MASTER'S THESIS

Authentic background in educational videos: attraction or distraction.

Gherghiceanu, Andra

Award date:
2021

Open
Universiteit

Authentic background in educational videos: attraction or distraction

The effect of an authentic video background on cognitive load and situational interest

Andra Elena Gherghiceanu

Master Onderwijswetenschappen

Open Universiteit

Course name and code:	Masterthesis OM9906
Supervisor:	Dr. Christian M. Stracke
Datum:	09-07-2021

Authentic background in educational videos: attraction or distraction

Abstract

Videos are one of the technological tools already in use for several years in education. Videos have proven their value as effective tools for learning when specific design criteria are followed. One aspect that has had only limited attention in educational research is the impact of background in an educational video on learning. The current study aimed to investigate this aspect: the influence of an authentic background on learning outcomes through the mediation of situational interest and cognitive load. For this study, a between-subject experiment has been carried out with 114 participants who were employees of two schools in the Netherlands. The participants were tested on their prior knowledge of the video's subject (glaciers) and then were randomly redirected to either a video with an authentic background (a picture of a glacier) or one with a neutral background (grey). Afterward, their learning outcomes were measured, and they were asked to rate their level of situational interest and cognitive load. Parallel mediation analysis with prior knowledge as a covariate was carried out. Results showed no mediation of situational interest or cognitive load on learning outcomes and no significant direct effect of the type of background on learning outcomes. Surprisingly, prior knowledge was associated with a lower level of situational interest. The study's findings pinpoint the need for more research in a more authentic setting and the need to focus on the impact of different design elements of educational material depending on learner characteristics (for example, low versus high prior knowledge).

Keywords: educational videos, video background, cognitive load, situational interest.

Introduction

Technology plays a vital role in everyday life and has had a significant impact on educational sciences (Mayer, 2019). The COVID-19 pandemic has accelerated these developments, forcing schools worldwide to rely, sometimes solely, on online teaching and digital educational materials (García-Morales et al., 2021). Having digital material as the primary form of delivering education in all schools has emphasized the importance of investigating what factors contribute to its quality.

Videos are one example of digital material already used in various educational forms (Bétrancourt & Benetos, 2018), ranging from short clips supplemental to already existing material to web lectures or, on the other side of the spectrum, as the primary form of instructions in online courses (De Koning et al., 2018). Multiple studies, carried out in different educational contexts, have shown that the use of videos can positively impact learning outcomes (Lloyd & Robertson, 2012; Rackaway, 2012; Salina et al., 2012) and student satisfaction (Stockwell et al., 2015). Searching for answers on what makes videos effective, educational research has focussed mainly on different design aspects (Fiorella et al., 2017; Hoogerheide, Loyens, et al., 2016; Hoogerheide, van Wermeskerken, et al., 2016; Ibrahim et al., 2012). However, the background of an instructional video has not been a topic often addressed in educational research before the experiments of Merkt et al. (2019). This study looked into the effect of using an authentic, static background in an educational video on knowledge retention and transfer. Their results were, however, inconclusive and called for additional research on the topic.

This paper aims to readdress this subject: the impact of using an authentic static background in an educational video on learning outcomes and, by doing so, to contribute to the body of knowledge of educational video design. However, it will do so by focusing on cognitive load and situational interest mechanisms.

From a theoretical perspective, the cognitive theory of multimedia learning (Mayer, 2014) and the cognitive affective theory of learning with (multi)media (Moreno, 2007) form the research framework and the basis of the hypotheses of this study. An authentic background may increase cognitive load due to its seductive detail effect (Harp & Mayer, 1997) and negatively impact learning. Another possibility is that the background will lead to increased motivation in the form of situational interest (Lenzner et al., 2013), which will trigger the learners' attention, which could positively impact the learning results. In this case, the increased situational interest would outweigh the potential impact of an increased cognitive load, leading to better learning outcomes. The following section provides a more detailed overview of the theoretical framework and its link to the research questions and hypotheses.

Literature Review

This study's foundation lies in several theories on how information is processed and stored by learners and how instruction can be best designed to facilitate learning: the *cognitive load theory, cognitive theory of multimedia learning,* and *cognitive affective theory of learning with multimedia*. The instruction principles that stem from these theories can also be applied to educational video design. However, when looking at the possible implications of a specific background in an educational video, the hypotheses based on these theories are contradictory. The following paragraphs aim to shed more light on the different views on the subject and how they lead to this study's hypotheses. The first part introduces the cognitive load theory, and it is followed by an introduction to the cognitive theory of multimedia learning. The addition of emotional aspects in multimedia learning is then described by looking into the cognitive, affective theory of multimedia learning and is linked to situational interest. The final part of the literature review presents a brief overview of research on educational videos and aims to present the final connection between all the theoretical aspects described and this current study.

Cognitive Load Theory

The cognitive load theory is built on the current knowledge of human cognition (Sweller, 2020). One of its fundamental principles especially interesting for this study's subject is that of the *narrow limits of change* (Paas & Sweller, 2014; Sweller, 2020). This principle refers to the limited capacity of the working memory: when dealing with new information, the working memory can only hold a limited amount of information for a limited amount of time (Paas & Sweller, 2014). The amount of cognitive resources used for a particular task is referred to as cognitive load (Paas & Van Merrienboer, 1994). The cognitive load theory tries to explain how the demand of processing new information impacts the learner (Sweller et al., 2019), and in order to understand this process, three types of cognitive load have been distinguished: intrinsic, extraneous better, and germane (Paas & Sweller, 2014). The amount of intrinsic load experienced by a learner depends on the complexity of the new information,on how many elements have to be processed simultaneously. The only way to influence intrinsic load is by changing the task or increasing prior knowledge (Paas & Sweller, 2014). The amount of extraneous load is dependent on the design of the instruction and the learning environment. A poorly designed instruction can, therefore, lead to an unnecessarily high cognitive load. Germane load, also called an effective load, refers to the cognitive resources used purely for handling the intrinsic cognitive load (Chandler & Sweller, 1991). Recently, the germane load has been considered having a distributive function of mental resources: rather than adding to the total load, it distributes resources to intrinsic aspects of the task (Sweller et al., 2019).

The cognitive load theory has had a significant influence on multimedia instruction as it provides the foundation for designing more effective instruction methods. The cognitive load theory has played an essential role in the development of the cognitive theory of multimedia

learning and multimedia instruction design principles. These theories will be described in the following section.

Cognitive Theory of Multimedia Learning and Instruction Design Principles

The increased interest in multimedia for instruction stems from the *multimedia principle*, which states that deeper learning occurs when words and pictures are combined (Mayer, 2014). The effect is not so much visible in terms of knowledge retention but more in understanding and transfer (Mayer, 2017). However, simply embellishing materials of pictures does not lead to meaningful learning; for this principle to work fully, the instruction must consider the workings of the human mind. The cognitive theory of multimedia learning aims to provide principles that guide the design of effective multimedia material.

At the basis of the cognitive theory of multimedia learning are three "cognitive science principles of learning" (Mayer, 2014, p. 47): the dual-channel principle, the limited capacity principle, and the active processing principle. The dual-channel principle has its origins in Paivio's dual-coding theory (Mayer, 2014). According to the dual-coding theory, the human mind processes information through a visual and auditory channel (Clark & Paivio, 1991). One of the implications of the theory for education is that learning appears to occur faster if a verbal explanation is accompanied by imagery, and the two explanations are presented in a coordinated way (Mayer & Anderson, 1991). The second principle is that of limited capacity and is based on the cognitive load theory (Paas & Sweller, 2014). This principle refers to the limited processing capacity of each channel for new information. Furthermore, the third principle states that learners need to actively pay attention, organize new information, and integrate it with previous knowledge to learn (Mayer, 2014).

The goal of multimedia instruction is to "minimize extraneous processing," "manage essential processing," and "foster generative processing" (Mayer, 2014, p. 61); in other words, it aims to ensure that the learner's cognitive capacities are used for learning. It does

this by taking into account the processes of human cognition (Paas & Sweller, 2014). Several instructional design techniques have been proposed to achieve this, out of which six are concerned explicitly with reducing extraneous load: coherence, signaling, redundancy, spatial and temporal contiguity principles, and segmenting (Mayer & Fiorella, 2014). The most relevant principle to elaborate for this research is the coherence principle since it is at the basis of one of the hypotheses of Merkt et al. (2019).

The coherence principle states that irrelevant details should be excluded from instruction in order to avoid overloading the learner (Mayer & Fiorella, 2014). *Irrelevant details (or extraneous details)* refer to material related to the topic but not directly contributing to the explanation (Harp & Mayer, 1997; Mayer et al., 2008). Irrelevant material can come in the form of pictures, graphics, and sounds added to embellish the instruction. These details are also called *seductive details* (Harp & Mayer, 1997), and their effect on learning is called the *seductive detail effect* (Harp & Mayer, 1997; Mayer & Fiorella, 2014).

Several experiments (Harp & Mayer, 1997; Ibrahim et al., 2012; Javora et al., 2018; Mayer & Fiorella, 2014; Rey, 2014) have proven the harmful effect of seductive details in both text and multimedia. Harp and Mayer (1997) have tested the emotional interest versus cognitive interest hypotheses in an experiment looking into the effect of attractive illustrations and text. According to the emotional interest theory, attractive illustrations should trigger the learners' to pay more attention. According to the cognitive interest theory, the interest of learners increases when they understand specific passages. The added attractive illustrations and text have increased the emotional interest but did not improve understanding, which led Harp and Mayer (1997) to back the cognitive interest hypothesis and the effect of seductive details. In another study (Ibrahim et al., 2012), novice learners using an educational video performed better (in terms of retention and transfer) when the video design employed signaling, segmenting, and weeding, which means eliminating

interesting but extraneously loaded information. In an eye-tracking study Rey (2014) has shown that seductive details, in the form of illustrations, interfered with learning (measured through transfer). However, it is worth adding that this was especially the case for learners with low attention control, who were thus easily distracted and had more difficulty focusing on important information. The advice that stems from this is to exclude irrelevant details from learning materials (Rey, 2014). Seductive details in the form of auditory elements to multimedia instruction have proven to have a similar effect. The complementation of instruction with background music or sounds has led to weaker retention and transfer performance than providing the instruction without these elements (Mayer & Fiorella, 2014). A study that compared two designs of educational games (high aesthetic value versus low aesthetic value) in terms of attractiveness, preference, and learning outcomes (Javora et al., 2018) showed similar results. The children involved in the study preferred the high aesthetic design, and this design also correlated strongly to higher enjoyment. Nevertheless, the researchers do add that the effect on learning has a 'borderline significance' and should be interpreted with caution (Javora et al., 2018, p. 1955).

Even though multiple studies have shown seductive details' detrimental effect on learning, as presented in the previous paragraph, other studies show that not all seductive details are made alike, and their effects are not that straightforward (Kühl et al., 2019; Rey, 2012, 2014; Sanchez & Wiley, 2006; Sitzmann & Johnson, 2014). There are moderating aspects such as type of seductive detail, the topic of the material, the use of a time limit for a specific task, or learner characteristics that influence the impact on the learner (Rey, 2012). Park (2011) showed that seductive details led to higher performance in a low load condition (narration versus on-screen text), possibly increasing students' cognitive engagement. It seems that some learners are more prone to experience the detrimental effects of seductive details, such as novices (Sitzmann & Johnson, 2014), learners with a lower attention control

(Rey, 2014), or lower working memory (Sanchez & Wiley, 2006). Eitel et al. (2019) showed that the seductive details effect was only present when the learner thought these seductive details were relevant. However, the study might have to be treated with caution since it has not been replicated. Moreover, a study on the impact of seductive details' emotional valence failed to prove the seductive detail effect on retention and transfer altogether (Kühl et al., 2019).

These findings have triggered researchers to state that the cognitive theory of multimedia learning is missing a key element, namely, motivation (Astleitner & Wiesner, 2004) and that the theory would benefit from including motivation (Mayer, 2019). According to Astleitner (2004), a learner's mental activities (such as selection, integration leading to learning) depend on how the learners manage their mental resources (attention, engagement, and monitoring). Motivation has a significant impact on the allocation of these resources: without motivation, the learner will not allocate the necessary mental resources for a specific task. Therefore, an alternative theory has been proposed: the cognitive affective theory of learning with media (Moreno, 2007), which will be discussed in the following section.

