What Homework Study Strategies Do Children Use and Can Vlogging Help to Make Homework More Effective and Motivating?

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ABSTRACT

Prior research has shown that the effectiveness of homework in primary education is mixed possibly because students use ineffective study strategies. However, it is unclear what students do when they are in control. So, the first aim of this study was to identify which study strategies students choose when regulating their homework approach and how effective they perceive these strategies. Additionally, previous laboratory research with older students and a homework field study with primary school students has shown that vlogging can be effective in stimulating learning and motivation. Thus, the second aim was to identify the effect of vlogging on students' learning outcomes and intrinsic motivation compared with students who chose their homework approach. The study included sixty primary school students (ages 9-13) randomly assigned to a Vlogging or Choosing Condition. The Vlogging Condition learned a text over the weekend by vlogging. The Choosing Condition chose their own study strategy. A questionnaire revealed that primary school students mostly rely on ineffective study strategies, perceiving these as effective. No significant differences in learning outcomes and perceived relatedness were observed between both conditions. However, participants in the Choosing Condition significantly perceived more competence and autonomy than participants in the Vlogging Condition.

Keywords: Homework; Study strategies; Vlogging; Learning; Competence; Autonomy; Relatedness.

INTRODUCTION

Homework is an important part of children's daily lives across all educational tracks (Cooper et al., 2006). Early definitions argue that homework has the potential to extend learning processes commenced in the classroom by providing opportunities for practicing skills, increasing learning-task involvement, and fostering self-discipline and responsibility (Epstein, 1988; Vatterott, 2018). More recently, homework is seen as a task assigned to students by school teachers meant to be carried out during noninstructional time, because students often do homework during school hours (Bembenutty, 2011). Teachers must also plan homework for students with a purpose (Syla, 2023).

However, homework has been a subject of debate for a long time (Tynan-Wood, 2018), and remains a source of friction more often than any other teaching activity (Cooper, 2007). This debate involves questions about the effectiveness of homework and what the right amount of homework should be (Armes, 2011; Tynan-Wood, 2018). In addition, students often see completing homework as something negative (e.g., punishment; Burris & Snead, 2017).

Correlational research on the relationship between homework use and academic achievement shows mixed results. Various meta-analyses found small, positive effects (Bas et al., 2017; Hattie, 2014), however, these positive effects depend on factors, such as the domain and nature of homework, grade level, and time spent on homework (Hattie, 2014). Especially in primary education, the effect of homework on academic achievement appears to be limited (Cooper et al., 2006; Jerrim et al., 2018).

These limited effects probably arise because students use suboptimal study strategies (Dirkx et al., 2019), or become disengaged while doing homework (Flunger et al., 2015). It seems that current student approaches are not yielding favorable results, however, it is not entirely clear what students do while doing homework. Therefore, the first aim of this study is to shed light on what students do if they can autonomously approach a homework assignment.

Vlogging appears to be a homework study strategy that could enhance students' learning outcomes and intrinsic motivation. Vlogging is an activity in which students create an instructional video by teaching (fictitious) others (Hoogerheide et al., 2016). Laboratory research with older students found that students develop deeper and more persistent understandings of the content (Fiorella & Mayer, 2013), long-term learning can be facilitated (Fiorella & Mayer, 2014) and transfer

performance may improve when explaining content to others (Hoogerheide et al., 2014). Similar effects of vlogging for primary school students may not be guaranteed because they differ in (meta)cognitive abilities compared to older students (Roebers, 2017). However, a homework field study with primary school students found that vlogging was perceived as more enjoyable than restudying or summarizing, and improved test performance to a greater extent compared to restudying (Hoogerheide et al., 2019). In addition, primary school students are heavily engaged in creating vlogs in their free time. Therefore, the second aim of this study is to explore whether vlogging improves learning outcomes and intrinsic motivation by comparing students who are instructed to create a vlog as homework with students who choose their homework approach.

THEORETICAL FRAMEWORK

Analyzing the Homework Problem: Which Study Strategies Do Primary School Students Use?

Homework is widely used in today's Dutch educational system, starting in grade 6 of primary school. From the first moment students encounter homework, they already have lots of freedom to determine their homework approach. Unfortunately, homework's effect is limited, especially in primary education (Cooper et al., 2006; Jerrim et al., 2018). Therefore, exploring which study strategies primary school students use while doing homework is important.

One would hope that students spontaneously rely on effective study strategies that elicit processes that help students learn. Decades of instructional design research have shown that, in part, we know what these effective study strategies are. For example, research showed beneficial effects of retrieval practice (e.g., Dunlosky et al., 2013; Hattie & Donoghue, 2016). Retrieval practice is effective because each time we try to recall information from our long-term memory, the memory for that information is strengthened, as is the ability to successfully recall that information in the future (Surma et al., 2019). Also, generative learning strategies are considered effective for learning because these strategies involve actively sensemaking of information by mentally reorganizing and integrating information with one's prior knowledge, enabling learners to transfer learned information to new situations (Fiorella & Mayer, 2016). In general, it seems that study strategies are effective for students' comprehension when these strategies encourage students to actively process and recall information, and connect students' memory with prior and future learning.

