Master Thesis Onderwijswetenschappen

Does peer mediated instruction result in better learning outcomes?

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Abstract

In higher education more and more peer-mediated education activities are being implemented. Having to present a lecture for fellow students is an assignment frequently used in higher education and is thought to fosters learning by the students presenting the lecture. Peer mediated instruction has shown to have benefits in education, but findings in studies in this field of research seem mixed. So, it's important to know if students learn less from lectures presented by peers versus their teachers, but this knowledge is currently lacking.

In a within-subject experimental design, 27 university students watched both a peer-mediated video as well as an expert-mediated video. Recall and comprehension were assessed in a posttest directly after watching each video. No significant main effect was found of the peer versus expert condition. The difference in effect between the peer and expert condition depended on the specific video, indicating that possibly other factors than model characteristics might influence learning outcomes.

Introduction

In higher education more and more peer-mediated education activities are being implemented. Having to present a lecture for fellow students is an assignment frequently used in higher education and is thought to fosters learning by the students presenting the lecture. Therefore, it's important to know if students learn less from these lectures presented by peers, but this knowledge is currently lacking. In online learning environments (e.g. blended learning, web lectures, knowledge clips), the use of peers as teachers is also increasingly popular.

Peer mediated instruction has shown to have benefits in education, but findings in studies in this field of research seem mixed. A lot of research has been done examining the critical aspects of models giving educational instruction, but most studies only examined the correlation between a peer mediated instruction and a learning outcome, instead of studying the cause-and-effect relationship, by using an experimental research strategy.

The present study aims to contribute to more knowledge regarding differences between peer teaching and expert teaching, by conducting a study with an experimental research strategy with a within-subject design.

Theoretical framework

People learn through observing others' behavior, attitudes, and outcomes of those behaviors. (Bandura, 1963). Observational learning, a social learning theory, states that learning takes place in a social context. Observational learning through modeling is hypothesized to comprise four subprocesses: attention, retention, production, and motivation (Bandura, 1986)

Children do not only learn from adults, but peers also play a powerful role in children's development (Santrock, 2017). Peer tutoring, where fellow students teach each other, has been studied since the 70's and it has been shown that can be very effective for both tutor and tutee (Wilkinson & Gaffney, 2016).

Present study focusses on the effect on tutees. A meta-study showed the positive impact of peer tutoring on academic outcomes, for kindergarten students, school students, as well as college students (Leung, 2015). Studies seem to point out that the effect of peer mediated instructions lie in increasing active learning and increasing self-efficacy among other things (Manzoor, 2014).

The concept *peer* is defined in dictionaries as: 'an equal'. But it appears that the concept of peer is defined according to each situation (Lincoln, 1993). A peer could be a colleague, a person of the same age, or a person from the same social group. For the purposes of this paper, a peer is defined as a fellow student.

Within the field of educational research, several studies have been done to examine the effect of characteristics of the instructor or model observed on the effectiveness of an instruction. These studies could contribute to a better understanding of the effect of a peer being the model or teacher giving the instruction. Examples of studies showing that peer-mediated instruction can be very effective for learners (Utley, 1997; Bowman-Perrott et al., 2013; Schunk, 1987; Greenwood et al., 1984).

On the other hand, there are the studies that found ádult models to be more effective than peer models (Hoogerheide, Deijkers, Loyens, Heijltjes, & van Gog, 2016, Lachner & Nückles, 2015, Boekhout, van Gog, van de Wiel, Gerards-Last, & Geraets, 2010). Lachner (2015) found that experts explanations lead to deeper learning than peer explanations.

Based on a large review, Schunk (1987) stated that peer modeling partly depends on perceived similarity between model and observer. This similarity serves as an important source of information for measuring one's own behavior, expectations, and self-efficacy for learning or performing tasks (Schunk, 1987). This model-observer similarity (MOS) hypothesis states that the effectiveness of modeling examples depends on the degree of perceived similarity (age, expertise, gender) between the learner and the model (Bandura, 1994; Schunk, 1987). The effectiveness of the model increases, when the degree of (perceived) similarity in age or in competence is high (Hoogerheide, 2017; Braaksma, Rijlaarsdam, and Van den Bergh, 2002; Krebs, Schüler, and Scheiter, 2019)

But, the MOS hypothesis cannot be confirmed in all studies (Hoogerheide, 2016; Krebs, 2019). It's being hypothesized even, that similarity might also lead to focusing more on task-irrelevant aspects of the model resulting in lower learning outcomes (Hoogerheide, 2016).

Most studies are reviews, correlations or show mixed findings. Present study aims to add a methodological contribution, by using the experimental condition as a within-subject factor.

Present study

An experiment was conducted where participants were presented an instructional video presented by a peer, as well as an instructional video presented by an expert. Peer and expert recorded two videos each: one on topic A and one on topic B. Participants watched a peer version of one topic and an expert version on the other topic. Scores on posttests were compared to examine if there was a difference in learning outcomes.

Also, by not completely scripting the peer-instruction, the peer instruction was operationalized not only by perceived model characteristics but also by the unique way a peer explained a certain content. With this design element, the study aims to contribute new knowledge in research on peer mediated instruction.

Because of mixed findings in literature, a two-sided hypothesis was tested stating that peer- and expert-mediated instruction would lead to different learning outcomes than expert-mediated instruction (Hoogerheide, 2017; Braaksma, Rijlaarsdam, and Van den Bergh, 2002). With this study we aim to expand the knowledge on peer mediated instruction, and to contribute to scientific base for the implementation of peer mediated instruction in the field of higher education.

Research question

Does an instruction given by a peer compared to an instruction given by an expert result in different scores on a comprehension test?

Methodology

Design

An experimental study was conducted with a 2 x 2 within-subject design. The two experimental conditions were: peer- versus expert mediated instruction. The dependent variable was the score on a comprehension posttest.

Participants

Participants were 27 university students (22 females, M^{age} = 23.96 years, SD = 4.50) of the University of Utrecht, enrolled in different courses in the second semester of the academic year 2019-2020. A convenience sample of students was recruited by placing a call on online platform of master educational science and placing a call under acquainted students of other faculties. Each participant was randomly assigned to two instructions, one peer instruction and one expert instruction.

Ten cases were removed from the raw data sample, because their survey was not completely filled out. Analysis was done on the remaining sample of 27 cases. Power analysis done with G*Power 3.1, and an estimated sample size for a power of 0.80, an alpha of 0.05, and an effect size of 0.04 (derived from Hoogerheide et al., 2016) of n = 1406 was recommended.

Materials

Survey

The materials consisted of instructional videos and posttests. The entire experiment took place in the online environment of an online survey made in Qualtrics.