Cognitive Affective Theory of Learning with (Multi-)Media

The cognitive affective theory of learning with (multi-)media considers the potential impact of emotional and motivational aspects of multimedia learning (Moreno, 2007). The theory adds three additional assumptions to those of the cognitive theory of multimedia learning (B. Park et al., 2014): *the affective mediation assumption*, *the metacognitive assumption*, and *the individual differences assumption* (B. Park et al., 2014). The affective and metacognitive assumptions suggest that motivation and metacognitive factors affect the extent of cognitive engagement while, according to the individual difference assumption, the learner's traits affect the effectiveness of the learning process (B. Park et al., 2014).

Several studies have shown the mediating effect of emotional and motivational aspects on cognitive load and learning. D'Mello and Grasser (2011) looked into the development of feelings during learning activities and their impact. Their results showed that feelings such as confusion, which can spark deep inquiry, have led to better learning. The opposite was true for states of boredom and negativity. In another study, students studying science who used materials designed to induce positive emotions performed better in comprehension and transfer tests without experiencing an increased extraneous cognitive load (Um et al., 2012). Background music in educational computer animation has been linked to a better learning outcome for students with higher prior knowledge, which led the researchers to propose the inclusion of arousal, besides cognitive load in the theoretical framework of multimedia learning (Huk et al., 2004). The study provides evidence for the different effects of seductive details depending on the audience, but the workings behind this effect seem vague since the students who performed better with music did not value this addition (Huk et al., 2004). Design features such as specific colors and shapes appear to induce positive emotions and positively affect comprehension and transfer (Plass et al., 2014). The term *emotional design* (Plass & Kalyuga, 2019; Um et al., 2012) has been introduced to refer to the use of specific design features in educational material that can influence the learners' emotional states, the goal being to elicit the emotions that stimulate learning.

To sum up, developments in the educational sciences have started seeing emotional aspects as significant factors that influence learning. Motivation has been considered particularly important (Moreno, 2010) as it affects the amount of resources a learner invests in learning. The questions that then arise are: can motivation be increased by triggering interest in learners, and can this be done by tweaking the design of learning material? It is, therefore, useful to take a more detailed look into theories on interest.

Situational Interest

Interest is considered a motivational variable and "refers to the psychological state of engaging or the predisposition to reengage with particular classes of objects, events, or ideas" (Renninger & Hidi, 2006, p. 112). In terms of its impact on learning, interest can influence goals, attention, and learning (Hidi, 2006).

Interest is divided into situational and individual interest (Hidi, 2006; Linnenbrink-Garcia et al., 2010). Individual interest is personal and more or less equal in different circumstances as opposed to situational interest, which can be triggered by environmental factors involving an "affective reaction and focussed attention" (Hidi, 2006, p. 72). Situational interest, in turn, is divided between triggered, the initial phase of catching someone's attention, and maintained situational interest (Linnenbrink-Garcia et al., 2010), also referred to as situational interest "catch" and situational interest "hold" (Mitchell, 1993, p. 425). If interest is maintained, it can, in time, develop into individual interest (Renninger & Hidi, 2006). While individual interest will help learners deal with less attractive material, situational interest might help those who do not have an initial personal interest (Hidi, 2001). Teachers can trigger situational interest in the way they present their material to students (Hidi & Harackiewicz, 2000). Lenzner et al. (2013) showed that learners, especially those with low prior knowledge, benefited from instructional pictures (pictures linked to the study topic) 11by showing increased situational interest and higher learning performance. Although decorative pictures (not linked to the study topic) did not seem to have the same effect on their own, they were more beneficial for learning in combination with instructional pictures than instructional pictures alone. Looking into the results of previous research on the use of pictures in educational material might give some insights into how a video background could influence learning.

In another study on the effect of decorative illustrations, it appeared that only learners with low prior knowledge had experienced the seductive details effect. For learners with low prior knowledge, the pictures triggered situational interest. They had an indirect positive effect on near transfer, leading the researchers to conclude that decorative pictures are neither distractive nor engaging, but rather that their influence depends on the learner and type of learning outcomes (Magner et al., 2014). Although this indirect positive effect of decorative pictures is limited to only triggered situational interest and only in near transfer learning outcomes, it does show that emotional aspects should also be taken into account in the theoretical framework of multimedia learning.

Although the research on decorative and instructional pictures has mainly focussed on text (Lenzner et al., 2013; Schneider et al., 2016), their interaction with learning might extend to multimedia learning and, in this case, video background. An authentic video background would be a form of "emotional/motivational (conducive) decorative picture" (Schneider et al., 2016, p. 67) that might trigger the learner's situational interest and, in turn, attention.

Since the current study will focus on videos, it is interesting to overview briefly the currently available findings on video design findings and describe how this study aims to contribute to this.

Videos as a Form of Instruction

The term *multimedia* refers to combining words with pictures (Butcher, 2014) or combining words (printed or spoken) with pictures (illustrations, charts, photos, or videos) (Mayer, 2014). However, the term currently refers to various forms of information delivery by combining words with pictures, including videos (Butcher, 2014).

Since videos have been part of educational instruction, researchers have been trying to assess their impact on learning (De Koning et al., 2018). Several studies in various contexts have proven that using videos can have a positive effect on learning: videos as supplementary

learning material in political sciences (Rackaway, 2012), in macroeconomics (Expósito et al., 2020), videos used as refresher instruction technique in medical education (Salina et al., 2012) or statistics (Lloyd & Robertson, 2012). These studies' results confirm the multimedia principle (Mayer, 2014), which states that people learn better from a combination of images and words than from only words under certain conditions.

Educational scientists have proven that videos could be a valuable resource in education. So, the focus then changed towards looking into which elements contribute to a video's effectiveness. Therefore, extensive research has been carried out on this particular subject (Fiorella & Mayer, 2018). Most of this research has focused on video design aspects such as segmentation, weeding, signalling (Ibrahim et al., 2012), duration of videos (Guo et al., 2014), the perspective of filming (Fiorella et al., 2017), the gender of the teacher and its effect on the learner (Hoogerheide, Loyens, et al., 2016), having peers or adults in the videos (Hoogerheide, van Wermeskerken, et al., 2016), and pacing and interactivity (Merkt et al., 2011). However, an educational video setting's background has remained a rarely tackled subject (Merkt et al., 2019). Choi has claimed that the physical environment should be considered a causal factor of cognitive load in learning (Choi et al., 2014); the question is whether this claim could be extended to the environment of an educational video and the background of the video. If one applies this claim to a video's background, then the type of background could also affect a learner's interest in the same fashion as an emotional decorative picture (Schneider et al., 2016).

Research Questions and Hypotheses

Based on the current research and theoretical framework, this study aims to test and analyze whether the relation between an authentic video background and learning outcomes is significantly mediated by cognitive load and situational interest while controlling for prior knowledge. The following research questions have been formulated:

- What is the mediation effect of situational interest on the relation between an authentic background in an educational video and learning outcomes?
- What is the mediation effect of cognitive load on the relation between an authentic background in an educational video and learning outcomes?
- How do the mediation effects of situational interest and cognitive load relate to each other in terms of their effect on learning outcomes?

The cognitive theory of multimedia learning (Mayer, 2014) and the cognitive affective theory of learning with media (Moreno, 2007) form the basis of the hypotheses.

Hypothesis 1: Situational interest positively mediates the relationship between an authentic video background and learning outcomes (while controlling for prior knowledge).

An authentic background in an educational video could be a facilitator for learning. According to the cognitive affective theory of multimedia learning, emotional and motivational aspects can impact learning (Moreno, 2007). A motivated learner is more likely to allocate the mental resources needed to process new information (Astleitner & Wiesner, 2004). Situational interest is one of many factors influencing motivation and can potentially impact a learner's attention and engagement (Renninger & Hidi, 2006). Situational interest is said to be triggered by, amongst others, meaningful learning environments (Renninger & Hidi, 2006) or even by a visual or auditory stimulus (Hidi, 2001). In light of this information, an authentic video background could potentially increase the initial situational interest of the learners. So, even though an authentic background might fit the definition of a seductive detail, its effect might not be detrimental to learning due to its potential to trigger situational interest, which, in turn, could lead to increased engagement with the instruction material and better learning outcomes.

Hypothesis 2: Cognitive load negatively mediates the relationship between an authentic video background and learning outcomes (while controlling for prior knowledge).

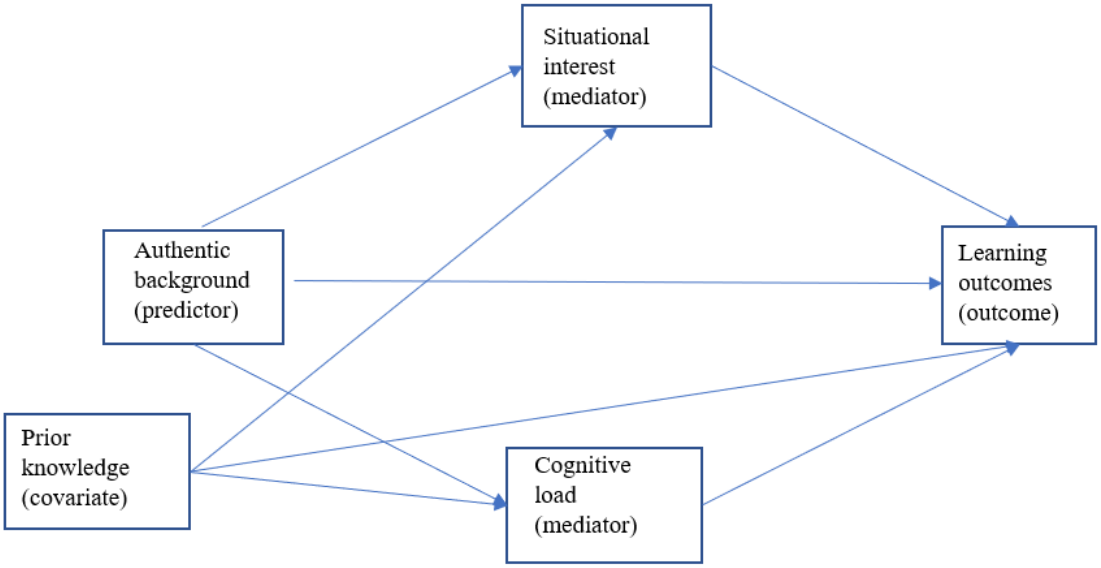
An authentic background could be considered a seductive detail. While it might be related to the video's subject, it does not explain a specific topic to the learners (Harp & Mayer, 1997). According to the coherence principle (Mayer & Fiorella, 2014; Mayer & Moreno, 2003), this could be a form of distraction, which would lead to an unnecessary increase in the extraneous cognitive load, in the form of *incidental processing*: a cognitive process that is not linked to the learning task but the design of the instructional material (Mayer & Moreno, 2003). Having an increased extraneous cognitive load depletes (cognitive) resources from the learners that they could use for the learning process, and it would have a detrimental effect on learning.

Hypothesis 3: The mediation of situational interest exceeds the mediation effect of cognitive load (while controlling for prior knowledge).

Even though cognitive load might significantly mediate the relation between the video background and learning outcomes, the triggered situational interest effect would offset the negative impact of a higher cognitive load. In other words, using an authentic background would be a form of emotional design which had a positive effect on learning outcomes through the mediation of situational interest. This hypothesis acknowledges that an authentic video background might act as a seductive effect. However, the situational interest is believed to outweigh the negative effect of (extraneous) cognitive load. Figure 1 offers a schematic overview of the three hypotheses described above.

Figure 1

Conceptual model of the hypotheses



Method

Design

The research was conducted as part of a thesis group focusing on the impact of the background in an educational video on different aspects of learning, such as working memory, learning results, and information processing.

We used a between-group experimental design to assess the influence of the background on these aspects. The participants were randomly assigned to two conditions: one group viewed the educational video with a neutral (grey) background, and the other group viewed the video with an authentic background. This design is the most suitable design for establishing a possible cause and effect relation between several variables (Creswell, 2014). Furthermore, by randomly assigning the participants, we control the participants' possible extraneous characteristics that might influence the results (Creswell, 2014).

For this particular study, the independent variable (predictor) is the video background, the dependent variable (outcome) is the learning outcome, and situational interest and cognitive load are the mediators. One aspect that might also influence the results is prior knowledge. Studies have shown that prior knowledge impacts learning results and the ratings on cognitive load (Huk et al., 2004; Magner et al., 2014). Therefore, the participants' prior knowledge was measured and added to the analysis as a covariate (Creswell, 2014).

Participants

The participants for the study were recruited from the staff of two schools in the Netherlands: a secondary school and a (mid-level) vocational school. In total, 228 persons received the invitation together with information on data collection, storage, and use. The questionnaire was open for a month (15th of February till the 15th of March), and in this period, it was accessed 194 times, and 114 participants (60 female and 54 male) completed it.