It is not entirely clear which study strategies primary school students use when they are in control, but they likely rely on ineffective study strategies, given the findings of earlier survey research with older students (Dirkx et al., 2019; Dunlosky et al., 2013). These surveys showed that older students often use rereading, summarizing, and highlighting during self-study activities. Suppose older students rely on ineffective study strategies. In that case, it is plausible to think that primary school students are even more likely to choose ineffective study strategies because their (meta)cognitive abilities and world knowledge still develop throughout childhood (Brod, 2021; Roebers, 2017; Schunk, 2014). These (meta)cognitive skills directly influence students' effective use of study strategies, while world knowledge has a strong indirect effect by helping students relate new materials to known concepts (Brod, 2021).

Students' underuse of effective study strategies may stem from false beliefs about learning, unawareness of effective strategies, or the counter-intuitive nature of these strategies (Carpenter et al., 2022). For example, students regularly underestimate their learning capacity because they underappreciate the role of effort and thereby assume that there are limits to what they can learn (Bjork et al., 2013). High-effort experiences may also give students the feeling that they are not learning affecting their perceptions of the strategy's effectiveness and willingness to use it (Janssen et al., 2023). On the other hand, students are more likely to choose ineffective study strategies because these require little effort and are easy to use in the short term. Furthermore, teachers affect student's strategy choices, because teachers mainly focus on teaching content and critical-thinking skills, while less time is spent instructing students to choose and develop effective study strategies that guide their learning (Dunlosky et al., 2013). Another explanation may be that students from secondary and university levels are more often presented with elaborate materials for self-study, which may elicit ineffective study strategies to a larger extent than using more effective strategies (Dirkx et al., 2019).

Analyzing the Homework Problem: How Motivated Are Primary School Students?

Ideally, you want all students to be motivated to do their homework because meta-analyses show that motivation is an important predictor of learning (Kriegbaum et al., 2018; Quílez-Robres et al., 2021). Motivation determines why a person invests time and effort into a specific activity (Deci & Ryan, 2000). Particularly, intrinsic motivation is associated with higher performance and seems to

benefit students' school achievement (Taylor et al., 2014) and predict student engagement (Froiland & Worrell, 2016). Intrinsic motivation concerns active engagement with tasks people enjoy and find interesting (Deci & Ryan, 2000). This can be accomplished by supporting one's basic psychological needs (competence, autonomy, and relatedness; Ryan & Deci, 2020). Competence concerns feelings of mastery and a sense of success and growth, autonomy refers to a sense of initiative and ownership in one's actions, and relatedness concerns a sense of belonging and connection (Ryan & Deci, 2020).

Unfortunately, students are often disengaged when doing homework (Flunger et al., 2015) which stems from various factors. In general, motivational problems arise because many homework assignments do not spark students' interest and seem irrelevant to them. However, being interested and recognizing relevance in tasks is crucial for satisfying students' intrinsic motivation (Deci & Ryan, 2000). In addition, homework assignments may demotivate students because their basic psychological needs are unmet. First, survey research found that students often use ineffective study strategies while working on a task (Dirkx et al., 2019; Dunlosky et al., 2013) which may lead to lower learning outcomes. For example, students who highlight information direct their attention to individual concepts (supporting memory for facts) instead of connections across concepts (supporting higher-order learning; Dunlosky et al., 2013). This lack of mastery and limited feelings of success and growth may negatively affect students' perceived competence. Second, students often choose study strategies without social components, such as summarizing or rereading (Dirkx et al., 2019; Dunlosky et al., 2013). Such a lack of connection with others while doing homework may hamper students' perceived relatedness. However, providing opportunities in which students are allowed to choose a study strategy may increase their perceived autonomy and benefit intrinsic motivation.

The Effects of Vlogging as a Homework Study Strategy

Nowadays, primary school students are heavily engaged in creating vlogs in their free time. Also, educational interest in the effects of video creation by primary school students has increased, shedding light on potential benefits on student learning (e.g., Gaston & Havard, 2019; Hoogerheide et al., 2019). Because current student approaches appear to be ineffective and demotivating, it is important to explore the effects of vlogging on student learning and motivation while doing homework.

Students explain content to (fictitious) others when creating a vlog allowing them to learn that content through the mental processes activated by explaining. Laboratory research indicated that students who prepare to explain already seem to outperform students who simply read a text (Fiorella & Mayer, 2013). It was also observed that students who actually explain the content, develop a deeper and more persistent understanding of the content and are more likely to facilitate long-term learning compared to students who were only prepared to explain (Fiorella & Mayer, 2013, 2024). From a generative view, explaining provokes important (meta)cognitive processes that help students learn, such as activating relevant prior knowledge, facilitating the integration and organization of information, and elaborating new information (Brod, 2021). Therefore, it seems that vlogging is conducive to students' comprehension, which contrasts with the current reality in which primary school students rely on study strategies that may lend themselves more to retention (Dunlosky et al., 2013). From a social view, we can argue that vlogging enables opportunities to connect with peers and observe their social presence by thinking of others while explaining.

Besides, we can argue that vlogging could facilitate students' intrinsic motivation by satisfying their basic psychological needs. If participants explain content to others, they provide themselves with efficacy-relevant feedback highlighting their competence (Ryan & Deci, 2020). At the same time, students may learn more when vlogging compared to students who use ineffective study strategies because they develop a deeper understanding of the content. This may also contribute to their perceived competence (Ryan & Deci, 2020). Additionally, feelings of connection with peers and belongingness while vlogging may increase students' perceived relatedness (Ryan & Deci, 2020). Finally, vlogging is a free-form activity in which students can unleash their creativity and therefore feel autonomous, however, instructing students to vlog may decrease their perceived autonomy (Ryan & Deci, 2020).