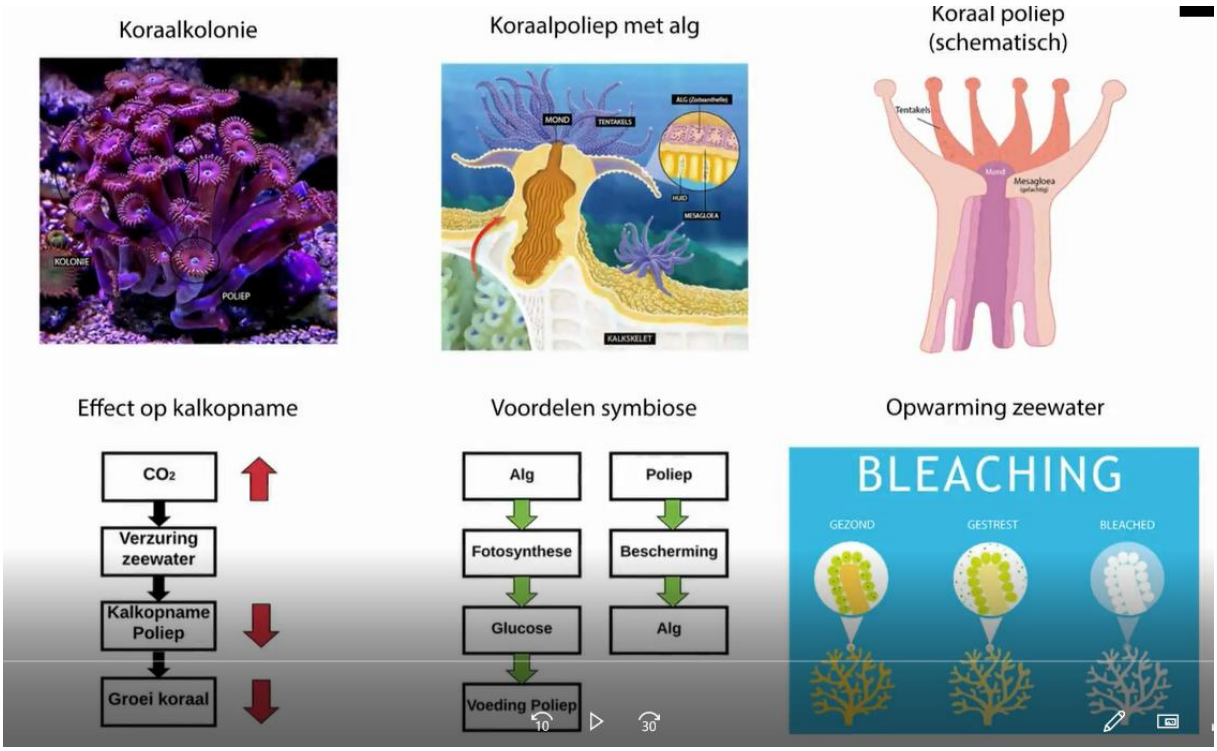
Video

Four video presentations (5 minutes) were recorded on two biology topics: Coral (A) and Headlice (B). Each video recording consisted of a slide with six images on the topic and an audio of a speaker giving an explanatory instruction on the topic while referring to the images

on the slide (see Figure 1 and Figure 2). Two videos of each topic were made: one with an expert giving the instruction, and one with a peer giving the instruction. The topic and content where selected by the expert.

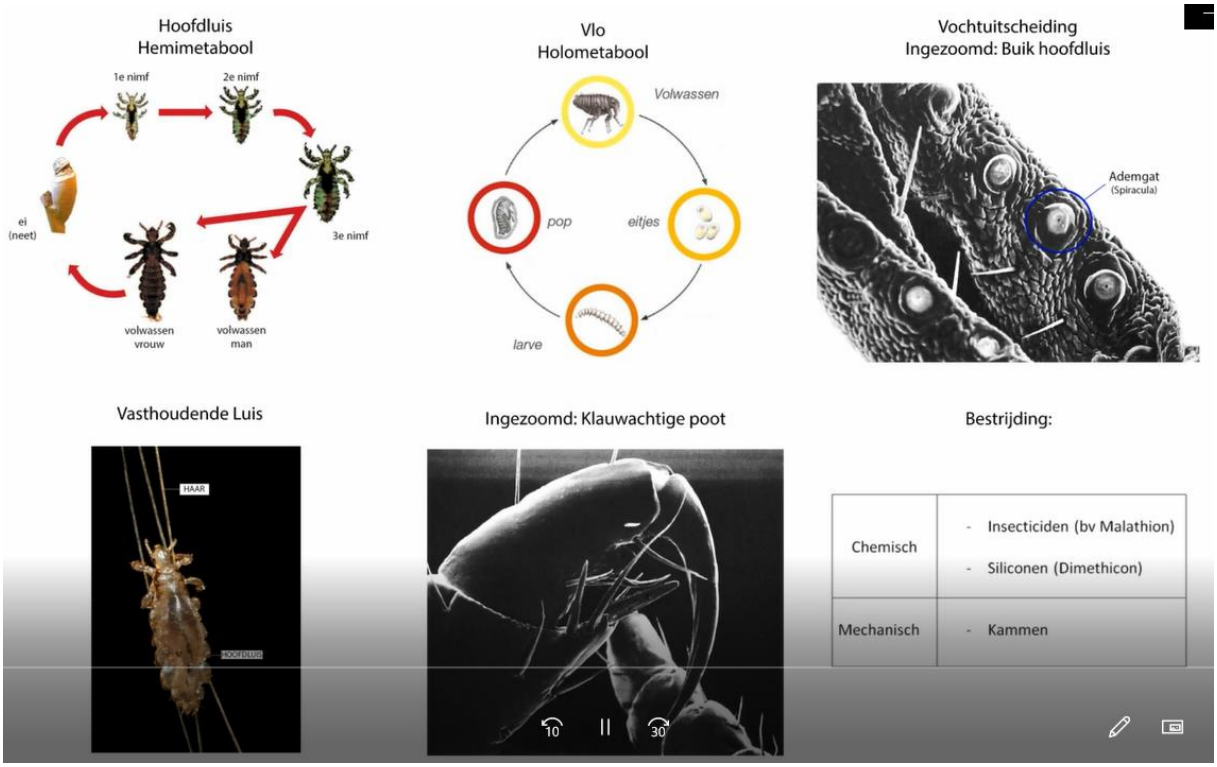
Care was taken to ensure that both contents were equal in covering the all subjects that would be addressed in the posttest. The peer was instructed to prepare his presentation based on the selected content (video recorded by expert). Besides these constraints, peer was told he was allowed to use his own words and formulation while explaining the content. In this way, the explanation would be more authentic, spontaneous, providing high ecological validity.

Figure 1. Slide of images in presentation video A (Coral)



Note. Slide visible during whole video with the audio of speaker giving an explanational instruction.

Figure 2. Slide of images in presentation video B (Headlice)



Note. Slide visible during whole video with the audio of speaker giving an explanational instruction.

Speakers

The expert speaker was a biologist by profession, male, 58 years old. He also provided the content for the instructional videos on the topics. The peer speaker was a 22 years old male biology student.

The experimental condition (‘peer-instruction’ versus ‘expert-instruction’) was operationalized by also presenting a short (video) introduction, just before the video started, in which the speaker of the video presented himself (Appendix A). In this way, it was made clear to the participant who the speaker would be in the video: the expert with (*perceived*) high competence level, older in age, or the peer with (*perceived*) less competence than expert, but still more competence than participant, with more or less same age as the student.

Table 1. Example of text fragment in introduction video

Speaker	Introduction text

Peer	*"Hallo, ik ben Leon en ik ben 23 jaar oud en ik ben biologie student en ga jullie iets vertellen over [topic] "*
Expert	*"Hallo, ik ben Geert-Jan en ik ben 58 jaar oud en ik ben bioloog en ga jullie iets vertellen over [topic] "*

Note. Topic = Coral (video A) or Headlice (video B).