Materials

This study used two types of materials: two videos and a questionnaire designed to measure prior knowledge, learning outcomes, cognitive load, and situational interest.

Videos

The members of the thesis group have created videos containing general information on glaciers. The videos were identical in terms of script, presenter, and additional visuals (pictures) used; the only difference was the video background: one video contained a neutral background, and the other video a picture of a glacier. The picture of the glacier was, in this case, the authentic background. In order to explain certain specific terms, additional pictures were used in both videos. Below are two screenshots of the videos.

Figure 2

Screenshot of the video with authentic background

Figure 3

Screenshot of the video with neutral (grey) background

Questionnaire- Prior Knowledge (pre-test)

Before viewing one of the videos, the participants were asked to answer nine open questions about glaciers. These questions aimed to measure the extent to which participants were already familiar with the information they would be viewing in the educational video.

We chose open questions instead of multiple-choice to avoid the potential testing effect (Creswell, 2014). This effect could have occurred if participants viewed questions and possible correct answers during the pre-test similar to those in the post-test. Participants could get a score of either zero, one, or two for each question; the maximum score was 18. The scoring was based on a set of key terms that had to be present in the answer. The raters scored an incorrect or unanswered question with none of the key terms present with zero points. A correct but incomplete answer with only one key term present received one point, and a correct and detailed answer, two or more key terms present, was scored with two points. The scoring guideline can be found in Appendix B. The two members of the thesis group were the raters. We scored the answers independently, and afterward, we discussed the differences, and we agreed on the final scores.

Questionnaire- Learning Outcomes (post-test)

The learning outcomes were measured with 12 multiple-choice questions developed by the thesis group members. These questions aimed to test the retention and transfer of the video's information and were therefore presented to the participants after they had finished viewing their assigned videos. This testing method was selected for two reasons: first, multiple-choice questionnaires have been proven to be valid tools for testing both retention and transfer (Hift, 2014; Ibrahim et al., 2012; Van Berkel et al., 2017), and second, they increase ease and correction reliability (Merkt et al., 2019). Each question had only one correct answer; for each correct answer, the respondents scored one point. The total score was automatically computed at the end of the study by adding up all the correct answers; the maximum score was 12.

Both the prior knowledge and the learning outcome (post-test) questions were not checked for reliability using Cronbach's Alpha because they aim to measure discrete pieces

of knowledge that occur in the video, and their aim is not to be a reliable instrument to test glacier knowledge in general (Taber, 2018).

Questionnaire- Situational Interest

The knowledge test was followed by questions aiming to measure situational interest and cognitive load. For situational interest (SI), three questions were used based on a study by Linnebrink et al. (2010). Their study developed and validated an instrument for assessing students' situational interest in an academic context. They used a self-reporting questionnaire containing items on triggered and maintained situational interest. The students could rate different aspects of interest (triggered SI, maintained SI) on a scale from 1 (strongly disagree) to 7 (strongly agree). This current study uses three out of the four items on triggered situational interest, which Linnebrink et al. (2010) have developed. One has been omitted because it is related purely to the extent that the teacher's actions trigger interest, a topic that is not of interest for this current study. The remaining questions were modified to fit the context and materials of this study. The reliability of their scale was satisfactory (Cronbach's $\alpha = .785$).

Questionnaire- Cognitive Load

In order to measure the experienced cognitive load, the participants were asked two questions based on a study of Schwamborn et al. (2011), which are, in turn, based on two studies of Kalyuga et al. (2011) and Paas (1992). The questions could be answered on a seven-point rating scale and measure mental effort and perceived difficulty. They have been rephrased for the current experiment to target video viewing instead of reading. The original questions were: "When reading for comprehension, I invested a very low…very high mental effort" and "Comprehending the text was very easy…very hard" (Schwamborn et al., 2011, p. 91). These questions have been adapted to: "When viewing the video, I invested very

low…very high mental effort" and "Comprehending the video was very easy….very difficult". This type of measurement is a subjective method of testing cognitive load and is one of the most widely used methods together with psychophysiological and (second) task tests (Paas et al., 2003). Rating scales are a subjective method for measuring cognitive load because they rely on the participants reflecting on their perceived cognitive load. Subjective measurement methods have several advantages compared to other methods: their simplicity, ease of measurement, and low interaction with the learning task (Paas et al., 1994; Sweller et al., 2019).

Although Schwamborn et al. (2011) did not report the reliability of the two-item scale, in general, the subjective ratings have proven to be reliable and sensitive (Paas et al., 1994). The current study measured Cronbach's Alpha; the result was a low value (Cronbach's $\alpha = .286$). A scale with a few items, such as this one, is more prone to a low value (Field, 2014). However, according to Ramstedt et al. (2014), this does not necessarily need to be a problem when comparing groups.

Manipulation Check

The internal validity of the study was checked by asking the participants to assess the suitability of the background for the subject of the video using a seven-point Likert scale from 1 ("completely agree*")* to 7 ("completely disagree").

The complete questionnaire can be found in Appendix B.

Procedure

Before the study, the members of the thesis group informed the management staff of the two schools involved about the details of the research. The schools agreed in writing to facilitate the experiment by inviting their employees to participate. The invitation to participate, including information on the study, was sent by email through the management's

email distribution list. The invitation used can be found in Appendix A. The participants received an email invitation to participate together with information on the study and the link to access the web platform (Limesurvey) on which the experiment and data collection took place. Those who accessed the link to the questionnaire could digitally consent to their participation; the rest of the questions and the video were accessible only after completing this step.

In Limesurvey, the participants were first asked a series of general demographic questions followed by nine questions to test their prior knowledge of glaciers. After that, they were randomly redirected to one of the two videos (neutral background or authentic background), which opened in a separate browser window. After viewing the video, they were instructed to close the video window and return to the questionnaire. First, the participants were asked whether they viewed a video with a grey background or with a glacier picture in order to be able to determine in which group they would fall. Then, the questions testing knowledge retention and transfer followed together with those testing situational interest, perceived cognitive load, and the manipulation check question. The participants could stop the questionnaire at any point.

Data Analysis

The questionnaire's raw data was first downloaded from Limesurvey into IBM SPSS Statistics 27. The questionnaire contained three different types of questions: open questions for the pre-test, multiple-choice for the learning outcomes, and seven-point Likert scales for cognitive load, situational interest, and the manipulation check. Since the pre-test contained open questions, the raters scored the answers, and the results were manually added to the data set. The learning outcome scores (based on the multiple-choice questions) had already been automatically calculated by Limesurvey and were left unchanged. The answers for the cognitive load and situational interest questions were recoded in the case of the negatively

formulated questions, and then, new variables were calculated by averaging the responses. The data was then checked for missing values with descriptive statistics. A manipulation check with an independent samples *t*-test was used to assess whether the glacier background was indeed perceived as more suitable for the subject of de video. The significance level is set at $\alpha = .050$ based on Pillai's trace test (Field, 2014).

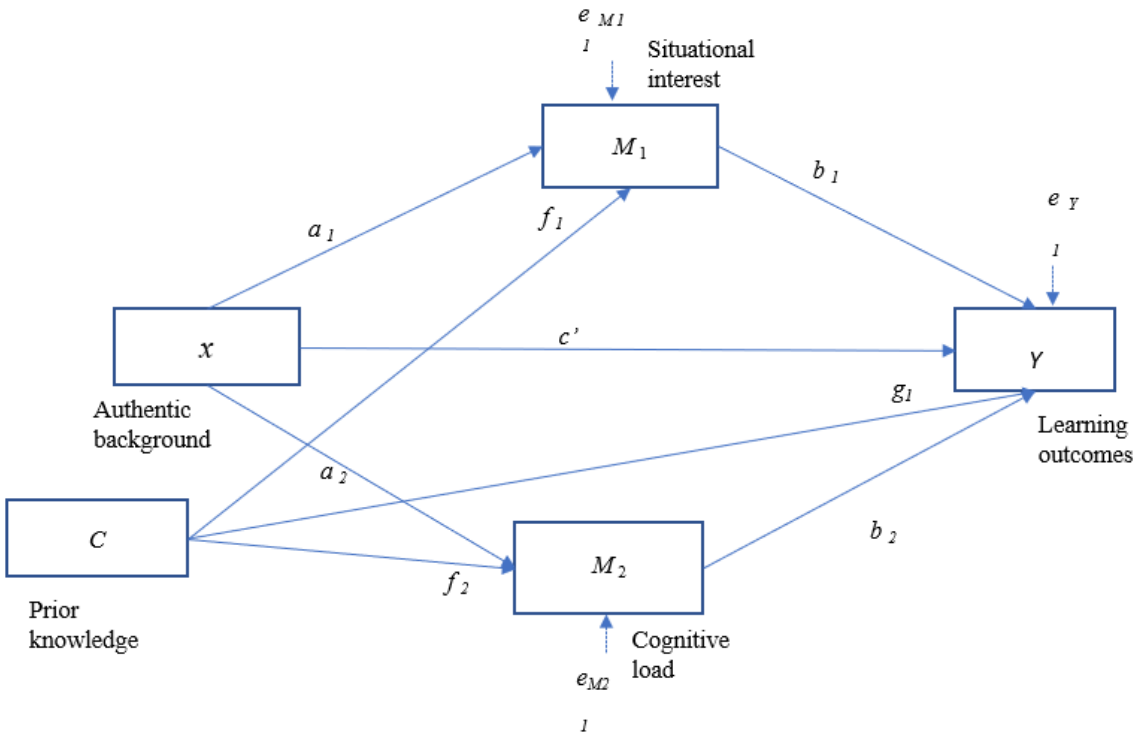
Before the primary analysis, a preliminary check was done for both univariate and multivariate outliers. Outliers were checked within the scores for prior knowledge and learning outcomes using standardized residuals with the cut-off value of 3.29 (Field, 2014; Tabachnick & Fidell, 2014). Several detection methods were used to check multivariate outliers since they have different limitations and tackle different aspects of how an outlier influences the model. These methods were: Mahalanobis distance, Cook's distance, and leverage (Cohen et al., 2003; Field, 2014; Tabachnick & Fidell, 2014). The cut-off score for Mahalanobis distance was 18.47 based on the chi-square value for $p < .001$ with degrees of freedom equal to the number of predictor variables in this case four (Tabachnick & Fidell, 2014). For Cook's distance, the cut-off score was 1 (Cohen et al., 2003; Field, 2014), and the leverage cut-off value was $2(k+1)/n$ (k represents the number of predictors and n the number of participants), in this case, this meant .087.

Besides detecting outliers, a preliminary check was done to see whether any of the regression assumptions were violated, namely: normality, linearity, homoscedasticity, and multicollinearity (Field, 2014; Hayes, 2018). Normality was controlled by looking at whether residuals are centered around the mean of 0 (Field, 2014; Tabachnick & Fidell, 2014), 2014). Linearity and homoscedasticity were visually inspected using the probability plot and the residual scatterplot (Tabachnick & Fidell, 2014). Multicollinearity was checked by looking at whether predictor variables are highly correlated (values above .80) using a correlation matrix (Field, 2014).

The primary data analysis was a parallel mediation analysis using Andy Hayes' PROCESS tool (Hayes, 2018) in IBM SPSS Statistics 27. The analysis used model number four (Hayes, 2018) with the type of video background as the independent variable, the learning outcomes (post-test) score as dependant variable, cognitive load and situational interest as mediators, and prior knowledge as a covariate, as depicted in Figure 4. The model uses 95% confidence intervals and 5000 bootstrap samples (Hayes, 2018). The "Results" section reports the unstandardized regression coefficients.

Figure 4

The statistical diagram of the mediation model.



Results

A total of 114 participants viewed one of the videos and completed the questionnaire. Most participants were aged 40-49 years old (n = 31), followed by the age group 31-39 (n = 26) and the 18-30 year old group (n = 23). The rest of the participants above the age of 50.

Most participants had a bachelor degree (n = 30) or a master's degree (n = 30). For this sample size, the post hoc power analysis with GPower 3.1.9.7 (Faul et al., 2009) was 91% for a medium effect and 18% for a small effect.

The participants were randomly redirected to view either the video with the neutral (gray) background (n= 51) or the video with the authentic background (n = 63).

The low mean score on prior knowledge (M = 2.17, SD = 3.195) indicates that most participants were unfamiliar with the material. Prior knowledge was positively skewed (skewness = 1.901) and heavy-tailed (kurtosis was 2.737). Learning outcomes were negatively skewed (skewness = -1.230) and also heavy-tailed (kurtosis = 1.396). Table 1 displays the mean and standard deviations for all variables of both the control and experimental group.