Although most findings discussed above are derived from laboratory research among older students, with presumably more developed (meta)cognitive capacities, a homework field study (Hoogerheide et al., 2019) conducted with primary school students offers compelling evidence. This study examined whether creating an instructional vlog was more effective on primary school students' conceptual knowledge, mental effort, and learning enjoyment in comparison to restudying and

summarizing. All participants completed a self-reported prior knowledge test on Friday. During the weekend all participants performed a homework assignment in which they learned the content of a text by either restudying, summarizing, or creating a vlog. Posttests on Monday indicated that vlogging was perceived as more enjoyable compared to restudying or summarizing, and improved test performance to a greater extent than restudying (Hoogerheide et al., 2019). Vlogging was not more effective than summarizing, however, summarizing did not improve test performance compared to restudying while vlogging did (Hoogerheide et al., 2019). Unfortunately, we do not know how these students approached their homework in their home environment.

The Present Study

This study involved 7th and 8th-grade students because they encounter most homework in primary school. The first research question is: "Which study strategies do students in grades 7 and 8 choose when given the autonomy to regulate their homework approach, and how do they assess the effectiveness of these strategies?". We expect that primary school students choose ineffective study strategies because they often have false beliefs about learning, are unaware of effective learning strategies, or because of the counter-intuitive nature of these strategies (Carpenter et al., 2022). In addition, primary school students still develop their (meta)cognitive capacities and world knowledge during childhood (Brod, 2021, Roebers, 2017; Schunk, 2014), while earlier research already shows that older students choose ineffective study strategies (Dirkx et al., 2019; Dunlosky et al., 2013). In addition to collecting questionnaire data about primary school students' study strategies, this study collects more objective data on how students approach homework assignments, contributing to prior survey research.

The second research question is: "What is the effect of being instructed to create a vlog on students' learning outcomes (retention and comprehension) and intrinsic motivation compared with a situation in which students choose their homework strategy?". Earlier research in controlled settings showed that students who create a vlog obtain higher learning outcomes (Hoogerheide et al., 2014) that seem conducive to students' comprehension because explaining elicits important (meta)cognitive processes (Fiorella & Mayer, 2016). Contrarily, ineffective study strategies mostly focus on retention (Dunlosky et al., 2013). Furthermore, a homework field study with primary school students found that

vlogging was perceived as more enjoyable than restudying or summarizing (Hoogerheide et al., 2019) while vlogging also seems to satisfy their basic psychological needs (Ryan & Deci, 2020). We expect that students who are being instructed to create a vlog score better on comprehension questions and intrinsic motivation compared to students who determine their homework strategy.

METHOD

Experimental Design

This study used an experimental pre-posttest design. Participants were randomly assigned to either the Vlogging or Choosing Condition. An a priori power analysis was computed using G*Power version 3.1.9.7 (Faul et al., 2007) to determine the minimum sample size required to examine the research questions. Results indicated that the sample size needed to be $n = 128$ to achieve 80% power for identifying a medium effect (Cohen, 1988), with a significance criterion of $\alpha = .05$ for a *t*-test. A medium effect size ($d = .05$) was obtained because this is the threshold of educational significance (Hattie, 2009).

Participants

Participants were 7th and 8th-grade students of Dutch primary education (cf. USA grades 5 and 6, ages 9-13) gathered from three different schools through convenience sampling. Of the 67 participants who obtained parental consent and gave consent themselves, nine were removed from the sample, either because they did not complete the homework assignment ($n = 5$), for being absent during the posttest ($n = 2$), or for not adhering to the instructions ($n = 2$). The final sample comprised 60 participants (age: $M = 11.07$, $SD = 0.82$; 36 girls). The oldest participant was thirteen years old and the youngest was nine years old. Participants were matched on gender and assigned to either the Vlogging Condition ($n = 29$; 20 girls) or Choosing Condition ($n = 31$; 16 girls).

Materials

The study text was paper-based. Other materials were administered digitally in Qualtrics. The materials were created for this study or adapted from an existing method (Blits) which is used in grade 8 of Dutch primary education.

Study Text

The study text (438 words) was about solar energy and consisted of two pages (see Appendix 1). It was expected that participants would have little prior knowledge about this topic because the content originated from a lesson in grade 8, and is taught in later phases of primary education (SLO, 2018). The study text explained what electric current is and how solar panels work. Three images were included, providing visual support for the text. A pilot with one 7th-grade student was conducted to ensure that the text's length and complexity were suitable for the participants and the time allocated in the study, to identify potential misunderstandings, and to evaluate the clarity of the posttest questions.

Homework Instructions

Although instructions were consistent with a previous homework field study (Hoogerheide et al., 2019), differences can be identified due to the natural environment of this study. Participants in both conditions completed a homework assignment over the weekend to learn as much of the study text as possible. Participants were asked to read the text at least once. Participants in the Vlogging Condition were instructed to create a vlog about the study text in which they explained the content of the text as if they were explaining it to a fellow student who did not know the subject. These participants used vlogging as a study strategy to learn as much of the study text as possible. Participants in the Choosing Condition were instructed to choose their study strategy to learn the content of the study text but did not have to create a vlog. They were free to use multiple study strategies, as this would reflect real-life scenarios. This differed from the homework field study because participants in that study were limited to restudying or summarizing and were not allowed to choose their strategy. Unlike prior research, participants also maintained a homework assignment check. All participants were instructed to work independently and without using the Internet.