Posttest

A questionnaire was developed for each topic: coral (A) and headlice (B): *posttest A* and *posttest B*. Both posttests consisted of 12 questions: one question about the (conceptual) prior knowledge on the topic, and 11 multiple choice questions about the content of the video (see Appendix B).

Measures

Comprehension test

Comprehension was operationalized by testing participants reproductive knowledge and understanding of the content of the instructional video. This posttest was developed for this experiment and consisted of 11 multiple-choice questions with three possible answers (see Appendix B). For each correctly answered question, one point was assigned. The score on the comprehension test was the total sum of scores. (range: 0-11).

Content validity was pursued, by making sure all subtopics discussed in the video were addressed in the posttest questions. But after preliminary analysis of the data, some items had to be eliminated for internal consistency reasons. Posttest A had a Cronbach's alpha of 0.22. After stepwise 5 items were eliminated with a negative *item-total* score or *increasing alpha if deleted*, resulting in a Cronbach's alpha of 0.56. Posttest B had a Cronbach's alpha of 0.74. Posttest B only had one item with a negative item-total score. Cronbach's alpha for posttest B after removing this item remained 0.74. Posttest A now had 6 remaining items, and posttest B 10. Weighted scores were calculated to make comparison possible: each sum score on posttest B was multiplied by 0.6.

Prior knowledge

As prior knowledge might influence the learning outcome as a bias (Baldwin, 1985; Hoogerheide, 2018), a topic that participants were not expected to be familiar with, as selected by the expert. In the posttests, prior knowledge on the topic was checked by asking the participant to report his/her knowledge on the subject before the experiment). A 5-point scale was used to score the level of prior knowledge (range: 0 = no prior knowledge, 5 = familiar with all main subtopics). Participants who scored 5 points on the scale, would be excluded from data-analysis.

Procedure

Participants were randomly assigned to one of the experimental conditions (one peer-video and one expert-video). Counterbalancing for task order was done, so participants were randomly distributed among four different surveys (see Table 2).

Table 1. A 2 x 2 design with counterbalancing for task order.

Survey subgroup	Task 1 (first video)	Task 2 (second video)
1	A_p	B_e
2	B_e	A_p
3	A_e	B_p
4	B_p	A_e

Note. Tasks: video A or video B. Manipulated condition: peer-mediated presentation (P); expert-mediated presentation (E).

At the start of the survey, participants were asked if they had read the information on the experiment which they had received before the start of the survey. The survey started with two statements they had to fill in: (1) if they agreed on participating in the experiment (digital informed consent, see Appendix B), (2) their confirmation that the surveys would be filled out in a quite environment on a PC or laptop (not on a mobile or iPad) and in one go, to guarantee optimal conditions for watching the instruction video's and doing the posttests.

After instruction on how to fill in the survey, the experiment started with a short introduction video (approx.0.5 minute) presenting the speaker of the first video, followed by the first video (approx. 5 minutes). After the first video, the participant had to complete a posttest on the topic of the first video (approx. 5 minutes). Then, the same cycle for the second video would follow.

The completion time of the survey was estimated on 15-20 minutes, but after analyzing the data the average time participants used to complete the survey turned out to be 34 minutes.

Analysis

Prior knowledge level

Participants who scored 5 points on the scale, would be excluded from data-analysis for having too much prior knowledge. None of the participants had a score of 5 on topic A (M = 1.26, SD = 0.45), nor on topic B (M = 2.04, SD = 0.90).

Outliers

Two outliers in the individual scores on the posttests were found, but they were < 1,5 IQR. One case with a score of 2 and the other with a score of 10 (range scale: 0 - 11). These outliers were not removed, because they were not extreme outliers.

Assumptions

The Sapiro-Wilk, F_{max} and Levene's test statistics were used to test the assumptions of normality and homogeneity of variance. The assumption of homogeneity of variance for a mixed model ANOVA was violated for within subject variable 'peer condition', but not for 'expert condition'. The assumption for normality was violated for the variable 'version', but not for the experimental conditions.

Version

Before conducting an ANOVA to test if there was a difference in the posttest scores between the peer condition and the expert condition (within subject variable), a check was done to examine if there would be a difference in outcome between posttest video A and posttest video B. Ideally, there should be no difference in outcome regardless of whether de peer condition would be presented via video A or B. For this purpose, a between-subject variable was created: *version.*

Each participant primarily was assigned to one of four conditions, yielding four subgroups. These four groups were paired to examine the effect of version: one version where peer presented video A (and expert video B) or where, and another version where expert presented

video A (and peer video B). The AP + BE and the BE + AP conditions were recoded as *version 1*. The BP + AE or the AE + BP conditions were recoded as *version 2* (see Table 3).

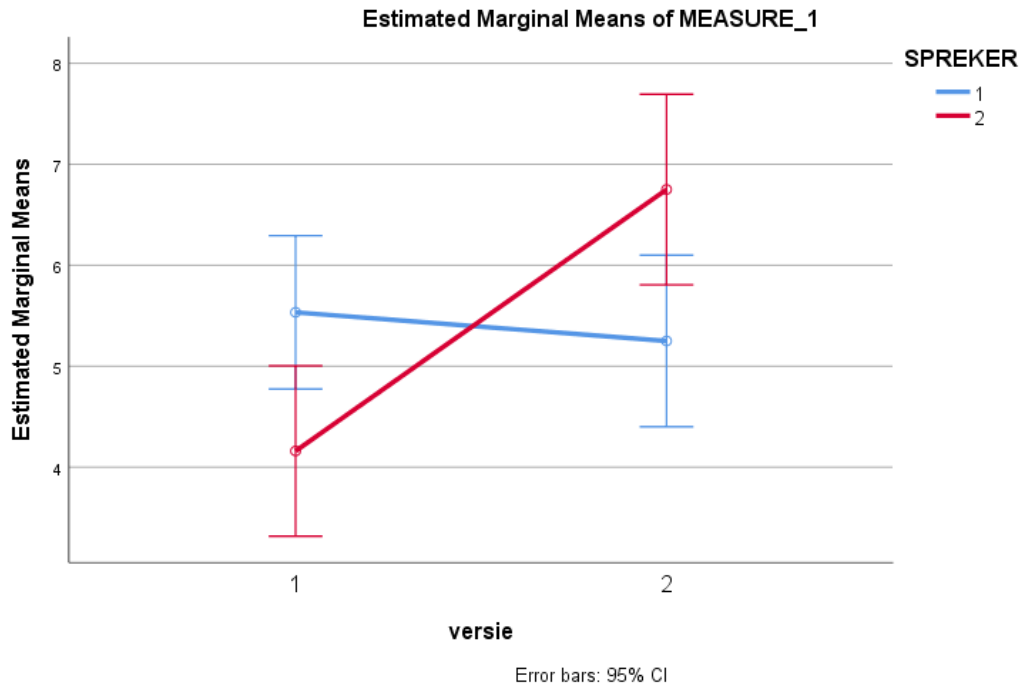
Table 3. Two versions of administered experimental conditions.

Subgroup	Experimental condition	Version
1	AP + BE	1
2	BE + AP	
3	AE + BP	2
4	BP + AE	

Note. Version 1 = video A presented by Peer and video B presented by Expert; Version 2 = video A presented by Expert and video B presented by Peer.