Table 1

Means and standard deviations per group

	Neutral background	Authentic background	Overall
Participants	51	63	114
Variable name	M (SD)	M (SD)	M(SD)
Prior knowledge	2.35 (3.35)	2.02 (3.08)	2.17 (3.19)
Learning outcomes	10.51 (1.77)	10.19 (1.65)	10.33 (1.70)
Situational interest	3.58 (1.30)	3.17 (1.10)	3.35 (1.21)
Cognitive load	2.68 (0.98)	2.64 (0.76)	2.66 (0.86)

Manipulation Check

The manipulation check using an independent t-test revealed that on average participants found the authentic background (M = 1.78, SD = 0.941) more suitable for the video than the grey background (M = 4.1, SD = 1.591). The difference, 2.32, BCa 95% CI [1.817, 2.833] was significant $t(112) = 9.679$, p = .001. The result shows that the participants perceived the background intended, which means the manipulation was successful.

Outliers and Assumptions Check

One univariate outlier was identified for the prior knowledge variable, which had a value higher than the cut-off value of 3.29 (Field, 2014; Tabachnick & Fidell, 2014). The participant was still included in the analysis since variability within prior knowledge is accounted for in the primary analysis. As for the multivariate outlier detection methods, only the leverage method detected six outliers. Since these outliers were visible in only one of the three measurements, they were initially left in the analysis. The mediation analysis was also rerun without these outliers; the significant differences will be mentioned in the following section.

The following assumptions were checked: normality, linearity, homoscedasticity, and multicollinearity (Field, 2014; Hayes, 2018). The normality and the linearity assumption were not violated; however, considering the shape of the scatterplot, heteroscedasticity was suspected. In order to minimalize its influence on the mediation analysis, the HC3 estimator was used (Hayes & Cai, 2007). The multicollinearity assumption was not violated as none of the variables were too highly correlated; there were no values above .80 using a correlation matrix (Field, 2014). The visualizations and correlation matrix can be found in Appendix D.

Mediation Analysis

A parallel mediation analysis was performed while statistically controlling for prior knowledge to test the mediation effect of situational interest and cognitive load. The main findings of the mediation analysis can be found in Table 2 (results including outliers), Table 3 (results without outliers), and Figure 5 (results including outliers).

Table 2

Regression Coefficients, Standard Errors, and Model Summary Information for Authentic Video Background Parallel Mediator Model with one Covariate- with outliers

	Outcome variable											
	M_1 (Situational interest)				M_2 (Cognitive Load)				Y (Learning outcomes)			
Predictor variable		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*
X (Authentic background)	a_1	-0.438	0.231	.060	a_2	-0.039	0.171	.820	c'	-0.359	0.334	.285
M_1 (Situational interest)		-----	-----	-----		-----	-----	-----	b_1	-0.142	0.115	.220
M_2 (Cognitive Load)		-----	-----	-----		-----	-----	-----	b_2	-0.206	0.188	.275
C (Prior knowledge)	f_1	-0.074	0.032	.021*	f_2	0.013	0.01	.514	*g 1*	0.083	0.038	.034
Constant	i_{M1}	3.763	0.216	<.001	i_{M2}	2.655	.1606	<.001	i_Y	11.38	0.782	<.001
		R^2 =	0.067			R^2 =	0.002				R^2 = 0.56	
		$F(2,111)$ =	3.745,	p = .026		$F(2,111)$ =	0.275,	p = .760		$F(4,109)$ =	2.51	p = .045

Table 3

Regression Coefficients, Standard Errors, and Model Summary Information for Authentic Video Background Parallel Mediator Model with one Covariate- without outliers

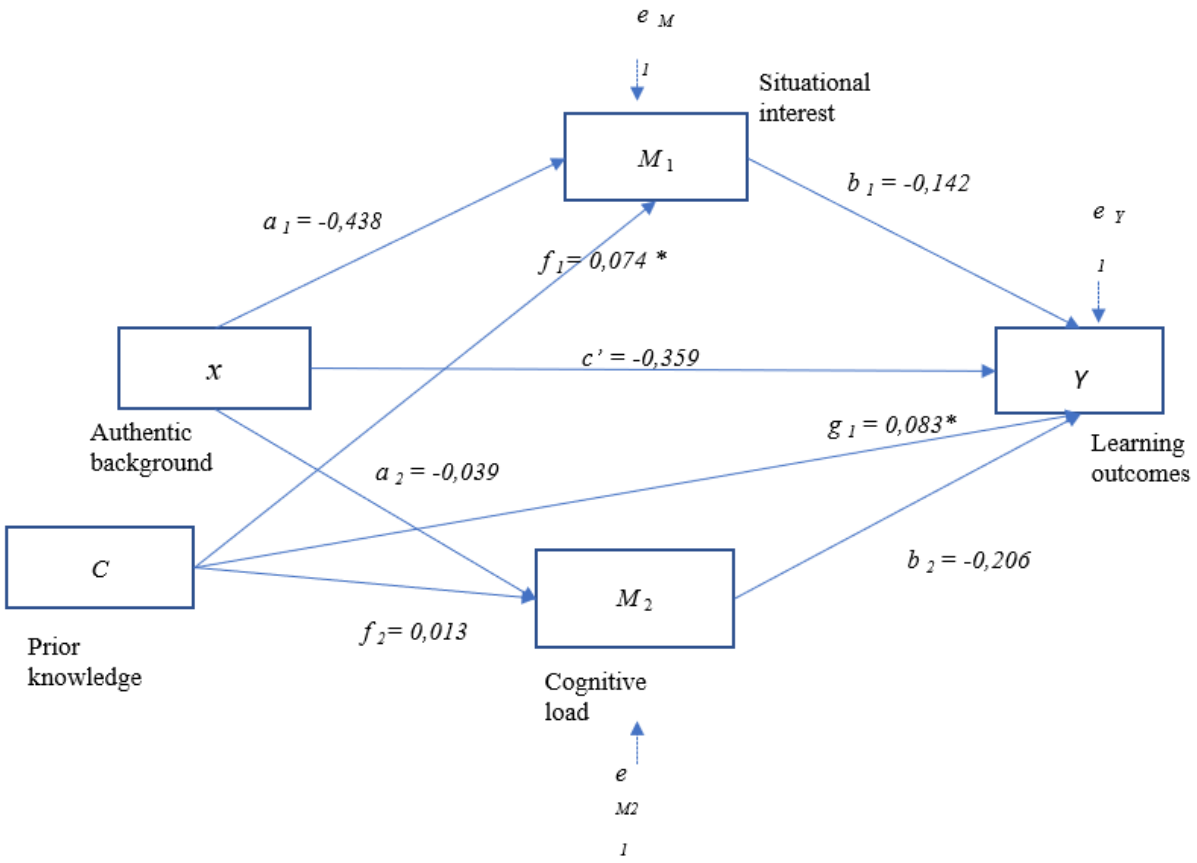
	Outcome variable											
	M_1 (Situational interest)				M_2 (Cognitive Load)				Y (Learning outcomes)			
Predictor variable		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*
X (Authentic background)	a_1	-0.351	0.222	.117	a_2	-0.016	0.164	.918	c'	-0.362	0.339	.288
M_1 (Situational interest)		-----	-----	-----		-----	-----	-----	b_1	-0.184	0.147	.214
M_2 (Cognitive Load)		-----	-----	-----		-----	-----	-----	b_2	-0.273	0.199	.173
C (Prior knowledge)	f_1	-0.094	0.042	.029*	f_2	0.005	0.031	.858	*g 1*	0.058	0.065	.379
Constant	i_{M1}	3.689	0.189	<.001	i_{M2}	2.633	.140	<.001	i_Y	11.71	0.830	<.001
		R^2 =	0.058			R^2 =	0.005				R^2 = 0.051	
		$F(2,105)$ =	3.263	p = .042		$F(2,105)$ =	0.024	p = .976		$F(4,103)$ =	2.51	p = .236

Note. Coefficients are unstandardized. * Reflects $p < .05$.

The differences in significance level are marked in blue.

Figure 5

Statistical diagram of the parallel mediation model with coefficients (results of the analysis with outliers)



Note. Coefficients are unstandardized. * Reflects $p < .05$.

Mediation Effect of Situational Interest (hypothesis 1 and 3)

The results show that the type of background had a negative, although not significant impact on situational interest (a_1 path) b = -0.438 SE = 0.231, p = .060. In turn, situational interest also had a negative, yet not significant effect on learning outcomes (b_1 path) b = -0.142 SE =0.115, p = .220. The total indirect effect of the video background on learning outcomes through the situational interest was not significant, b = 0.062, SE = 0.067, 95% CI [-0.034, 0.226], meaning situation interest is not a significant mediator. Prior knowledge was included as a covariate in the model and was associated with a significantly decreased level

of situational interest b = -0.074, SE = 0.032, p = .021. The result of the analysis without outliers is similar (b = -0.094, SE = 0.042, p = .029). Prior knowledge also correlated with higher learning outcomes, however, this was only the case the analysis without the outliers (b = 0.083, SE = 0.038, p = .034).

Mediation Effect of Cognitive Load (hypothesis 2 and 3)

The type of background was not a significant predictor of experienced cognitive load (a_2 path) b = -0.039 SE = 0.171, p = .820 and in turn the experienced cognitive load did not significantly affect learning outcomes b = -0.206, SE = 0.188, p = .275. The total effect through cognitive load was also positive but not significant b= 0.008, SE = 0.048 95% CI [-0.092, 0.119], meaning cognitive load is also not a significant mediator in the model. Prior knowledge had no significant influence on cognitive load (b = 0.01, SE = 0.019, p = .514).

Direct Effect of the Background on Learning Outcomes

The direct effect of the background on learning outcomes (c' path) for participants experiencing the same levels of situational interest and cognitive load, was not significant b = -0.359, *SE (HC3) = 0.334*, p = .285. And also the total effect (the sum of the direct and total indirect effects) of the video background and learning outcomes was not significant b = -0.288 *SE (HC3)* = 0.326, p = .378. Prior knowledge had a positive and significant effect on learning outcomes (b = 0.083, SE = 0.38, p = .034).

In conclusion, although the three predictors (type of background, cognitive load, and situational interest) explained 56.8 % of the variance (R^2= 56.8 %), there was no significant mediation through cognitive load or situational interest.

Conclusion and Limitations

Conclusion

This study aimed to examine whether cognitive load and situational interest mediate the effect of using an authentic background in an educational video on learning results. Based on previous research, three hypotheses were formulated which described the relationships between these variables. Firstly, it was expected that situational interest would mediate the relation between viewing an authentic video background and learning outcomes. In other words, the expectation was that the use of an authentic video would trigger an increase in situational interest which would have a positive impact on learning outcomes. Secondly, a negative mediation effect of cognitive load in the relation between using an authentic background and learning outcomes was expected. Lastly, it was expected that the mediation of situational interest would outweigh that of the cognitive load, leading to better learning outcomes.

The results of this study's analysis did not support any of the hypotheses: neither situational interest nor cognitive load was a significant mediator of the relationship between the authentic video background and learning outcomes. The use of the authentic video background had no significant effect on learning outcomes. The results neither support nor contradict the cognitive theory of multimedia learning or the cognitive affective theory of learning with multimedia. In this case, the authentic background was neither a seductive detail nor an element that triggered situational interest in the participants. The only significant result and a surprising one was that learners with a high level of prior knowledge did not find the video with the authentic background that interesting: prior knowledge correlated with a lower level of situational interest. The following paragraphs will examine the hypotheses and their implications and positions in relation to previous literature.

First of all, the authentic background did not trigger significantly more situational interest than the neutral background, although the participants who viewed the video with the authentic background found it significantly more suitable than those who viewed the grey background. These findings are not in line with previous results in which emotional design seemed to lead to more interest (S. Park, 2005; Parker et al., 1992; Um et al., 2012).

Specific details of similar studies provide some clues for possible explanations for these results. Endres et al. (Endres et al., 2020) showed that situational interest positively influenced learning outcomes only in later phases of learning. In their study, interest started playing a role after the first ten minutes of the video display. Also, to trigger and maintain situational interest, Endres et al. (2020) used various elements such as warm colors, animations, friendly language, not just one element, such as an authentic background. Although this was considered a limitation in their study (Endres et al., 2020), it might be that a variety of elements is necessary to trigger interest. So this means that only an authentic background might not be enough to trigger situational interest. Also, considering that in the study of Endres et al. (2020), emotional design played a role only during prolonged study, the video might have had to last longer to measure significant effects of situational interest.