Self-Reported Prior Knowledge

Participants rated their general knowledge of solar energy on a seven-point scale ranging from 1 (very low) to 7 (very high).[1] Then, participants marked whether each of the following four

[1] For all questionnaires, the center of the scale was used as a starting point because a high reliance on a specific side may cause an anchoring effect and bias participants to that side (Park & Xiong, 2021).

statements applied to them or not on the same scale (Hoogerheide et al., 2019): (1) “How much do you know about how solar energy can be used to generate power”, (2) “Exactly how much do you know about how electricity works?”, (3) “How much do you know about how solar panels generate solar energy”, and (4) “How much do you know about how the amount of electric current can be measured”. Given the expected limitedness of knowledge about this topic, participants were instructed to self-report their prior knowledge, consistent with earlier research (Fiorella & Mayer, 2013; Hoogerheide et al., 2019). A pretest may alert participants and direct their attention to relevant topics (Kim & Willson, 2010), which was less likely to occur during the self-reporting of prior knowledge.

Study Strategy Questionnaire

Participants reported if and how often they used each study strategy from an outlined list (see Table 1) during a week when they were free to determine their homework approach. They used a relative scale ranging from 0 (never) to 10 (always). Strategies one through ten were included because survey research by Dunlosky et al (2013) showed that students reported heavily relying on them or because they are relatively easy to use for many students. Distributed and interleaved practices were not included because these strategies cannot be used for a single homework assignment. Based on recent survey research, copying and thinking of real-life examples were included because students reported using these strategies (Dirkx et al., 2019). Cramming was omitted because the homework assignment was not used as preparation for a follow-up assignment and completing practice problems was omitted because it did not match the content of the homework assignment. Additionally, concept mapping, predicting, and drawing were included because these strategies were identified as popular generative learning strategies (Brod, 2021). Finally, vlogging was included because this study strategy was used as intervention. Vlogging involves explaining things to others, distinguished by the act of recording the explanation. To simplify the term vlogging for the participants it was reformulated to “explaining information to others”.

Participants who indicated using a certain study strategy also rated how well they thought each strategy helped them remember and learn something new by assigning a school grade from 0 (very bad) to 10 (very good) because participants were most likely to be familiar with this idea of grading. Afterward, participants could add study strategies that were not included in the outlined list. The

strategy order was randomized by chance for each class because the sequence in which study strategies are addressed can affect responses to the questionnaire (Carr et al., 2020).

Table 1

Outlined List of Study Strategies

Study Strategy	Explanation
1. Elaborative interrogation	Generating an explanation for why an explicitly stated fact or concept is true.
2. Self-explanation	Explaining how new information is related to known information, or explaining steps taken during problem-solving.
3. Summarization	Writing summaries (of various lengths) of to-be-learned- texts.
4. Highlighting/underlining	Marking potentially important portions of to-be-learned materials while reading.
5. Keyword mnemonic	Using keywords and mental imagery to associate verbal materials.
6. Imagery for text	Attempting to form mental images of text materials while reading or listening.
7. Rereading	Restudying text material again after an initial reading.
8. Practice testing	Self-testing or taking practice tests over to-be-learned material.
9. Copying	Copying the textbook chapter.
10. Thinking of real-life examples	Think of an example.
11. Concept mapping	Relating and ranking concepts with each other.
12. Predicting	Hypothesizing about a specific fact or outcome before providing them with the to-be-learned information.
13. Drawing	Draw an illustration of the to-be-learned information.
14. Explaining others	Explaining information to others.

Note. Definitions for strategies 1-8 originated from Dunlosky et al. (2013), strategies 9 and 10 from Dirkx et al. (2019), and strategies 11-13 from Brod (2021).

Motivation Questionnaire

A fourteen-item motivation questionnaire (five competence, five autonomy, and four relatedness items) evaluated participants' basic psychological need satisfaction while doing homework (see Appendix 2). This new motivation questionnaire was created using items from the popular Basic Psychological Need Satisfaction Scale (BPNSS; Deci et al., 2001; Ilardi et al., 1993; Kasser et al., 1992) and Basic Psychological Need Satisfaction and Frustration Scale (BPNSNF; Chen et al., 2015) because there was no single motivation questionnaire available that matched this study's purpose and

context. Both were well-established in the self-determination theory and commonly used to evaluate students' basic psychological need satisfaction in an educational context (Deci & Ryan, 2000; Van der Kaap-Deeder et al., 2020). Nine items from the BPNSS were translated and adapted addressing competence (four), autonomy (four), and relatedness (one). While the perceived competence and autonomy items aligned with the study's purpose and context, the perceived relatedness items were less suitable. These items were either too general or focused on collaboration and interaction with others, which was not allowed during the homework assignment. Five additional items from the BPNSNF were translated and adapted to cover all dimensions of basic psychological needs. Although both questionnaires originally had over twenty items, only fourteen were included to ensure that all participants could complete the items within the available time without losing focus. It was also ensured that all items were easily recognizable for participants by tailoring the word choice to suit their understanding.