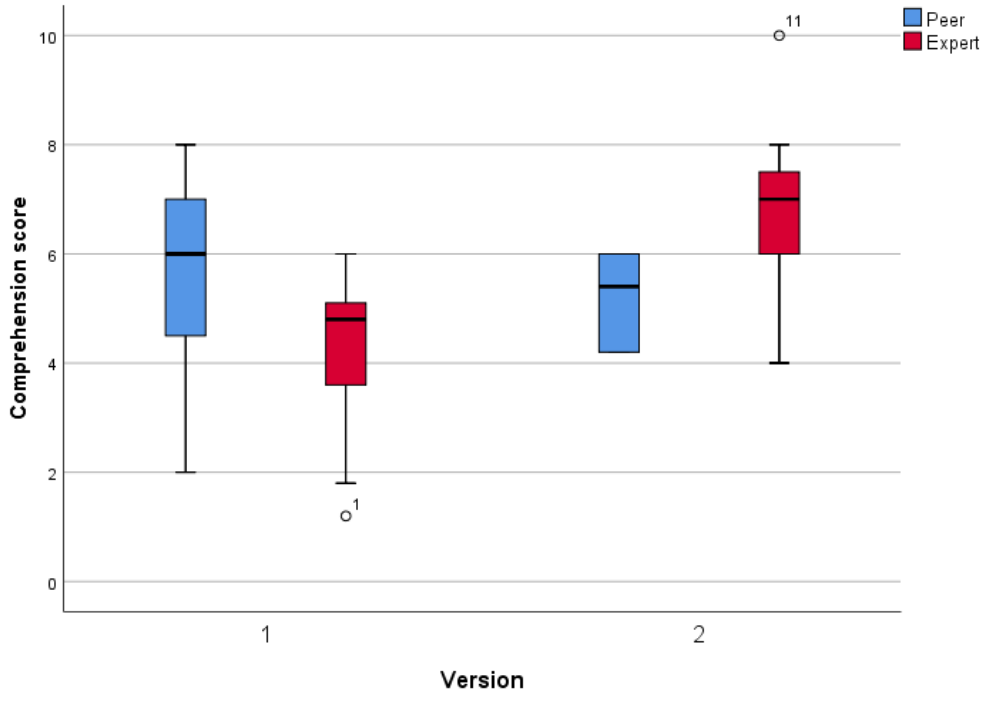
Exploration of the data showed a crossover effect of version on the experimental condition (see Figure 3). Therefore, the decision was made to include version as a between factor in the ANOVA testing. A mixed model ANOVA was utilized, because there was both a within-subjects (repeated measures) and a between-subjects independent variable. Post-hoc testing was done when a significant main effect was found.

Figure 3. Line graph of the interaction between version and experimental condition on comprehension scores.



Note. Crossing lines suggesting an interaction effect. Version 1: video A presented by peer and video B presented by expert; Version 2: video A presented by expert and video B presented by peer.

Figure 4. Comprehension test scores of peer instructions and expert instructions by version.



Note. Version 1: peer scores higher than expert scores. Version 2: expert scores higher than peer scores. Error bars: 95% CI.

Results

No significant main effect for type of speaker (experimental condition) on the comprehension test scores was found: F (1, 25) = 0.03, p = 0.87, partial η^2 = 0.001.

A significant effect of 'version' was found on the comprehension test scores*:* F (1, 25) = 6.92, p = 0.01, partial η^2 = 0.22 (large effect).

A significant interaction between peer/expert condition and version was reported, F (1, 25) = 13.78, p = 0.001, partial η^2 = 0.32. Post-hoc analysis (paired t-tests) was done using a significance level of 0.05, and revealed that in version 1, comprehension test scores for the peer instructions were higher than the comprehension test scores for the expert instruction, p = 0.03 (see Table 4). In version 2, the scores for expert instructions were higher, p = 0.01.

Table 4. Comprehension test scores for peer-instruction and expert-instruction by version.

	Version 1				Version 2			
Speaker	*n*	*M*	*SD*	*p*	*n*	*M*	*SD*	*p*
Peer	15	5.53	1.77		12	5.25	0.81	
Expert	15	4.16	1.53		12	6.75	1.66	
Difference Peer-Expert	15	1.37	2.18	0.03	12	-1.50	1.75	0.01

Note. Version 1: video A presented by peer and video B presented by expert; Version 2: video A presented by expert and video B presented by peer.

Discussion

The aim of current study was to examine if there is difference between peer mediated instruction and expert mediated instruction regarding learning outcomes. No difference was found between the effect of the experimental condition (peer versus expert instruction) on the learning outcomes. This finding that no significant difference was found, is difficult to interpret because of the interaction effect found between the experimental condition and the 'version-effect' that was found.

Version turned out to have a significant and large main effect on the learning outcomes. For counterbalancing reasons, there were two versions of the experiment: one where topic A was presented by the peer and topic B by the expert, and another where topic A was presented by the expert and topic B by the peer. The findings will now be discussed.

The findings of present study might point out in the direction of other factors influencing the difference between peer instruction and expert instruction, besides model characteristics like age, gender and (perceived) competence level. The findings of this study might be more in agreement with a model proposed by Parr and Townsend (2002). This model describes all processes involved in of peer group influences in learning. Parr and Townsend (2002) state that mechanisms of peer influence rarely operate singly but are interactive in their effects. Their model illustrates the interconnectedness, variety and complexity of peer sources of learning (Parr & Townsend, 2002). Possible explanations for finding a main effect for 'version' in present study, could indeed lie in topic, posttest, or the way of explaining given by the speaker.

Topic

The topic in video A was *Coral*, and video B was about *Headlice*. In the peer-instruction on Coral, comprehension scores were higher than peer-instruction on Headlice. Both expert and peer had a background on the domain of biology, the expert was an experienced biologist, the peer a student biology. Perceived competence level cannot explain this finding, because in that case outcomes scores should have been in the same direction with or peer or expert instruction showing highest scores. Possibly other factors might have influenced the effectivity of the instruction. For example, the level of interest of peer on the topic, might have been higher on topic A (Coral) than on topic B (Headlice), resulting in a way of explaining that was more appealing to the participants. Interesting in this context are

the results in the study of Hoogerheide, Visee, Lachner, and van Gog (2019), indicating that students generating an instructional video for peers, report higher levels of learning enjoyment.

Posttest and Way of Explaining

Lachner and Nückles (2015) conducted a study to examine if factors like abstractness and cohesion of an instructional explanation would explain a difference between an expert and a peer instruction. They found that expert explanations resulted in better transferable knowledge, by providing more global cohesion. Their findings extended the finding of Boekhout, Gog, van de Wiel, Gerards-Last, and Geraets, (2010), that peer instruction could be appropriate when the primary learning goal is acquisition of factual knowledge, and expert instruction more effective when deeper learning is requested.

In present study higher scores on topic A were achieved when peer gave the instruction, and higher scores on topic B when expert gave instruction. With the findings of Lachner and Nückles (2015) in mind, this could mean that in this study the peer provided enough cohesion in his explanation on topic A, but not enough cohesion while explaining topic B. This could have been caused by the competence level of peer on the subject matter. The competence level on topic B might not have been sufficient enough to result in an instructional explanation with sufficient global cohesion. Not only factors like cohesion of the instruction, but also the type of knowledge assessed by the posttest might explain why scores on peer instruction were better than the scores on expert instruction for topic A than B. For example, if posttest A tested only factual knowledge and no deep learning.