Prior knowledge was included in the hypotheses as a covariate, and surprisingly the results of the analysis showed that a higher level of prior knowledge was negatively correlated to situational interest. Situational interest is seen as the interplay of triggered interest and maintained interest. Triggered interest is linked to the design of learning material, which can catch the learner's attention. On the other hand, maintained interest depends on the importance and the meaningfulness of the topic for the learner; in time, this can develop into individual interest (Magner et al., 2014). It might be possible that participants with higher lever prior knowledge already possess a certain amount of individual interest, making them less sensitive to the design features of learning material. An authentic background might

simply no longer be “entertaining” enough to trigger (more) situational interest. If that is the case, learners with a higher level of prior knowledge might need more powerful and diverse triggers to stimulate their interest. However, we can also ask ourselves if educational designers must try and trigger situational interest for these learners. These are all topics that might be worth looking into in the future.

The second hypothesis predicted that cognitive load would negatively mediate the relation between the authentic video background and the learning outcomes. This hypothesis was based on the seductive details; it considered the authentic background a form of distraction that would correlate to an increased cognitive load. The expected consequence of the increased cognitive load would be lower learning outcomes. The analysis showed that the authentic background group did not experience significantly more cognitive load than the neutral background group. The results are not in line with previous research regarding the seductive detail effect (Harp & Mayer, 1997). According to the coherence principle (Mayer & Fiorella, 2014; Mayer & Moreno, 2003), this could be a form of distraction, which would lead to an unnecessary increase in the extraneous cognitive load, in the form of incidental processing: a cognitive process that is not linked to the learning task but the design of the instructional material (Mayer & Moreno, 2003). According to Mayer (Mayer et al., 2008), the more interesting the extraneous details are made, the more detrimental they are to the learner’s capacity to understand the materials. This finding could apply to this study as well, and we could say that the authentic background might not have been seductive enough to increase cognitive load. So, the reason why an authentic background might not have been a situational interest trigger could also be why it did not trigger the seductive details effect.

Another potential reason behind the lack of the seductive details effect is the specific population sample used in this experiment: the participants in this study were school employees, primarily teachers with quite a high level of education. This specific population

sample is probably not very susceptible to the seductive details effect. Learners with low working memory (Sanchez & Wiley, 2006) and low attention control (Rey, 2012) are more vulnerable to seductive details. Although the participants' working memory was not measured, one could assume that their education level indicates a good working memory capacity and attention control. At least for children, it has been shown that working memory is a good predictor of academic success (Alloway et al., 2010; Alloway & Alloway, 2010). Although it is only an assumption, it is plausible that the participants were less vulnerable to seductive details.

The third hypothesis was heavily dependant on the outcome of the first two hypotheses and stated that mediation of situational interest would outweigh that of the cognitive load, resulting in better learning outcomes for the participants who viewed the authentic background. Since neither situational interest, not cognitive load were mediators, this hypothesis also has to be rejected. The results are not in line with previous studies on emotional design, which showed that this could trigger situational interest, resulting in improved learning outcomes (Magner et al., 2014; S. Park, 2005; Um et al., 2012). However, a slight similarity is present with the study of Park et al. (2015), in which they found that positive emotions led to better comprehension and transfer but without a significant influence of design on cognitive load and situational interest. Their cognitive load measurement has similarities to the one used in this current study: both are subjective measurements with only a few items. Park et al. (2015) found this manner of measuring cognitive load less reliable since it might not detect minor changes in cognitive load. Nevertheless, they encouraged future researchers to look further into the relationship between situational interest, cognitive load, and learning outcomes.

All in all, it appears that using an authentic background in an educational video does not lead to significantly better learning outcomes but also does not harm the learning process.

However, the influence of the authentic background, or lack of it, on situational interest perceived by knowledgeable learners emphasizes how much design effects differ depending on learner characteristics. It is important to note that this conclusion needs to be treated with caution since it has certain limitations. These will be described in detail in the following paragraphs.

Limitations

The study has several limitations which need to be taken into account. The first one is the experiment setup. The experiment did not occur in a controlled environment. Because of this, researchers have no insight into whether the participants followed all instructions. For example, although the participants were instructed to close the browser window depicting the video after viewing, whether this happened cannot be guaranteed. There is a possibility that some participants might have reviewed the video during the multiple-choice questionnaire. Also, one cannot say if the participants were interrupted during the experiment or whether they took notes and then reviewed them during the multiple-choice test. Moreover, the time on task was not monitored: participants could pause, rewind and review the video as many times as they wanted. Although convenient, especially considering it took place during a lockdown, the experiment setup undermines the reliability of the learning outcome scores.

Another limitation is the brief period in which the experiment took place. The learning outcomes have been tested directly after viewing the video, which is not entirely an authentic learning situation. The short period of the experiment also means that it fails to test whether knowledge has been stored in the learners' long-term memory. If the following definition of learning is considered: "learning is defined as an alternation in long-term memory. If nothing has altered in long-term memory nothing has been learned" (Paas & Sweller, 2014, p. 30), then simply testing retention and transfer after viewing a video is not a reliable representation of learning. Future research should occur in an authentic learning environment and have a

longer duration to increase reliability; for example, a course with multiple videos followed by a test.

The study also has a low level of generalisability due to the population sample used. As mentioned earlier, the participants in the study were primarily teachers or employees in schools. The results could apply to, for example, adult higher education but not for much for younger students.

Not only the participant sample type but also the size could be an issue. The analysis had enough power for expected medium effects. However, if the expected effects were small, the sample size could have been too small to detect them.

The measurement for cognitive load used in this study has been seen as slightly inferior in terms of validity and objectivity because it requires participants to assess their level of cognitive effort and because they take place after a learning task takes place (Brünken et al., 2003; Mayer, 2019). The subjective measures of cognitive load seem suitable for measuring intrinsic load, such as task difficulty, while other objective measures seem more suitable for measuring extraneous cognitive load (Korbach et al., 2017). This type of cognitive load is the type expected to increase due to seductive details.

Future studies could improve measurement reliability by combining subjective and objective measures of cognitive load in an experimental setting in which participants are monitored. The “lab” experiment could help refine the measurement methods of cognitive load and, this knowledge can then be used in a more prolonged study in an authentic setting. The authentic setting (such as a course) would then provide more generalizable data. It would be interesting to use different emotional designs (for example, animations or an authentic environment) to understand better which features trigger interest while keeping the extraneous cognitive load in check. Furthermore, future research could investigate to what extent prior knowledge and individual interest are linked and whether learners who possess

individual interest still have advantages from educational material which aims to trigger their interest in a particular situation.

References

Alloway, T. P., & Alloway, R. G. (2010). Investigating the predictive roles of working memory and IQ in academic attainment. *Journal of Experimental Child Psychology*, *106*(1), 20–29. https://doi.org/10.1016/j.jecp.2009.11.003

Alloway, T. P., Banner, G. E., & Smith, P. (2010). Working memory and cognitive styles in adolescents' attainment. *British Journal of Educational Psychology*, *80*(4), 567–581. https://doi.org/10.1348/000709910X494566

Astleitner, H., & Wiesner, C. (2004). An integrated model of multimedia learning and motivation. *Journal of Educational Multimedia and Hypermedia*, *13*(1), 3–21.

Bétrancourt, M., & Benetos, K. (2018). Why and when does instructional video facilitate learning? A commentary to the special issue "developments and trends in learning with instructional video." *Computers in Human Behavior*, *89*(August), 471–475. https://doi.org/10.1016/j.chb.2018.08.035

Brünken, R., Plass, J. L., & Leutner, D. (2003). Direct measurement of cognitive load in multimedia learning. *Educational Psychologist*, *38*(1), 53–61. https://doi.org/10.1207/S15326985EP3801_7

Butcher, K. R. (2014). The multimedia principle. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (2nd ed., p. 174). Cambridge University Press.

Chandler, P., & Sweller, J. (1991). Cognitive load theory and the format of instruction. *Cognition and Instruction*, *8*(4), 291–332. https://doi.org/10.1207/s1532690xci0804

Choi, H. H., van Merriënboer, J. J. G., & Paas, F. (2014). Effects of the physical environment on cognitive load and learning: Towards a new model of cognitive load. *Educational Psychology Review*, *26*(2), 225–244. https://doi.org/10.1007/s10648-014-9262-6

Clark, J. M., & Paivio, A. (1991). Dual coding theory and education. *Educational Psychology Review*, *3*(3), 149–210. https://doi.org/10.1007/BF01320076

Creswell, J. W. (2014). *Educational research: Planning, conducting and evaluating quantitative and qualitative research* (4th ed.). Pearson Education Limited.

D'Mello, S., & Graesser, A. (2011). The half-life of cognitive-affective states during complex learning. *Cognition and Emotion*, *25*(7), 1299–1308. https://doi.org/10.1080/02699931.2011.613668

De Koning, B. B., Hoogerheide, V., & Boucheix, J.-M. (2018). Developments and trends in learning with instructional videos. *Computers in Human Behavior*, *89*, 395–398. https://doi.org/10.1016/j.chb.2018.08.055

Eitel, A., Bender, L., & Renkl, A. (2019). Are seductive details seductive only when you think they are relevant? An experimental test of the moderating role of perceived relevance. *Applied Cognitive Psychology*, *33*(1), 20–30. https://doi.org/10.1002/acp.3479

Endres, T., Weyreter, S., Renkl, A., & Eitel, A. (2020). When and why does emotional design foster learning? Evidence for situational interest as a mediator of increased persistence. *Journal of Computer Assisted Learning*, *36*(4), 514–525. https://doi.org/10.1111/jcal.12418

Expósito, A., Sánchez-Rivas, J., Gómez-Calero, M. P., & Pablo-Romero, M. P. (2020). Examining the use of instructional video clips for teaching macroeconomics. *Computers and Education*, *144*(September 2019). https://doi.org/10.1016/j.compedu.2019.103709

Field, A. (2014). *Discovering statistics using IBM SPSS Staistics* (4th ed.). Publications, Sage.

Fiorella, L., Gog, T. Van, Hoogerheide, V., & Mayer, R. E. (2017). It's all a matter of perspective: Viewing first-person video modeling examples promotes learning of an assembly task. *Journal of Educational Physchology*, *109*(5), 653–665. https://doi.org/ht

Fiorella, L., & Mayer, R. E. (2018). What works and doesn't work with instructional video.

Computers in Human Behavior, *89*(July), 465–470. https://doi.org/10.1016/j.chb.2018.07.015

García-Morales, V. J., Garrido-Moreno, A., & Martín-Rojas, R. (2021). The transformation of higher education after the COVID disruption: Emerging challenges in an online learning scenario. *Frontiers in Psychology*, *12*(February), 1–6. https://doi.org/10.3389/fpsyg.2021.616059

Guo, P. J., Kim, J., & Rubin, R. (2014). How video production affects student engagement: An empirical study of MOOC videos. *L@S 2014 - Proceedings of the 1st ACM Conference on Learning at Scale*, 41–50. https://doi.org/10.1145/2556325.2566239

Harp, S. F., & Mayer, R. E. (1997). The role of interest in learning from scientific text and illustrations: On the distinction between emotional interest and cognitive interest. *Journal of Educational Psychology*, *89*(1), 92–102. https://doi.org/10.1037/0022-0663.89.1.92

Hidi, S. (2001). Interest, reading, and learning: Theoretical and practical considerations. *Educational Psychology Review*, *13*(3), 191–209. https://doi.org/10.1023/A:1016667621114

Hidi, S. (2006). Interest: A unique motivational variable. *Educational Research Review*, *1*(2), 69–82. https://doi.org/10.1016/j.edurev.2006.09.001

Hidi, S., & Harackiewicz, J. M. (2000). Motivating the academically unmotivated: A critical issue for the 21st century. *Review of Educational Research*, *70*(2), 151–179. https://doi.org/10.3102/00346543070002151

Hoogerheide, V., Loyens, S. M. M., & van Gog, T. (2016). Learning from video modeling examples: Does gender matter? *Instructional Science*, *44*(1), 69–86. https://doi.org/10.1007/s11251-015-9360-y

Hoogerheide, V., van Wermeskerken, M., Loyens, S. M. 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. https://doi.org/10.1016/j.learninstruc.2016.02.004

Huk, T., Bieger, S., Ohrmann, S., & Weigel, B. (2004). Computer animations in science education: Is background music beneficial or detrimental? *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2004*, *2001*, 4227–4234. http://www.editlib.org/p/11685

Ibrahim, M., Antonenko, P. D., Greenwood, C. M., Ibrahim, M., Antonenko, P. D., & Greenwood, C. M. (2012). Effects of segmenting , signalling , and weeding on learning from educational video. *Learning, Media and Technology*, *37*(3), 220–235. https://doi.org/10.1080/17439884.2011.585993

Javora, O., Hannemann, T., Stárková, T., Volná, K., & Brom, C. (2018). Children like it more but don't learn more: Effects of esthetic visual design in educational games. *British Journal of Educational Technology*, *50*(4). https://doi.org/10.1111/bjet.12701

Kühl, T., Moersdorf, F., Römer, M., & Münzer, S. (2019). Adding emotionality to seductive details—Consequences for learning? *Applied Cognitive Psychology*, *33*(1), 48–61. https://doi.org/10.1002/acp.3477

Lenzner, A., Schnotz, W., & Müller, A. (2013). The role of decorative pictures in learning. *Instructional Science*, *41*(5), 811–831. https://doi.org/10.1007/s11251-012-9256-z

Linnenbrink-Garcia, L., Durik, A. M., Conley, A. M. M., Barron, K. E., Tauer, J. M., Karabenick, S. A., & Harackiewicz, J. M. (2010). Measuring situational interest in academic domains. *Educational and Psychological Measurement*, *70*(4), 647–671. https://doi.org/10.1177/0013164409355699

Lloyd, S. A., & Robertson, C. L. (2012). Screencast tutorials enhance student learning of statistics. *Teaching of Psychology*, *39*(1), 67–71.

https://doi.org/10.1177/0098628311430640

Magner, U. I. E., Schwonke, R., Aleven, V., Popescu, O., & Renkl, A. (2014). Triggering situational interest by decorative illustrations both fosters and hinders learning in computer-based learning environments. *Learning and Instruction*, *29*, 141–152. https://doi.org/10.1016/j.learninstruc.2012.07.002

Mayer, R. E. (2014). Cognitive theory of multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 43–71). Cambridge University Press.