Participants answered each item on a seven-point scale ranging from 1 (not at all) to 7 (absolutely). Reverse-worded items were included to prevent participants from acquiescence bias, which helps to ensure construct validity (Carr et al., 2020). Examples of questions are: "During the homework assignment, I felt competent to do the homework well" (competence), "During the homework assignment, I had to do what was asked of me." (autonomy), and "I had the opportunity to work with people I like when doing my homework" (relatedness). The competence ($\alpha = .74$) and autonomy ($\alpha = .78$) subscales showed good internal consistency while the relatedness subscale ($\alpha = .55$) had low internal consistency (Kline, 1999). The motivation questionnaire was generally reliable ($\alpha = .83$; Kline, 1999). A three-factor CFA in Mplus8.9 (Muthén & Muthén, 2017) evaluated the motivation questionnaire's validity which yielded insufficient model fit, $\chi2(74) = 145.91$, $p < .001$, CFI = 0.80, TLI = 0.76, RMSEA = 0.13 (Maximum Likelihood was used), SRMR = 0.11.[2] After exploring alternative structures (see Appendix 3), a sufficient model that preserved the original structure without distortion was not found. Therefore, the original structure was retained.

[2] The model fit of all CFAs were evaluated through the goodness-of-fit test ($p > .05$) and the following guidelines: CFI/TLI > 0.95, RMSEA <0.06, and SRMR <0.08 (Hu & Bentler, 1999; Knekta et al., 2019).

Posttest

A posttest with thirteen open-ended items measured participants' retention (nine) and comprehension (four; see Appendix 4). Both subscales were measured because students who determine their homework approach seem to rely on strategies that might lend themselves more to retention (Dunlosky et al., 2013). Vlogging also seems conducive to students' comprehension, as explaining elicits important (meta)cognitive processes that help students learn (activating relevant prior knowledge, facilitating integration and organization, and elaborating on new information; Brod, 2021). Examples of questions are: "Name two reasons why it is important to use green energy" (retention) and "Explain what is meant by green energy" (comprehension). The retention subscale (α = .79) showed good internal consistency, while the comprehension subscale (α = .44) demonstrated low internal consistency (Kline, 1999). The posttest was generally reliable (α = .82; Kline, 1999). A two-factor CFA was conducted to evaluate the posttest's validity which yielded insufficient model fit, $\chi 2(64) = 172.76$, $p < .001$, CFI = 0.48, TLI = 0.36, RMSEA = 0.19 (Maximum Likelihood was used), SRMR = 0.14. A sufficient model could not be found after exploring alternative structures (see Appendix 5). Therefore, the original structure was retained.

Homework Assignment Check

All participants documented their actions in an empty timetable and the duration while doing homework. So, the success of the intended manipulation could be assessed. The list of performed actions also provided more objective data about which study strategies participants used during the homework assignment.

Procedure

The current procedure was consistent with earlier research by Hoogerheide et al. (2019). Parents or caretakers were asked for active informed consent before the first session, wherein permission was requested for students' participation and data use. It was emphasized that only researchers could see all students' products and collected data would not affect students' reports. Additionally, all data were anonymized by giving each participant a personal code during the first session. Participants were temporarily traceable in the dataset during the data collection in case

students withdrew from the study. Privacy was assured by limiting the collection of personal data to gender and age.

Envelopes containing a personal code and condition (written on the front) were distributed. Participants were instructed to take out the first form which explained how to log into Qualtrics. Informed consent from the participants was requested during this first session on Friday in the participants' classroom. Then, participants were asked to complete the first part which contained a short demographic questionnaire (about gender, age, and prior experiences with vlogging) and the self-report prior knowledge test. Next, participants were instructed to proceed to the second part of Qualtrics, which contained the study strategy questionnaire. The researcher explained each strategy aloud and provided an example. Then, the participants were instructed to rate how often they used each strategy when they had the autonomy to choose their homework approach. Participants who indicated using a certain study strategy also rated to what extent the strategy helped them remember and learn something new. The strategy order was randomized by chance for each class.

Afterward, all participants were instructed to place the first form back in the envelope and take the second form containing the condition-specific instructions. The experimenter explained that the class was divided into two different groups as part of a scientific study. Both conditions would complete a homework assignment over the weekend. During this homework assignment participants were asked to learn as much as possible about a study text about solar energy. Next, the researcher read both instructions aloud one by one. Participants in the Choosing Condition were instructed to choose their study strategy to study the text and learn as much as possible. Participants in the Vlogging Condition were instructed to create a vlog in which they needed to explain the content of the text to a fictitious peer who did not know anything about the topic. They were allowed to use any digital device to record the vlog. The vlogs were not visible to others to ensure participants' privacy. Each condition was instructed to read the study text at least once, to follow given instructions, and to not spend longer than an hour on the homework assignment. Additionally, participants were instructed to administer their actions while doing the homework assignment along with the duration of each action. Moreover, a parent letter was included in the envelope which emphasized that it was important that the participants did not receive guidance from others or use the internet, and stick to the instructions.

Finally, it was ensured that all participants placed the envelopes in their bags and wrote down the details in their agenda.

The second session took place on Monday in which participants were instructed to complete a posttest and motivation questionnaire in Qualtrics. Afterward, the researcher answered the remaining questions from the participants and debriefed them. Parents received an e-mail address to contact the researcher if questions during a later stadium arose.