The version effect could also be explained by the length of the videos. The optimal length of an online educational video is shorter than six minutes. Guo, Kim and Rubin (2014) found that educational online videos shorter than six minutes resulted in the highest engagement time (100%). The videos in present study had a length of time between 3’48 and 5’39 minutes. The length of time of the peer video and expert video were slightly different: the length of time of the peer video for topic A was 48 sec. longer than the expert video on topic A, and the length of time of the expert video for topic B was 49 sec. longer than the peer video on topic B. The direction in these differences are in line with the direction found in the version effect: topic A had higher learning outcomes for the peer instruction, topic B for the expert instruction. So, a longer length of time of the instruction might have contributed to the version effect.

Limitations

In this study, the peer and expert instruction contain the same content regarding subtopics and factual information, but the peer presented the instructional explanation in his own words. The benefits of allowing the peer to use his own words, resulting in a more authentic explanation and therefore being more representative for the real-world situation: peer students giving a lecture to fellow students in higher education. Findings therefore are limited to comparable settings where peers give an instruction where they are allowed to use their own words, but the content is based on content provided by an expert.

This experiment was conducted in an online (survey) environment where students had to complete the tasks in a home setting. This might be representative for online instructional videos, but generalization to more real- world situations like a classroom setting might be restricted. In a classroom setting the students and speaker are close together and interact. To foster social interaction in an online environment, social presence (feeling of community) is important (Short, Williams, & Christie, 1976). So, social presence, when studying learning in an online environment seems relevant to consider.

As this experiment was conducted with a sample of university students, caution has to be taken to generalize the findings to other educational settings, like primary and secondary education, vocational education and applied sciences universities.

Future research.

More research is needed to gain more knowledge on moderating factors regarding the unique way peers give instructional explanations (e.g. linguistic factors).

Also, studies investigating the effects of peer instruction on different learning outcomes (e.g. factual knowledge, deep learning), would contribute to a better understanding of the difference between peer mediated instruction and expert mediated instruction.

Conclusion.

The findings of this study indicate that not only model characteristics, but also other factors like subject matter and the way of explaining might be relevant to consider in research

investigating the effectiveness of peer instruction. The evidence will help making sound decisions whether to choose peer to present lectures in higher education or not.

Acknowledgements

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References

Andrist, S., Collier, W., Gleicher, M., Mutlu, B., & Shaffer, D. (2015). Look together: Analyzing gaze coordination with epistemic network analysis. *Frontiers in psychology*, *6*, 1016.

Bandura, A. (1986). Social foundations of thought and action. *Englewood Cliffs, NJ*, *1986*.

Baldwin, D. A. (1991). Infants' contribution to the achievement of joint reference. *Child development*, *62*(5), 875-890.

Boekhout, P., van Gog, T., van de Wiel, M. W., Gerards-Last, D., & Geraets, J. (2010). Example-based learning: Effects of model expertise in relation to student expertise. *British Journal of Educational Psychology*, *80*(4), 557-566.

Bowman-Perrott, L., Davis, H., Vannest, K., Williams, L., Greenwood, C., & Parker, R. (2013). Academic benefits of peer tutoring: A meta-analytic review of single-case research. *School psychology review*, *42*(1), 39.

Braaksma, M. A., Rijlaarsdam, G., & Van den Bergh, H. (2002). Observational learning and the effects of model-observer similarity. *Journal of educational psychology*, *94*(2), 405.

Gegenfurtner, A., Lehtinen, E., Jarodzka, H., & Säljö, R. (2017). Effects of eye movement modeling examples on adaptive expertise in medical image diagnosis. *Computers & Education*, *113*, 212-225.

Greenwood, C. R., Dinwiddie, G., Terry, B., Wade, L., Stanley, S. O., Thibadeau, S., & Delquadri, J. C. (1984). Teacher-versus peer-mediated instruction: An ecobehavioral analysis of achievement outcomes. *Journal of applied behavior analysis*, *17*(4), 521-538.

Guo, P. J., Kim, J., & Rubin, R. (2014, March). How video production affects student engagement: An empirical study of MOOC videos. In *Proceedings of the first ACM conference on Learning@ scale conference* (pp. 41-50).

Hoogerheide, V., Deijkers, L., Loyens, S. M., Heijltjes, A., & van Gog, T. (2016). Gaining from explaining: Learning improves from explaining to fictitious others on video, not from writing to them. *Contemporary Educational Psychology*, *44*, 95-106.

Hoogerheide, V., van Wermeskerken, M., Loyens, S. M., & van Gog, T. (2016). Learning from video modeling examples: Content kept equal, adults are more effective models than peers. *Learning and instruction*, *44*, 22-30.

Hoogerheide, V., Loyens, S. M., Jadi, F., Vrins, A., & van Gog, T. (2017). Testing the model-observer similarity hypothesis with text-based worked examples. *Educational psychology*, *37*(2), 112-127.

Hoogerheide, V., Visee, J., Lachner, A., & van Gog, T. (2019). Generating an instructional video as homework activity is both effective and enjoyable. *Learning and Instruction*, *64*, 101226.

Krebs, M. C., Schüler, A., & Scheiter, K. (2019). Just follow my eyes: The influence of model-observer similarity on Eye Movement Modeling Examples. *Learning and Instruction*, *61*, 126-137.

Lachner, A., & Nückles, M. (2015). Bothered by abstractness or engaged by cohesion? Experts' explanations enhance novices' deeplearning. *Journal of Experimental Psychology: Applied*, *21*(1), 101.

Levine, M. H., & Sutton-Smith, B. (1973). Effects of age, sex, and task on visual behavior during dyadic interaction. *Developmental Psychology*, *9*(3), 400.

Lincoln, M. A., & McAllister, L. L. (1993). Peer learning in clinical education. *Medical teacher*, *15*(1), 17-26.

Manzoor, I. (2014). Peer assisted versus expert assisted learning: a comparison of effectiveness in terms of academic scores. *J Coll Physicians Surg Pak*, *24*(11), 825-9.

Newman, R. S. (2000). Social influences on the development of children's adaptive help seeking: The role of parents, teachers, and peers. *Developmental Review*, *20*(3), 350-404.

Parr, J. M., & Townsend, M. A. (2002). Environments, processes, and mechanisms in peer learning. *International journal of educational research*, *37*(5), 403-423.

Santrock, J. W. (2017). *Educational psychology*. McGraw-Hill Education.