Mayer, R. E. (2017). Using multimedia for e-learning. *Journal of Computer Assisted Learning*, *33*(5), 403–423. https://doi.org/10.1111/jcal.12197

Mayer, R. E. (2019). Thirty years of research on online learning. *Applied Cognitive Psychology*, *33*(2), 152–159. https://doi.org/10.1002/acp.3482

Mayer, R. E., & Anderson, R. B. (1991). Animations need narrations: An experimental test of a dual-coding hypothesis. *Journal of Educational Physchology*, *83*(4), 484–490. https://doi.org/https://doi.org/10.1037/0022-0663.83.4.484

Mayer, R. E., & Fiorella, L. (2014). Principles for reducing extraneous processing in multimedia learning: Coherence, signaling, redudancy, spacial contiguity and temporal contiguity principles. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 279–315). Cambridge University Press.

Mayer, R. E., Griffith, E., Jurkowitz, I. T. N., & Rothman, D. (2008). Increased interestingness of extraneous details in a multimedia science presentation leads to decreased l earning. *Journal of Experimental Psychology: Applied*, *14*(4), 329–339. https://doi.org/10.1037/a0013835

Merkt, M., Lux, S., Hoogerheide, V., van Gog, T., & Schwan, S. (2019). A change of scenery: Does the setting of an instructional video affect learning? *Journal of Educational Psychology*. https://doi.org/10.1037/edu0000414

Merkt, M., Weigand, S., Heier, A., & Schwan, S. (2011). Learning with videos vs. learning with print: The role of interactive features. *Learning and Instruction*, *21*(6), 687–704. https://doi.org/10.1016/j.learninstruc.2011.03.004

Mitchell, M. (1993). Situational interest: Its multifaceted structure in the secondary school mathematics classroom. *Journal of Educational Psychology*, *85*(3), 424–436. https://doi.org/10.1037/0022-0663.85.3.424

Moreno, R. (2007). Optimising learning from animations by minimising cognitive load: cognitive and affective consequences of signalling and segmentation methods. *Applied Cognitive Psychology*, *21*(September 2007), 765–781. https://doi.org/10.1002/acp.1348

Moreno, R. (2010). Cognitive load theory: more food for thought. *Instructional Science*, *38*(2), 135–141. https://doi.org/10.1007/s11251-009-9122-9

Moreno, R., & Mayer, R. E. (2000). A coherence effect in multimedia learning : The case for minimizing irrelevant sounds in the design of multimedia instructional messages. *Journal of Educational Psychology*, *92*(1), 117–125. https://doi.org/10.1037//0022

Paas, F. G. W. C., & Sweller, J. (2014). Implications of cognitive load theory for multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 27–41). Cambridge University Press.

Paas, F. G. W. C., & Van Merrienboer, J. J. G. (1994). Instructional control of cognitive load in the training of complex cognitive tasks. *Educational Psychology Review*, *6*(4), 351–371. https://doi.org/10.1007/bf02213420

Park, B., Knörzer, L., Plass, J. L., & Brünken, R. (2015). Emotional design and positive emotions in multimedia learning: An eyetracking study on the use of anthropomorphisms. *Computers and Education*, *86*, 30–42. https://doi.org/10.1016/j.compedu.2015.02.016

Park, B., Moreno, R., Seufert, T., & Brünken, R. (2011). Does cognitive load moderate the

seductive details effect? A multimedia study. *Computers in Human Behavior*, *27*(1), 5–10. https://doi.org/10.1016/j.chb.2010.05.006

Park, B., Plass, J. L., & Brünken, R. (2014). Cognitive and affective processes in multimedia learning. *Learning and Instruction*, *29*, 125–127. https://doi.org/10.1016/j.learninstruc.2013.05.005

Park, S. (2005). *The effects of seductive augmentation and agent role on learning interest, achievement, and attitude*. Florida State University.

Parker, L. E., Lepper, M. R., Bartholomew, K., Cordova, D., & Mayer, J. (1992). Effects of fantasy contexts on children ' s learning and motivation: Making learning more fun. *Journal of Personality and Social Psychology*, *62*(4), 625–633. https://doi.org/10.1037/0022-3514.62.4.625

Plass, J. L., Heidig, S., Hayward, E. O., Homer, B. D., & Um, E. (2014). Emotional design in multimedia learning: Effects of shape and color on affect and learning. *Learning and Instruction*, *29*, 128–140. https://doi.org/10.1016/j.learninstruc.2013.02.006

Plass, J. L., & Kalyuga, S. (2019). Four ways of considering emotion in cognitive load theory. *Educational Psychology Review*, *31*(2), 339–359. https://doi.org/10.1007/s10648-019-09473-5

Rackaway, C. (2012). Video killed the textbook star? Use of multimedia supplements to enhance student learning. *Journal of Political Science Education*, *8*(2), 189–200. https://doi.org/10.1080/15512169.2012.667684

Renninger, S., & Hidi, K. A. (2006). The four-phase model of interest development. *Educational Psychologist*, *41*(2), 111-127,. https://doi.org/10.1207/s15326985ep4102

Rey, G. D. (2012). A review of research and a meta-analysis of the seductive detail effect. *Educational Research Review*, *7*(3), 216–237. https://doi.org/10.1016/j.edurev.2012.05.003

Rey, G. D. (2014). Seductive details and attention distraction - An eye tracker experiment. *Computers in Human Behavior*, *32*, 133–144. https://doi.org/10.1016/j.chb.2013.11.017

Salina, L., Ruffinengo, C., Garrino, L., Massariello, P., Charrier, L., Martin, B., Favale, M. S., & Dimonte, V. (2012). Effectiveness of an educational video as an instrument to refresh and reinforce the learning of a nursing technique: a randomized controlled trial. *Perspectives on Medical Education*, *1*(2), 67–75. https://doi.org/10.1007/s40037-012-0013-4

Sanchez, C. A., & Wiley, J. (2006). An examination of the seductive details effect in terms of working memory capacity. *Memory and Cognition*, *34*(2), 344–355. https://doi.org/10.3758/BF03193412

Schneider, S., Nebel, S., & Rey, G. D. (2016). Decorative pictures and emotional design in multimedia learning. *Learning and Instruction*, *44*, 65–73. https://doi.org/10.1016/j.learninstruc.2016.03.002

Sitzmann, T., & Johnson, S. (2014). The paradox of seduction by irrelevant details: How irrelevant information helps and hinders self-regulated learning. *Learning and Individual Differences*, *34*, 1–11. https://doi.org/10.1016/j.lindif.2014.05.009

Stockwell, B. R., Stockwell, M. S., Cennamo, M., & Jiang, E. (2015). Blended Learning Improves Science Education. *Cell*, *162*(5), 933–936. https://doi.org/10.1016/j.cell.2015.08.009

Sweller, J. (2020). Cognitive load theory and educational technology. *Educational Technology Research and Development*, *68*(1), 1–16. https://doi.org/10.1007/s11423-019-09701-3

Sweller, J., van Merriënboer, J. J. G., & Paas, F. G. W. C. (2019). Cognitive architecture and instructional design: 20 years later. *Educational Psychology Review*, *31*(2), 261–292. https://doi.org/10.1007/s10648-019-09465-5

Tabachnick, B. G., & Fidell, L. S. (2014). *Using multivariate statistics*. Pearson Education Limited.

Um, E. R., Plass, J. L., Hayward, E. O., & Homer, B. D. (2012). Emotional design in multimedia learning. *Journal of Educational Psychology*, *104*(2), 485–498. https://doi.org/10.1037/a0026609

Appendices

Appendix A: Information Letter for Participants

Inleiding

Geachte mevrouw/heer,

Wij vragen u om mee te doen aan een wetenschappelijk onderzoek. Meedoen is vrijwillig. Om u mee te laten doen, hebben wij wel uw schriftelijke toestemming nodig.

Voordat u beslist of u wilt meedoen aan dit onderzoek, krijgt u uitleg over wat het onderzoek inhoudt. Lees deze informatie rustig door en indien u vragen heeft kunt u contact opnemen met: (wordt ingevuld na het verkrijgen van het OU-emailadres).

1. Doel van het onderzoek

Het doel van het onderzoek is het in kaart brengen van de informatieverwerking bij het leren met instructievideo's. Deze informatie is van belang bij het ontwerpen van instructievideo's.

2. Achtergrond van het onderzoek

Het leren met instructievideo's wordt in het hedendaagse onderwijs veel ingezet. Er is in de afgelopen jaren beginnend onderzoek gedaan naar het ontwerpen van instructievideo's om het effectief leren te optimaliseren. Er zijn richtlijnen ontwikkeld voor het ontwerpen van instructievideo's, maar deze richtlijnen zijn nog niet compleet. Daardoor is aanvullend onderzoek nodig.

3. Wat meedoen inhoudt en wat wordt er van u verwacht

Het onderzoek vindt plaats online en bestaat uit drie onderdelen Er zit geen tijdslimiet op de deelname aan het onderzoek; de gemiddelde deelname zal 15 tot 20 minuten bedragen. De onderdelen in chronologische volgorde zijn:

- *Vragenlijst voorkennis en demografische vragen:* In deze vragenlijst stellen wij u een paar korte vragen om uw voorkennis in kaart te brengen. Ook stellen wij u een aantal vragen over uw leeftijd, geslacht en opleidingsniveau.
- *Instructievideo:* De instructievideo bestaat uit een onlinevideo waar een instructiegever uitleg gaat geven over Gletsjers. De video duurt ongeveer 7 minuten.
- *Vragenlijst:* De vragenlijst bestaat uit een kennistest bestaande uit 12 meerkeuzevragen. De vragen in de kennistest zijn gebaseerd op de inhoud van de instructievideo. Gevolgd door vragen over cognitieve load, interesse en een algemene evaluatie.

4. Mogelijke voor- en nadelen

U heeft zelf geen voordeel van deelname aan dit onderzoek. Het zal van u zelfs de nodige tijd vragen om mee te doen. Wij hopen echter dat het onderzoek wel nuttige informatie kan geven over het verbeteren van de richtlijnen voor het ontwerpen van instructievideo's.

2. Als u niet wilt meedoen of wilt stoppen met het onderzoek

U beslist zelf of u meedoet aan het onderzoek. Deelname is vrijwillig. Als u niet wilt deelnemen heeft dat geen nadelige gevolgen voor u. Als u wel meedoet, kunt u zich altijd bedenken en toch stoppen, ook tijdens het onderzoek door simpelweg de vragenlijst te sluiten.

6. Einde van het onderzoek

Uw deelname aan het onderzoek stopt als u de kennistest en de vragenlijst heeft ingevuld en ingestuurd. U kunt deelnemen aan het onderzoek tot 15 februari 2021. De uitkomsten van het onderzoek worden in een tweetal masterthesis' beschreven en zijn na ongeveer 4 maanden te vinden op: https://research.ou.nl/en/studentTheses .