Data Analysis

Two researchers independently scored 15% of the responses on the posttest to evaluate the inter-rater reliability of agreement for a categorical level. Therefore, Kappa's guidelines were used: "0.00-0.20 slight agreement, 0.21-0.40 fair agreements, 0.41-0.60 moderate agreement, 0.61-0.80 substantial agreement, and 0.81-1.00 almost perfect agreement" (Warrens, 2015). The intraclass correlation coefficient was almost perfect for the retention subscale (0.98), comprehension subscale (0.86), and the posttest in general (0.94). Thus, the remaining responses were scored by one rater.

All negatively worded items of the motivation questionnaire were reversed. Then, mean scores were calculated for each subscale on the motivation questionnaire. Sum scores were calculated for the pre- and posttest. The homework assignment check was quantified by categorizing all responses. Significance was indicated by $p < .05$.

Descriptive statistics were performed at the sample level to analyze the research question about which study strategies 7th and 8th-grade students chose when regulating their homework approach and to evaluate how effective they estimated these strategies. In addition, the homework assignment check was considered to assess which study strategies students in the choosing condition used during the homework assignment and whether students' behavior matched their self-reports.

The original plan was to analyze whether creating a vlog positively affected students' learning outcomes (retention and comprehension) and intrinsic motivation (competence, autonomy, and relatedness) compared to students who chose their study strategy with parametric analyses. An independent samples *t*-test was intended to analyze the effect on retention and comprehension, while a MANOVA was planned to analyze the effects on perceived competence, autonomy, and relatedness. However, the assumption of normal distribution was violated in all cases, except for the competence

subscale (see Appendix 6). Therefore, this research question was analyzed using a non-parametric Mann-Whitney test (cf. Field, 2018). The subscales were used as a dependent variable (continuous level) in each analysis. The condition was an independent variable (two categorical, independent groups). Levene's test for homogeneity of variances was checked. Effect sizes were evaluated using Pearson's *r*: small at .1, medium at .3, and large at .5 (Cohen, 1988).

RESULTS

Questions regarding participants' prior experiences with vlogging and instructional videos showed that participants primarily watched vlogs in their free time (*M* = 21.24 minutes) and rarely for school (*M* = 2.17 minutes). Participants reported that they did not commonly watch instructional videos in their free time (*M* = 3.17 minutes) or for school (*M* = 1.44 minutes). In addition, they did not regularly create vlogs or instructional videos in their free time (*M* = 1.02 minutes; *M* = 0.48 minutes) or for school (*M* = 0.28 minutes; *M* = 0.17 minutes).

Table 2 presents the descriptive statistics for the pretest, posttest, intrinsic motivation, and reading time. First, participants reported having average prior knowledge about solar energy, which did not differ between the conditions. Second, both conditions scored quite similarly on both posttest subscales. Despite participants scoring higher on the posttest retention subscale, scores on both posttest subscales were low. In addition, participants in the Choosing Condition reported a higher perceived competence and autonomy than participants in the Vlogging Condition. Both conditions indicated to have similar feelings of perceived relatedness. Finally, participants in the Choosing Condition spent more time reading the study text, while the total time invested in doing homework was quite similar.

Table 2

Descriptive Statistics for Pretest, Posttest, Intrinsic Motivation, and Reading Time

	Total *n* = 60				Choosing Condition *n* = 31				Vlogging Condition *n* = 29			
Variable	Range	*M*	*Mdn*	*SD*	Range	*M*	*Mdn*	*SD*	Range	*M*	*Mdn*	*SD*
1. Pretest	21.00	15.80	15.00	5.26	21.00	15.71	15.00	5.45	18.00	15.90	15.00	5.15
2. Posttest Retention	8.50	3.98	4.00	2.37	8.00	3.71	4.00	2.54	8.50	4.28	5.00	2.17

3. Posttest comprehension	3.00	1.65	1.50	0.79	3.00	1.58	1.50	0.72	3.00	1.72	1.50	0.87
4. Perceived competence	3.80	5.46	5.50	0.99	3.80	5.70	5.80	0.96	3.80	5.21	5.40	0.98
5. Perceived autonomy	5.80	4.41	4.70	1.36	4.40	5.04	5.40	0.99	4.80	3.74	3.80	1.38
6. Perceived relatedness	5.00	4.27	4.25	1.02	3.75	4.28	4.25	0.85	5.00	4.26	4.25	1.20
7. Reading time	13.00	5.47	5.00	2.94	12.42	7.08	5.00	3.84	10.00	4.73	4.00	2.35
8. Total time invested	59.00	26.14	25.50	14.77	54.00	27.75	20.00	5.36	56.12	28.20	25.00	14.92

Note. The pretest was based on a total score of eight items indicated on a seven-point scale. The posttest subscales were based on the total scores of each subscale. The motivation subscales were based on mean scores indicated on a seven-point scale. Reading time and total time invested is indicated in minutes. *M* = Mean; *Mdn* = Median; *SD* = Standard deviation.

Students' Perceived Use and Effectiveness of Study Strategies

Table 3 shows participants' perceived use of each study strategy. Sixty participants were instructed to indicate if and how often they chose each study strategy on a scale from 0 to 10 when regulating their homework approach. Descriptive statistics on the sample level found that participants most often chose rereading (*M* = 6.78), practice testing (*M* = 5.65), and highlighting (*M* = 5.58). The least chosen study strategies were drawing (*M* = 1.87), copying (*M* = 2.72), and explaining others (*M* = 3.02). Participants also indicated using other strategies, such as being tested by others (*n* = 6), asking others for an explanation (*n* = 4), or using the Internet to collect information (*n* = 2).