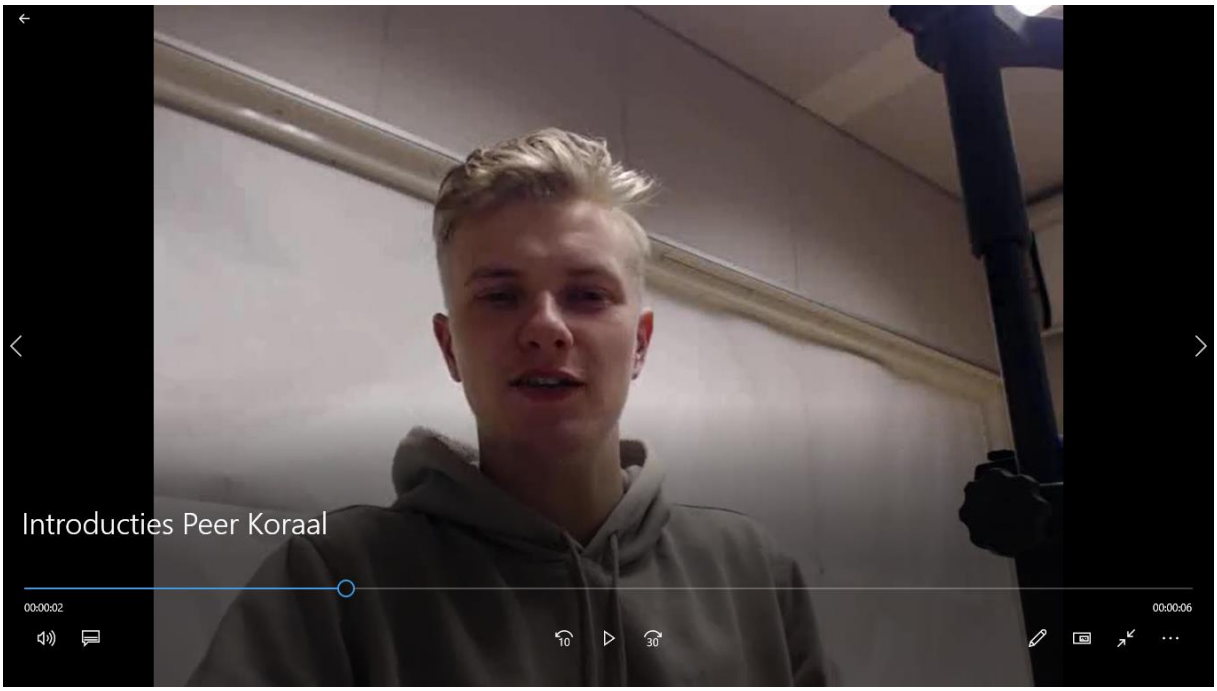
Short, J., Williams, E., & Christie, B. (1976). *The social psychology of telecommunications*. John Wiley & Sons.

Schunk, D. H. (1987). Peer models and children's behavioral change. *Review of educational research*, *57*(2), 149-174.

Utley, C. A. (1997). Peer-mediated instruction and interventions. *Focus on Exceptional Children*, *29*(5), 1-23.

Wilkinson, I. A., & Gaffney, J. S. (2016). Literacy for schooling: Two-tiered scaffolding for learning and teaching.

Appendix A: Example screenshot short introduction video of speakers.



Appendix B: Example Questionnaire

(including: informed consent, posttest and prior knowledge check)

Is there a difference in learning through expert- versus peer-mediated instruction?

Start van blok: Uitleg overview.

Q2
Bedankt dat je mee wilt doen met dit onderzoek!

Deze vragenlijst bestaat uit de volgende onderdelen. toestemmingsverklaring uitleg over hoe de vragenlijst in te vullen twee korte presentaties (ca 5 min.) over een onderwerp iedere presentatie wordt voorafgegaan door een korte kennismaking met de spreker die het onderwerp presenteert na iedere presentatie volgen twaalf korte vragen over het besproken onderwerp het voltooien van dit onderzoek duurt ca 15-20 min.
Succes!

Einde blok: Uitleg overview.

Start van blok: Praktische info.

Q3
Praktische info

PC/laptop Vul de vragenlijst alleen in op een laptop of pc, niet op een mobiel.
Dit is nodig voor een goede weergave van de filmpjes.

Toestemming Vergeet op de volgende pagina's niet je naam in te vullen en je bevestiging van toestemming aan te vinken.
Dit is cruciaal, anders mogen we jouw data niet gebruiken.

Presentaties Bekijk iedere presentatie maximaal 1 x.
Beantwoord de vragen na de filmpjes alleen op basis van de presentatie.
Zoek niks op in andere bronnen.

Belangrijk In deze vragenlijst is geen mogelijkheid om terug te bladeren naar een vorige pagina of vraag.
Blader daarom pas door als je ECHT alles gelezen en ingevuld hebt op de pagina.

Einde blok: Praktische info.

Start van blok: IC onderzoek met naam

Q43 Informed Consent

Is there a difference in learning through expert- versus peer-mediated instruction? Ik ben (online) geïnformeerd over deze studie en heb verder geen vragen meer. Ik heb het recht om deelname aan deze studie te stoppen, zonder opgave van reden.

☐ Ik ga akkoord met deelname aan dit onderzoek (1)

Q44 Vul hier je naam in

○ Naam: (1) _____

Einde blok: IC onderzoek met naam

Start van blok: IC stille ruimte

Q5
Voor een goede kwaliteit van onze data is dat je de vragenlijst in een stille omgeving invult waar geluid afgespeeld kan om de presentaties goed te kunnen beluisteren. Ook is het belangrijk om de vragenlijst in te vullen op een laptop of pc, en niet op een telefoon.Let erop dat je de vragenlijst in een aaneengesloten sessie doorloopt, zonder pauze tussendoor. Daarom willen graag je bevestiging van het volgende:

○ Ik ben deze vragenlijst in een stille omgeving aan het invullen op een computer/laptop met geluidsweergave en ik heb tijd om de vragenlijst aaneengesloten in een keer in te vullen (ca. 15 minuten) (1)

Einde blok: IC stille ruimte

Start van blok: leeftijd

Q6 Wat is je leeftijd?

- ◯ vul hier je leeftijd in (1) _____

Einde blok: leeftijd

Start van blok: geslacht

Q7 Wat is je geslacht?

- ◯ vrouw (1)
- ◯ Man (2)

Einde blok: geslacht

Start van blok: Aankondiging eerste intro/video

Q9
De spreker van de eerste presentatie stelt zich hierna aan je voor.

Speel dit videofragment af.

Ga daarna door naar de volgende pagina voor het presentatie-filmpje.

Einde blok: Aankondiging eerste intro/video

Start van blok: Introductie AP.

Q10

Einde blok: Introductie AP.

Start van blok: video AP.

Q11
Gelieve deze video slechts 1x te bekijken & op full screen.

Einde blok: video AP.

Start van blok: aankondiging posttest (alle)

Q12
Op de volgende pagina volgen de vragen over het onderwerp van de presentatie die je net hebt gezien.

Succes!

Einde blok: aankondiging posttest (alle)

Start van blok: A voorkennis

Q13 We willen graag weten of je over het onderwerp Koraal al kennis bezat, voordat je mee deed aan dit onderzoek. Kun je aangeven wat van toepassing is voor jou?

- ○ Ik wist alleen wat koraal betekende maar had er verder niet meer kennis over (1)
- ○ Ik wist wat koraal was en ook van de term bleaching gehoord, maar had er verder niet meer kennis over (2)
- ○ Ik wist wel dat koraal en algen in symbiose samenleefden, maar meer kennis had ik er niet over (3)
- ○ Ik wist wel van de symbiose tussen koraal en algen, en ook wat voordelen van symbiose voor koraal en alg zijn (4)
- ○ Vrijwel alles van de informatie uit de video was mij al bekend (5)

Einde blok: A voorkennis

Start van blok: A MC 1

X→ X→

Q14 Wat is geen voordeel van symbiose

- ○ Productie van voedsel voor koraaldier (1)
- ○ Alg helpt de poliep bij kalkbinding (2)
- ○ Alg kan zich beter reproduceren (3)

Einde blok: A MC 1

Start van blok: A MC 2

Q15 Wat is Mesogloea?