7. Gebruik en bewaren van uw gegevens

Voor dit onderzoek worden er persoonsgegevens verzameld, gebruikt en bewaard. Het gaat om uw leeftijd, geslacht en opleidingsniveau. Het verzamelen, gebruiken en bewaren van uw gegevens is nodig om de vragen die in dit onderzoek worden gesteld te kunnen beantwoorden. De uitkomsten van het onderzoek zullen worden gedeeld met collega's. De gegevens die worden gedeeld bevatten geen informatie die tot u te herleiden is. Ook in rapporten en publicaties over het onderzoek zijn de gegevens niet tot u te herleiden.

Vertrouwelijkheid van uw gegevens

Om uw privacy te beschermen krijgen uw gegevens een code. De gevraagde gegevens worden geanonimiseerd, dat houdt in dat uw antwoorden niet tot u te herleiden zijn. Uw gegevens worden op deze wijze versleuteld. De sleutel van de code blijft veilig opgeborgen, binnen de Open Universiteit. Personen die toegang krijgen tot de niet-versleutelde informatie zijn: Christian M. Stracke, Halszka Jarodzka, Andra Gherghiceanu en Lisanne de Koning.

Toegang tot uw gegevens voor controle

Om te kunnen beoordelen of het onderzoek op een betrouwbare wijze is uitgevoerd, kunnen leden van een visitatiecommissie inzage krijgen in de niet-versleutelde informatie.

Bewaartermijn gegevens

Uw gegevens moeten 10 jaar worden bewaard door de Open Universiteit.

Meer informatie over uw rechten bij verwerking van gegevens

Voor algemene informatie over uw rechten bij verwerking van uw persoonsgegevens kunt u de website van de Autoriteit Persoonsgegevens raadplegen. De privacy disclaimer van de Open Universiteit vindt u via www.ou.nl/privacy .

8. Geen vergoeding voor meedoen

Voor de deelname aan dit onderzoek geldt geen vergoeding.

9. Heeft u vragen?

Bij vragen kunt u contact opnemen met het onderzoeksteam. (OU e-mailadres zal hiervoor gebruikt worden)

10. Ondertekening toestemmingsformulier

Wanneer u voldoende bedenktijd heeft gehad, wordt u gevraagd te beslissen over deelname aan dit onderzoek; dit kan uiterlijk tot 15 februari 2021. Uw toestemming wordt gevraagd bij aanvang van de digitale vragenlijst.

Door uw toestemming geeft u aan dat u de informatie heeft begrepen en instemt met deelname aan het onderzoek.

Bijlage A: Contactgegevens

Onderzoekers:

Andra Gherghiceanu: andra.gherghiceanu@gmail.com

Lisanne de Koning: lisanne.dekoning@gmail.com

Hoofdonderzoekers:

Halszka Jarodzka: halszka.jarodzka@ou.nl

Christian Stracke: christian.stracke@ou.nl

Klachten: https://www.ou.nl/en/klachten-en-geschillen

Functionaris voor de Gegevensbescherming van de instelling: Ms. S.E.M. van der Westen LLB (e-mail: FG@ou.nl, telefoon: 045-5762431)

Appendix B: Transcript of the Educational Video

Indrukwekkend, mooi, grimmig, gevaarlijk maar ook bedreigd- Deze woorden kunnen allemaal worden gebruikt om gletsjers te omschrijven. Maar wat zijn ze, hoe zijn ze gevormd en wat is hun toekomst?

Een gletsjers is een soort ijsrivier die langzaam bergafwaarts stroomt met een snelheid tussen 45 en 400 meter per jaar. De grootste gletsjer ter wereld ligt in Antartica;(slide 1) de Lambert Fisher Glacier (animatie in slide 1). Deze gletsjer is wel 400 kilometer lang en 100 kilometer breed. De gletsjer die het record van de grootste groei heeft ligt in Pakistan (slide 2) de Kutiah Lungma Gletsjer (animatie in slide 2). De Kuthia Lungma gletsjer groeide met meer dan 12 kilometer in drie maanden .

Gletsjers ontstaan door een heel simpele reden: door de accumulatie van sneeuw door de seizoenen heen. Sneeuw die in de winter valt en niet smelt in de zomer wordt in de volgende winter seizoen bedekt door een nieuwe laag. De sneeuwkristallen veranderen in firn, dat ijskorrels zijn, en daarna in gletsjerijs. Op dit plaatje zie je een schematische dwarsdoorsnede. (slide 3)

Als dit proces zich jarenlang herhaalt ontstaat er langzaam een massa ijs en sneeuw die bergafwaarts beweegt en zo het hele landschap verandert. Op die manier zijn bijvoorbeeld de fjorden in Noorwegen (slide 4) en de spitse bergtoppen van de Alpen (slide 4 animatie 1) ontstaan.

Gletsjers zijn constant in verandering onder de invloed van sneeuwaccumulatie en temperatuurswisselingen. Door deze constante bewegingen en obstakels in het terrein ontstaan bijzondere formaties zoals (slide 5):

- Spleten (slide 5, animatie 1)
- bergschrund (slide 5, animatie 2)
- ijsvallen (slide 5, animatie 3)

- seracs en (slide 5, animatie 4)
- moraines.

Spleten zijn breuken in het ijs die ontstaan door de bewegingen en de bochten.. Hoe steiler de hellingshoek van de gletsjer hoe meer druk op het ijs komt dus hoe meer spleten worden gevormd en hoe breder ze kunnen zijn. Als een gletsjer een bocht maakt of als twee gletsjers bij elkaar komen ontstaan er meer spleten. Op deze dwarsdoorsnede van een gletsjer zie je de spleten (slide 6 animatie & slide).
(slide 8 animatie) Een wat bijzondere soort spleet is een bergschrund deze komt altijd voor op de hogere gelegen deel van een gletsjer. Op de plek waar deze van de rots afbreekt door zijn afstromende beweging van de ijs en, in de zomer, ook door de hogere temperatuur van de rots(slide 9).

Sommige delen van een gletsjer kunnen ‘aper’ zijn, wat wil zeggen dat er geen sneeuw meer ligt op het ijs (slide 10, animatie 1). Andere delen kunnen daarentegen nog bedekt zijn met sneeuw, waardoor de spleten verborgen liggen onder sneeuwbruggen (slide 10, animatie 2). In de zomer of na recente sneeuwval kunnen deze sneeuwbruggen gevaarlijk zijn (slide 11): ze zijn namelijk soms niet sterk genoeg om het gewicht van één persoon te houden. Daarom wordt sterk afgeraden om alleen, of zonder touw en reddingsmateriaal op een niet-apere, dus met sneeuw bedekte gletsjer te lopen.

Op deze foto zie je een ijsval (slide 12), deze wordt gevormd op de plekken waar een gletsjer veel smaller of steiler stroomt. Hier bevinden zich veel meer spleten, vaak groter en omringd door enorme, vaak instabiele blokken ijs (slide 12, animatie 1),dit zijn seracs. Dit is, vooral in de warme middagzon, de meeste gevaarlijke plek van een gletsjer. Hier hoor je de gletsjer kraken, breken…leven.

Morenen (slide 13) markeren de zijkanten en het eind van een gletsjer. Ze zijn een ophoping van puin die de gletsjer heeft meegenomen bij de erosie van omringende rotsen (slide 14).

Het ijs van een gletsjer kan wel duizenden jaren oud zijn en is een rijke bron van informatie voor wetenschappers. Het ijs geeft inzicht in het verleden van ons klimaat en is een basis voor prognoses voor de toekomst. De toekomst van gletsjers ziet er somber uit. Door CO_2 en andere broeikasgassen stijgt de temperatuur. Hierdoor ontstaat een vicieuze cirkel die leidt tot het 'terugtrekken', het kleiner worden, van gletsjers: er smelt meer ijs in de zomer dan er in het winterseizoen aangroeit. Ook wordt bij sommige gletsjers een steeds grotere ijs oppervlakte niet meer bedekt door een beschermende laag sneeuw die de zon reflecteert, wat ook weer leidt tot een snellere smelting. In Groenland en Antarctica leidt de stijgende temperatuur van de oceanen tot het smelten van gletsjers.

In Europa trekken alle gletsjers zich terug sinds 1850 maar dit proces is in de afgelopen 50 jaar versneld. Ze hebben 30 tot 40% van hun oppervlakte verloren en hun volume is gehalveerd. Op deze foto's (slide 15) van een gletsjer in Italië zie je duidelijke het verschil tussen de bovenste foto uit de jaren dertig en de onderste foto die ongeveer 80 jaar later genomen is.

Ook in Nieuw Zeeland is de oppervlakte met 25% afgenomen en er is voorspeld dat de gletsjers in West Canada wel 70% van hun volume zullen verliezen voor 2100.

Dit is een zeer zorgwekkend fenomeen omdat het smelten van gletsjers, ook voor ons land, vergaande consequenties heeft. Het smelten van de gletsjers draagt immers bij aan de stijging van het zeeniveau.

Voor de getroffen berggebieden brengt het smelten van de gletsjers niet alleen een verhoogd risico op rotsval en erosie met zich mee, maar ook een flinke verandering in hun waterhuishouding.

En tot slot zorgt het smelten van de gletsjers er natuurlijk voor dat het mooie berglandschap een stukje van zijn magische sfeer verliest……

Bedankt voor het kijken naar deze informatievideo over gletsjers.

U mag nu de video sluiten en terugkeren naar het tabblad met de vragenlijst behorende bij deze video.

Appendix C: Questionnaire

Pretest

Je gaat zo dadelijk een filmpje over gletsjers bekijken. Na het kijken van het filmpje maak een kennistoets. We willen graag weten hoeveel je geleerd hebt van het filmpje en hoeveel je vooraf al wist. Daarom vragen we je om eerst de onderstaande vraag te beantwoorden:

Lambert Fisher	
Kutiah	
Firn	
Spleten	
Bergschrund	
Ijsvallen	
Seracs	
Morenen	
Aper	

Beoordeling: Score 0-18; Per onderdeel 0 – 2 punten te behalen; uitwerking: 1 element genoemd= 1 punt; 2 of meer elementen= 2 punten

Rubric:

Lambert Fisher	• Grootste ter wereld • Antartica
Kuthia	• Snelste groei • Pakistan

Firn	• ijskorrels (uit sneeuwkristallen) • middelste laag
Spleten	• breuken in (gletsjer)ijs • ontstaan door beweging (en/of bochten)
Bergschrund	• (gletsjerspleet) op hoger deel • ontstaat waar de gletsjer van de rots breekt
Ijsvallen	• soort waterval van ijs • ontstaat waar gletsjer smaller of steiler stroomt
Seracs	• instabiele blokken ijs (gevaarlijk) • ontstaan bij ijsvallen
Morenen	• gletsjerpuin • aan einde (of zijkant) van gletsjer
Niet-aper	• plek op de gletsjer met sneeuw • gevaarlijker dan apere plekken

Demografische vragen

D1 Wat is uw geslacht?

- Man
- vrouw
- anders

D2 Hoe oud bent u?

- 18-30
- 31-39
- 40-49
- 50-59
- 60 of ouder

D3 Wat is het hoogste opleidingsniveau dat u hebt voltooid of de hoogste graad die u hebt behaald?

- Lager dan middelbareschooldiploma
- Middelbareschooldiploma of vergelijkbaar
- HBO of universiteit maar geen diploma
- Bachelor degree
- Master degree
- Kandidaats/PhD

Posttest vragen

The questions include the correct answer (in bold letters) and the code it had in Limesurvey

PO1 Waar ligt de Kuthia Lungma gletsjer?

- Antarctica
- **Azië**
- Europa
- Zuid-Amerika

PO2 Wat is bijzonder aan de Kuthia Lungma gletsjer?

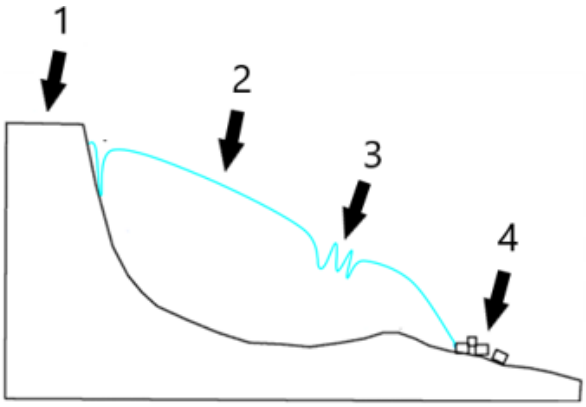
- Het is de grootste gletsjer ter wereld.
- **Het is de gletsjer met het record van grootste groei.**
- Het is de langste gletsjer ter wereld.
- Het is de gletsjer die het snelst smelt.

