität haben	1	2	3	4	5	6	7
29. Ich kann mich an den Inhalt des Videos gut erinnern	1	2	3	4	5	6	7
30. Es war einfach für mich, konzentriert zu bleiben	1	2	3	4	5	6	7