- ○ Maagdarmstelsel (1)
- ○ Buitenzijde van de opperlaag/huid (2)
- ○ Binnenzijde van de opperlaag/huid (3)

Einde blok: A MC 2

Start van blok: A MC 3

Q16 Met welk zeedier is koraal verwant?

- ○ Zee-egel (1)
- ○ Krab (2)
- ○ Kwal (3)

Einde blok: A MC 3

Start van blok: A MC 4

Q17 Waarom zitten de alg-cellen op die plek waar ze zitten in de koraalpoliep?

- ○ In het maagdarmstelsel zodat het koraaldier kan profiteren van voedsel (oa glucose) dat de alg produceert? (1)
- ○ In het kalkskelet want daar profiteert de alg maximaal van de beschutting die het skelet biedt (2)
- ○ Onder de huid van de poliep omdat daar meer licht komt dan op andere delen van de koraalpoliep (3)

Einde blok: A MC 4

Start van blok: A MC 5

Q18 Niet alle koralen zijn rif bouwend. Wanneer spreekt men van een rif bouwend koraal?

- ○ Als ze vastzit aan een kalkhoudende ondergrond (1)
- ○ Als ze een gezamenlijk kalkskelet vormen (2)
- ○ Als er sprake is van een ecosysteem, oftewel als het ook andere zeedieren herbergt (3)

Einde blok: A MC 5

Start van blok: A MC 6

Q19 In welke fase spreek je van ‘bleaching’ van koraal?

- ○ Als algen uit de koraalpoliepen zijn verdwenen, maar het koraal zelf nog niet is afgestorven (1)
- ○ Als algen uit de koraalpoliepen zijn verdwenen, en het koraal zelf is afgestorven (2)
- ○ Als de algen stoppen met fotosynthese (3)

Einde blok: A MC 6

Start van blok: A MC 7

Q20 Wat is de juiste oorzaak-gevolg keten?

- ○ Broeikaseffect leidt tot bleaching en koraalsterfte (1)
- ○ Verzuring (pH daling) van zeewater leidt tot bleaching en koraalsterfte (2)
- ○ Temperatuurstijging zeewater leidt tot verminderde (skelet)groei van het koraal (3)

Einde blok: A MC 7

Start van blok: A MC 8

Q21 Wat zijn twee eigenschappen van de alg die het voor het koraaldier zo nuttig maakt?

- ○ Produceert voeding voor koraalpoliep en voorkomt bleaching (1)
- ○ Produceert voeding en helpt bij vorming van kalkafzetting in skelet (2)
- ○ Produceert voeding voor koraalpoliep en helpt bij afweer van vijanden (3)

Einde blok: A MC 8

Start van blok: A MC 9

Q23 Waarom is de alg van levensbelang voor de koraalpoliep?

- ○ De alg heeft bladgroenkorrels (1)
- ○ De alg geeft een stevigere structuur aan de poliep (2)
- ○ De alg heeft voordelen voor de koraalpoliep, maar de poliep kan ook zonder (3)

Einde blok: A MC 9

Start van blok: A MC 10

Q24 Hoe heten de eencellige algen die in het inwendige van de koraalpoliep leven?

- ○ Zooxanthellen (1)
- ○ Zooplasmiden (2)
- ○ Zoogloea (3)

Einde blok: A MC 10

Start van blok: A MC 11

Q25 Waarom remt een toename van CO2 in zeewater de groei van koraal?

- ○ Omdat te veel CO2 giftig is voor de algen in het koraaldier (1)
- ○ Omdat CO2 een lagere zuurgraad van het zeewater veroorzaakt en hierdoor minder makkelijk kalk uit het water kan worden opgenomen (2)
- ○ Omdat CO2 zuurstof uit het water verdringt waardoor het koraaldier sterft (3)

Einde blok: A MC 11

Start van blok: Aankondiging tweede intro/video

Q26
De spreker van de tweede presentatie stelt zich hierna aan je voor.

Speel dit videofragment af.

Ga daarna door naar de volgende pagina voor het presentatie-filmpje.

Einde blok: Aankondiging tweede intro/video

Start van blok: Introductie BE.

Q27

Einde blok: Introductie BE.

Start van blok: Video BE.

Q28
Gelieve deze video slechts 1x te bekijken & op full screen.

Einde blok: Video BE.

Start van blok: aankondiging posttest (alle)

Q29
Op de volgende pagina volgen de vragen over het onderwerp van de presentatie die je net hebt gezien.

Succes!

Einde blok: aankondiging posttest (alle)

Start van blok: B voorkennis

Q30 We willen graag weten of je over het onderwerp Hoofdluis al kennis bezat voordat je mee deed aan dit onderzoek. Kun je aangeven wat van toepassing is voor jou?

- ○ Ik wist alleen wat een hoofdluis was, maar had er verder geen kennis over (1)
- ○ Ik wist wat een hoofdluis was , maar wist niets over zijn levenscyclus (van eitje/neet tot volwassen) (2)
- ○ Ik wist wat een hoofdluis was en wist ook iets over zijn levenscyclus, maar niet het verschil tussen holometabole en hemimetabole insecten (3)
- ○ Ik wist wel iets over het verschil tussen holometabole en hemimetabole insecten en ook over de ademhalingsgaten van de hoofdluis. (4)
- ○ Ik wist wel iets over het verschil tussen holometabole en hemimetabole insecten en ook over de ademhalingsgaten en ook over de vochtuitscheiding bij de hoofdluis (5)

Einde blok: B voorkennis

Start van blok: B MC 1

Q31 Waarom zijn onderstaande maatregelen niet effectief tegen hoofdluis?- het gebruik van luizencapes (dit zijn plastic capes om een jas heen aan de kapstok)
het wassen van kleding en/of beddengoed

- ○ Omdat de hoofdluis een wasbeurt makkelijk overleeft, ook op hoge temperatuur (1)
- ○ Omdat de luizen hun weg via de luizencape terug weet te vinden naar een jas en via de jas weer naar de haarbos (2)
- ○ Omdat de hoofdluis alleen overstapt op een andere haardos, en zelden vrijwillig op een kledingstuk over zal stappen (3)

Einde blok: B MC 1

Start van blok: B MC 2

Q32 Welke stadia kent de levenscyclus van de hoofdluis?

- ○ Ei-> larve-> nimfe1-> nimfe2-> volwassen (1)
- ○ Ei-> larve1-> larve2-> nimfe-> volwassen (2)
- ○ Ei-> nimfe1-> nimfe2-> nimfe3-> volwassen (3)

Einde blok: B MC 2

Start van blok: B MC 3

Q45 Wat is het voordeel dat de hoofdluis alleen droge uitwerpselen heeft?