PO3 Hoe ontstaan gletsjers?

- Door de bevriezing van rivieren op bergen.
- **Door de accumulatie van sneeuw door de seizoenen heen.**
- Door de bevriezing van meren op bergen.
- Door de hoogte van de bergen

PO4 Bekijk de afbeelding. Welke pijl geeft de ‘spleten’ aan?

- Pijl 1
- Pijl 2
- **Pijl 3**
- Pijl 4

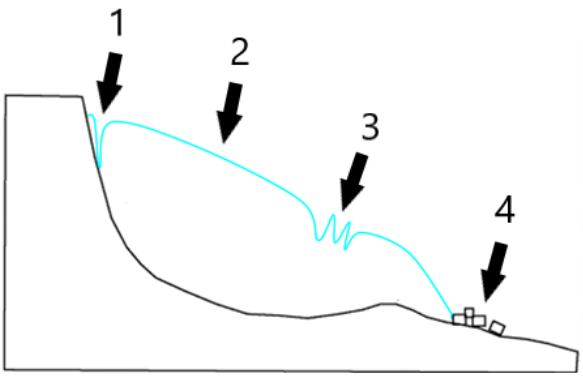


PO5 Hoe ontstaan spleten?

- Door de bewegingen die de gletsjer maakt, de druk en de hoeveelheid sneeuwval.
- Door de bewegingen die de gletsjer maakt, de hoeveelheid ijs en sneeuwval.
- Door de hoogte, de druk en de bochten die hij tegenkomt.
- **Door de bewegingen die de gletsjer maakt, de druk en de bochten die hij tegenkomt.**

PO06 Bekijk de afbeelding. Welke pijl geeft de ‘bergschrund’ aan?

- **Pijl 1**
- Pijl 2
- Pijl 3
- Pijl 4



PO7 Hoe ontstaat de “bergschrund”?

- Door steenval.
- **Voor de afstromende beweging van het ijs en, in de zomer, ook door de hogere temperatuur van de rots.**
- Deze wordt gevormd op de plekken waar een gletsjer veel smaller of steiler stroomt.
- Het is een opeenhoping van puin dat de gletsjer heeft meegenomen bij de erosie van de omringde rotsen.

PO8 Bekijk foto A. Welke term past het beste bij de foto?

Foto A

- Morenen
- **Serac**
- Bergschrund
- Spleet

PO9 Bekijk foto B. Welke term past het beste bij de foto?

Foto B

- Bergschrund
- Ijsval
- Seracs
- **A4 Morenen**

PO10 Waarom wordt het afgeraden om alleen en zonder touw en reddingsmateriaal op een niet-apere gletsjer te lopen?

- **Omdat je de spleten niet kan zien en omdat de sneeuwbruggen zwak kunnen zijn.**
- Omdat het gletsjerijs glad kan zijn.
- Zodat mensen beter nadenken voordat zij een gletsjer beklimmen.
- Omdat het verplicht is om reddingsmateriaal bij je te hebben op een gletsjer.

PO11 Op foto C en D zie hoe een gletsjer in Italië wordt ingepakt met witte doeken. Foto D is een close-up van het doek. Waarom wordt dit gedaan?

Foto C

Foto D

- Om het uitzicht te verbeteren.
- **Om de zonnestralen te weerkaatsen en zo het gletsjerijs te beschermen.**
- Om de gletsjers stevig te maken, zodat er geen ijs valt.
- Om de gletsjer veiliger te maken, zodat wandelaars niet in een spleet kunnen vallen.

PO12 “De Volkskrant” 19 juni 2019:

Zo’n 1,6 miljard mensen in landen als India, Pakistan en China zijn geheel of gedeeltelijk afhankelijk van water uit de Himalaya voor irrigatie (landbouw), waterkracht en drinkwater.

Is er een verband tussen dit stukje tekst en gletsjers?

- Er is geen verband, omdat gletsjers niet genoemd worden in het stukje uit Volkskrant.
- **Het water uit de Himalaya is grotendeels afhankelijk van gletsjers; als gletsjer grote veranderingen ondergaan, zal dit een impact hebben op de waterhuishouding van deze landen.**
- Er is geen verband, de gletsjers in landen als India, Pakistan en China zijn niet groot.
- Er is geen verband, het water komt mogelijk uit gletsjers van de Himalaya, maar er is minder vervuiling in deze landen, dus smelten de gletsjers minder hard.

Cognitive load, situational interest & manipulatie check vragen

CO1 Het begrijpen van de video was …….

1 2 3 4 5 6 7

Heel makkelijk Heel moeilijk

CO2 Het heeft me ….. mentale inspanning gekost om de video te volgen.

1 2 3 4 5 6 7

Heel weinig Heel veel

SI1 De presentatie in de video was boeiend.

1 2 3 4 5 6 7

Helemaal mee eens Helemaal niet mee eens

SI2 De video had elementen die mijn aandacht hebben getrokken.

1 2 3 4 5 6 7

Helemaal mee eens Helemaal niet mee eens

SI3 De video was zo boeiend dat het makkelijk was om aandachtig te blijven kijken.

1 2 3 4 5 6 7

Helemaal mee eens Helemaal niet mee eens

MC De setting van de video past goed bij het onderwerp.

1 2 3 4 5 6 7

Helemaal mee eens Helemaal niet mee eens

Appendix D: Figures, table of data analysis assumptions check

Figure 6

Histogram of residuals- test for normally distributed errors

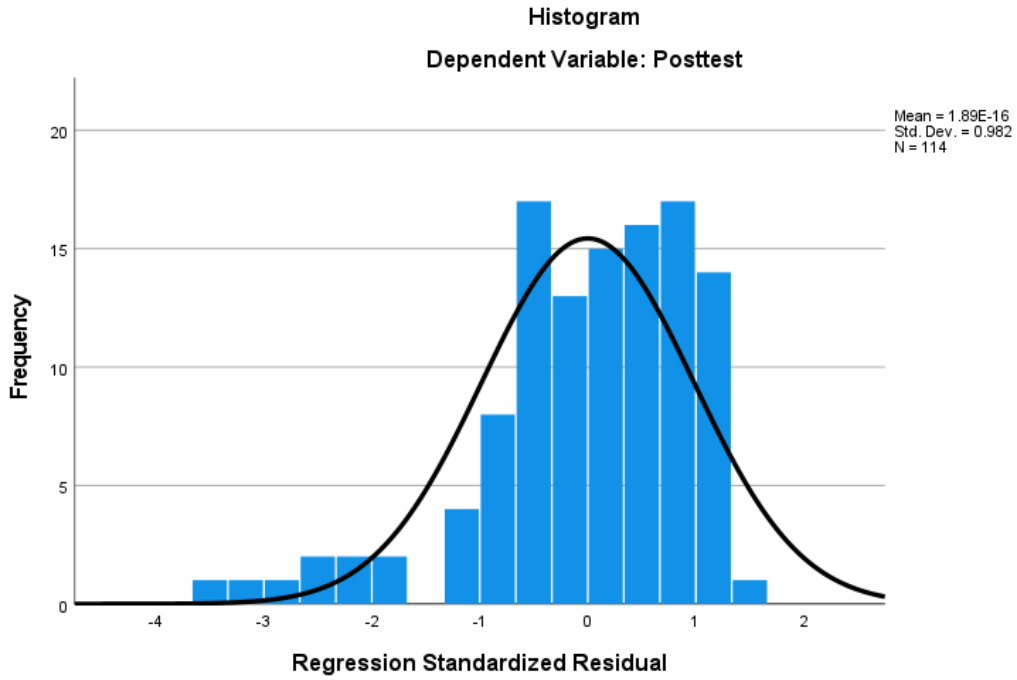


Figure 7

P-P plot for testing linearity assumption

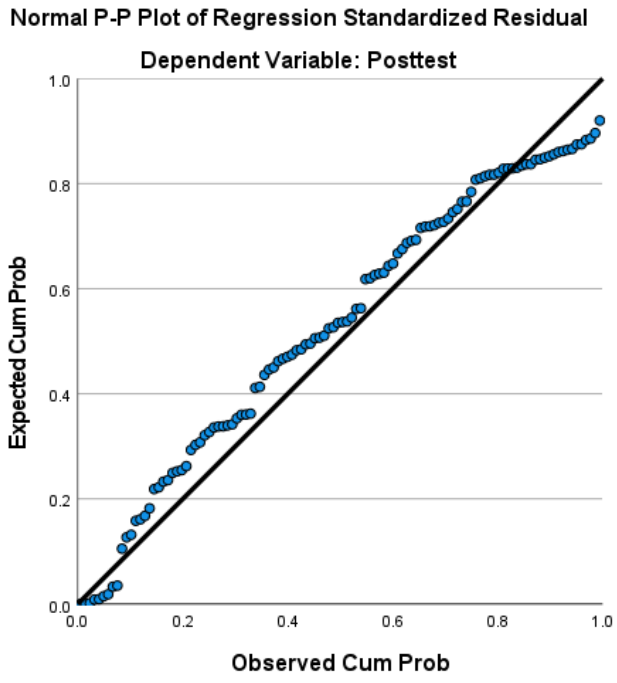


Figure 8

Standardized residual scatter plot for testing homoscedasticity

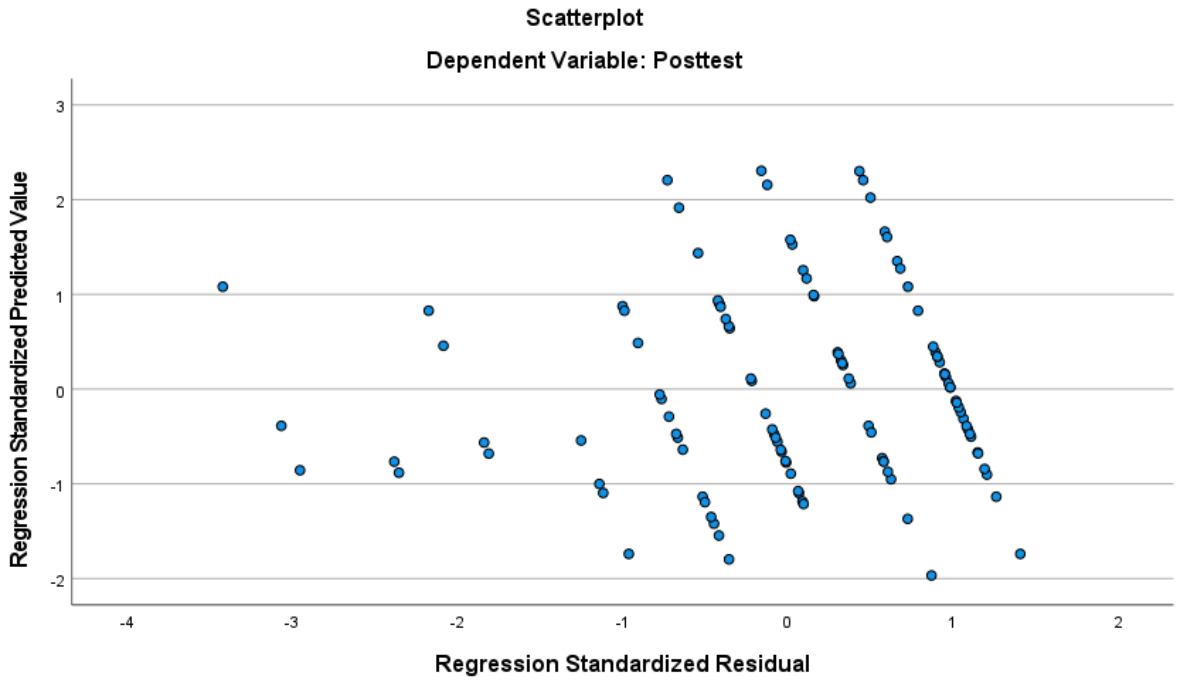


Figure 9

Correlation matrix- multicollinearity test

Correlations

		Backgr dummy variable	Mean_SI	Mean_CL	Pretest total score
Backgr dummy variable	Pearson Correlation	1	-.171	-.025	-.053
	Sig. (2-tailed)		.070	.791	.578
	N	114	114	114	114
Mean_SI	Pearson Correlation	-.171	1	-.065	-.187*
	Sig. (2-tailed)	.070		.495	.046
	N	114	114	114	114
Mean_CL	Pearson Correlation	-.025	-.065	1	.049
	Sig. (2-tailed)	.791	.495		.602
	N	114	114	114	114
Pretest total score	Pearson Correlation	-.053	-.187*	.049	1
	Sig. (2-tailed)	.578	.046	.602	
	N	114	114	114	114

*. Correlation is significant at the 0.05 level (2-tailed).