Table 3

Overview of Participants' Perceived Use of Each Study Strategy Indicated On a 0 to 10 Scale

Study Strategy	*M*	*Mdn*	*SD*
Rereading	6.78	7.00	2.71
Practice testing	5.65	7.00	3.60
Highlighting/underlining	5.58	6.00	3.36
Summarizing	5.25	6.00	2.64
Imagery for text	4.63	4.50	3.36

Thinking of real-life examples	4.57	4.00	3.40
Keyword mnemonic	4.23	4.00	3.35
Self-explanation	4.20	4.00	3.16
Elaborative interrogation	3.85	3.00	3.02
Concept mapping	3.08	1.00	3.58
Predicting	3.03	2.50	2.91
Explaining others	3.02	3.00	2.80
Copying	2.72	0.50	3.19
Drawing	1.87	1.00	2.57

Table 4 shows participants' perceived effectiveness of each study strategy for learning something new on a 0 to 10 scale, reported by those using that strategy. Results showed that participants perceived practice testing (M = 7.32), rereading (M = 7.16), and summarizing (M = 6.84) as the most effective strategies. Drawing (M = 4.91), predicting (M = 5.20), and explaining others (M = 5.45) were perceived as least effective.

Table 4

Overview of Students' Perceived Effectiveness of Each Study Strategy Indicated On a 0 to 10 Scale

Study Strategy	*n*	*M*	*Mdn*	*SD*
Practice testing	47	7.32	8.00	2.08
Rereading	58	7.16	7.00	2.02
Summarizing	55	6.84	7.00	2.29
Highlighting/underlining	54	6.81	7.00	2.43
Keyword mnemonic	46	6.76	7.00	2.24
Concept mapping	34	6.71	7.00	2.78
Copying	30	6.47	7.00	2.19
Thinking of real-life examples	49	6.27	7.00	2.94
Imagery for text	49	6.00	7.00	2.49
Self-explanation	48	6.00	6.00	2.12
Elaborative interrogation	47	5.62	6.00	2.68

Explaining others	40	5.45	5.50	2.41
Predicting	40	5.20	5.50	2.47
Drawing	32	4.91	4.00	2.51

Table 5 presents all responses to the homework assignment check. These answers were evaluated to identify which study strategies participants used during the homework assignment and whether their homework behavior matched their reports on the study strategy questionnaire. Consistent with reports on the study strategy questionnaire, participants in the Choosing Condition primarily reported using highlighting (n = 22) and rereading (n = 19). Similar strategies were reported by participants in the Vlogging Condition when preparing to vlog. Contradictory, only one participant in the Choosing Condition reported to explain to others.

Table 5

Overview Homework Assignment Check

	Choosing Condition (n = 31)				Vlogging Condition (n = 29)			
Study strategies	*n*	*M*	*Mdn*	*SD*	*n*	*M*	*Mdn*	*SD*
Rereading	19	10.43	9.52	6.04	22	8.59	5.85	6.79
Explaining others	1	4.00	4.00	.	29	10.66	8.75	7.78
Highlighting/underlining	22	6.77	5.00	3.05	6	3.45	4.35	1.76
Summarizing	5	12.20	13.02	6.08	8	14.94	15.00	9.03
Concept mapping	3	12.67	15.00	5.55	5	12.40	10.00	6.86
Practice testing	2	2.65	2.65	.	5	5.45	4.27	2.47
Elaborative interrogation	3	3.18	1.53	2.71	2	15.50	15.50	.
Imagery for tekst	3	3.41	4.00	1.74	.	.	.	.
Drawing	3	10.00	7.00	8.75	.	.	.	.
Copying	2	6.50	6.50	.	.	.	.	.
Keyword mnemonic	1	5.00	5.00	.	.	.	.	.
Self-explanation	.	.	.	.	2	10.00	10.00	.
Asking others for explanation	1	6.00	6.00	.	.	.	.	.
Watching/analyzing images	4	4.10	2.95	6.01	2	1.37	1.37	.

Note. Mean, median, and standard deviation are indicated in minutes.

Does Vlogging Positively Affect Students' Learning and Intrinsic Motivation?

A Mann-Whitney test evaluated the condition's effect on the learning outcomes and intrinsic motivation because the scores on all subscales (except for perceived competence) were nonnormally distributed when using parametric analyses (see Appendix 6). The homogeneity of variance assumption was met for retention, comprehension, and perceived competence (see Table 6). Although this was not the case for perceived autonomy and relatedness, these subscales were still analyzed.

Table 6

Statistics of Levene's Tests for Homogeneity of Variances

Subscale	*F*	df1	df2	*p*
Retention	1.77	1	56.40	.189
Comprehension	2.29	1	57.85	.136
Perceived competence	0.001	1	57.74	.979
Perceived autonomy	4.88	1	57.90	.031*
Perceived relatedness	4.08	1	55.79	.048*

Note. Statistics are based on the median and with adjusted degrees of freedom because of the nonnormal distribution and smaller sample size. Significant *p*-values are marked.