- ○ Het veroorzaakt minder irritatie bij de gastheer (1)
- ○ Hij heeft geen urinewegsysteem nodig, waardoor hij meer bloed kan opnemen (2)
- ○ De hoofdluis verliest minder vocht (3)

Einde blok: B MC 3

Start van blok: B MC 4

Q34 Wat kun je zeggen over de ademfrequentie van de hoofdluis?

- ○ Is nul (1)
- ○ Is niet nul, maar vindt plaats zonder pomp-activiteit (2)
- ○ Is niet nul, er is pomp-activiteit, maar ademt zonder longen (3)

Einde blok: B MC 4

Start van blok: B MC 5

Q35 Wat zijn de voordelen van het middel Dimethicon t.o.v. insecticides:

- ○ Er ontstaat geen resistentie tegen, bij insecticides wel (1)
- ○ Het is niet giftig voor de mens, insecticides wel (2)
- ○ Er kan wel resistentie tegen ontstaan, maar het is goedkoper in de aanschaf (3)

Einde blok: B MC 5

Start van blok: B MC 6

Q36 Wat is het voordeel voor de hoofdluis dat hij een hemi-metabool insect is?

- ○ Dan bereikt hij sneller het volwassen stadium om bloed te kunnen drinken (1)
- ○ Dan kan hij in elk stadium aan de haren vast blijven houden (2)
- ○ Dan heeft hij minder voedsel nodig (3)

Einde blok: B MC 6

Start van blok: B MC 7

Q37 Hoe werkt het antiluizenmiddel Dimeticon?

- ○ Door verstikking van de hoofdluis (1)
- ○ Door vergiftiging van de hoofdluis (2)
- ○ Door uitdroging van de hoofdluis (3)

Einde blok: B MC 7

Start van blok: B MC 8

Q42 Hoe lang kan een hoofdluis maximaal buiten zijn biotoop het behaarde hoofd overleven

- ○ ca. 8 uur (1)
- ○ ca. 18 uur (2)
- ○ ca. 24 uur (3)

Einde blok: B MC 8

Start van blok: B MC 9

Q38 Een vliegenmade is:

- ○ Een larve (1)
- ○ Een nimf (2)
- ○ Een pop (3)

Einde blok: B MC 9

Start van blok: B MC 10

Q39 De hoofluis leeft van het bloed van zijn gastheer. Hoe zou je de relatie mens-hoofdluis omschrijven?

- ○ Opportunistische relatie (1)
- ○ Symbiotische relatie (2)
- ○ Parasitaire relatie (3)

Einde blok: B MC 10

Start van blok: B MC 11

Q40 Welke stadia heeft een holo-metabool insect wel en een hemi-metabool insect niet?

- ○ Larve + pop (1)
- ○ Nimf + volwassen dier (2)
- ○ Nimf + pop (3)

Einde blok: B MC 11

Start van blok: bedankt en einde incl evt mail

Q41
Dit waren alle vragen.

Hartelijk dank voor het meedoen aan dit onderzoek!

Mocht je graag een samenvatting van de resultaten willen ontvangen, laat dan hier je mailadres achter.

Zodra jouw antwoorden ontvangen zijn, wordt je e-mailadres uit onze database verwijderd. Op die manier kunnen jouw antwoorden niet langer aan jouw e-mailadres gekoppeld worden.

Ik hoop je hiermee voldoende te hebben geïnformeerd en wil je nogmaals bedanken voor je medewerking.

Met vriendelijke groet, Susana van der Klei

- ○ ik wil graag een samenvatting van de resultaten van het onderzoek ontvangen. Mijn email-adres is: (1) _____

Appendix C: FETC form

Section 1: Basic Study Information

1. Name student:

Susana van der Klei

2. Name(s) of the supervisor(s):

Ellen Kok

3. Title of the thesis (plan):

Does peer mediated instruction result in better learning outcomes?

4. Does the study concern a multi-center project, e.g. a collaboration with other organizations, universities, a GGZ mental health care institution, or a university medical center?

No

5. Where will the study (data collection) be conducted? If this is abroad, please note that you have to be sure of the local ethical codes of conducts and permissions.

Utrecht University

Section 2: Study Details I

6. Will you collect data?

Yes

7. Where is the data stored?

See questions 11 and further

8. Is the data publicly available?

9. Can participants be identified by the student? (e.g., does the data contain (indirectly retrievable) personal information, video, or audio data?)

no

10. If the data is pseudonymized, who has the key to permit re-identification?

Section 3: Participants

11. What age group is included in your study?

graduate students on the university (average age approximately 25 years)

12. Will be participants that are recruited be > 16 years? Yes
13. Will participants be mentally competent Yes
14. Does the participant population contain vulnerable persons? (e.g., incapacitated, children, mentally challenged, traumatized, pregnant) No
15. If you answered 'Yes' to any of the three questions above: Please provide reasons to justify why this particular group of participants is included in your study.

16. What possible risk could participating hold for your participants?

none

17. What measures are implemented to minimize risks (or burden) for the participants?

Not needed

18. What time investment and effort will be requested from participants?

15-20 minutes

19. Will be participants be reimbursed for their efforts? If yes, how? (financial reimbursement, travelling expenses, otherwise). What is the amount? Will this compensation depend on certain conditions, such as the completion of the study?

gift card 20 euro raffle among participants

20. How does the burden on the participants compare to the study's potential scientific or practical contribution?

No burden besides investment of 20 minutes of time

21. What is the number of participants? Provide a power analysis and/or motivation for the number of participants. The current convention is a power of 0.80. If the study deviates from this convention, the FERB would like you to justify why this is necessary.
(Note, you want to include enough participants to be able to answer your research questions adequately, but you do not want to include too many participants and unnecessarily burden participants.)

N = 27 (37)

22. How will the participants be recruited? Explain and attach the information letter to this document.

Convenience sample: by asking students within our own course to participate, and via social network

23. How much time will prospective participants have to decide as to whether they will indeed participate in the study?

< 24 hours

24. Please explain the consent procedures. Note, active consent of participants (or their parents) is in principle mandatory. Enclose the consent letters as attachments. You can use the consent forms on Blackboard.

See Appendix B

25. Are the participants fully free to participate and terminate their participation whenever they want and without stating their grounds for doing so? Explain.

Yes, see Appendix B

26. Will the participants be in a dependent relationship with the researcher?

This could be the case when if participant is fellow student of a friend of researcher

27. Is there an independent contact person or a general email address of a complaint officer whom the participant can contact?

Yes, see Appendix B (informed consent)

28. Is there an independent contact person or a general email address of a complaint officer whom the participant can contact in case of complaints?

Yes, se Appendix B (informed consent)

Section 4: Data management

29. Who has access to the data and who will be responsible for managing (access to) the data?

Reseachers (Susana van der Klei) and supervisor (Ellen Kok)

30. What type of data will you collect or create? Please provide a description of the instruments.

Random assignment table Online Survey data

31. Will you be exchanging (personal) data with organizations/research partners outside the UU?

No

32. If so, will a data processing agreement be made up?

33. Where will the data be stored and for how long?

Data will be anonymized. Storage of the data will be done on Surfdrive Raw data will be stored for 10 years

34. Will the data potentially be used for other purposes than the master's thesis? (e.g., publication, reporting back to participants, etc.)

Unknown yet.

35. Will the data potentially be used for other purposes than the master's thesis? (e.g., publication, reporting back to participants, etc.)

Unknown yet.