Regarding participants' learning outcomes, there was no significant performance difference in retention between participants in the Vlogging Condition and Choosing Condition, $U = 502.50$, $z = 0.79$, $p = .431$, $r = 0.10$, with a mean rank score of 32.33 for the Vlogging Condition and 28.79 for the Choosing Condition. Similarly, no significant performance difference in comprehension was found between participants in the Vlogging Condition and Choosing Condition, $U = 475.50$, $z = 0.39$, $p = .694$, $r = 0.05$, with a mean rank score of 31.40 for the Vlogging Condition and 29.66 for the Choosing Condition.

As for intrinsic motivation, participants in the Vlogging Condition perceived significantly less competence than participants in the Choosing Condition, $U = 315.00$, $z = -2.00$, $p = .046$, $r = -0.26$, with a mean rank score of 25.86 for the Vlogging Condition and 34.84 for the Choosing Condition. This indicated a small to medium effect. Against our expectation, primary school students who chose their study strategy perceived more competence than students who were instructed to vlog.

Participants in the Vlogging Condition also perceived significantly less autonomy than participants in the Choosing Condition, $U = 213.00$, $z = -3.51$, $p < .001$, $r = -0.45$, with a mean rank score of 22.34 for the Vlogging Condition and 38.13 for the Choosing Condition. This was also against expectations and indicated a medium to large effect. Finally, there was no significant difference in perceived relatedness between participants in the Vlogging and Choosing Condition, $U = 427.50$, $z = -0.33$, $p = .744$ with a mean rank score of 29.74 for the Vlogging Condition and 31.21 for the Choosing Condition.

CONCLUSION AND DISCUSSION

Survey research with older students showed that students often rely on ineffective study strategies (Dirkx et al., 2019; Dunlosky et al., 2013). It was plausible that primary school students are more likely to choose ineffective study strategies because their (meta)cognitive abilities and world knowledge are still developing (Brod, 2021). They also may have false beliefs about learning and are unaware of effective study strategies (Carpenter et al., 2022). The first aim was to identify which study strategies 7th and 8th-grade students chose when regulating their homework approach and how they perceived the effectiveness of these strategies. Additionally, the self-determination theory, laboratory research, and a homework field study suggested that vlogging can enhance students' learning and intrinsic motivation. So, the second aim was to identify the effect of being instructed to create a vlog on students' learning outcomes and intrinsic motivation compared to students who chose a strategy.

Students' Perceived Use and Effectiveness of Study Strategies

Participants reported mostly using rereading, highlighting, summarizing, and practice testing, consistent with earlier survey research with older students (Dirkx et al., 2019; Dunlosky et al., 2013). Responses to the questionnaire showed that these strategies were viewed as the most effective. More objective data from the homework assignment check confirmed that students in the Choosing Condition primarily used rereading, highlighting, and to a lesser extent summarizing. Even students in the Vlogging Condition used mostly these strategies when preparing to vlog. While participants also reported commonly using practice testing and perceived this strategy as the most effective, the homework assignment check showed that participants hardly used practice testing during the homework assignment. So, participants were generally unaware of effective study strategies and primarily used ineffective ones while doing homework. An explanation could be that high-effort

experiences may not gave students the feeling that they were learning, possibly affecting their perceptions of the strategy's effectiveness and willingness to use it (Janssen et al., 2023). Also, the learning context could have affected students' decision to use a study strategy (Fiorella, 2023; Rivers, 2020), which may explain why practice testing was not used in practice while perceived as effective.

Does Vlogging Positively Affect Students' Learning and Intrinsic Motivation?

This study showed no differences in retention and comprehension between the Vlogging and Choosing Conditions. Vlogging did not lead to higher retention and comprehension compared to students who chose their study strategy. Yet, laboratory research with older students found that students develop deeper and more persistent understandings of the content (Fiorella & Mayer, 2013), long-term learning can be facilitated (Fiorella & Mayer, 2014) and transfer performance could improve when students explain to others (Hoogerheide et al., 2014). Also, a homework field study with primary school students found that vlogging improved test performance to a greater extent compared to restudying (Hoogerheide et al., 2019). The lack of clear learning effects in this study might be due to differences in control conditions. In earlier studies, students in the control condition used only one ineffective study strategy while those participants in this study used multiple ineffective study strategies. So, this study's participants from the Choosing Condition engaged with the content in various ways, which may have led to fewer low results, and, therefore, to less obvious differences in participants' learning outcomes compared with participants in the Vlogging Condition. Another explanation is that this study investigated the effect of vlogging between both conditions in less controlled settings. This enabled participants in the Vlogging Condition to spend less time vlogging and more time using ineffective study strategies, which may impeded potential learning effects. Besides, whether the reported vlogging time involved learning or designing a nice vlog was unclear.

Furthermore, findings showed that participants who chose their study strategy perceived more competence than participants who created a vlog. Initially, it was expected that if participants explained the content, they would provide themselves with efficacy-relevant feedback highlighting their competence (Ryan & Deci, 2020). Conversely, explaining to someone else, without using the text, may have exposed participants to possible knowledge gaps. This could have hampered the perceived competence of participants in the Vlogging Condition. Additionally, participants in the

Choosing Condition used superficial strategies that did not require active engagement with the content possibly leading to inaccurate higher judgments about their competence (Bjork, 2013).

Although the opposite was intended, participants in the Choosing Condition also perceived more autonomy than participants in the Vlogging Condition. Tentative arguments already suggested that participants in the Vlogging Condition may perceive less autonomy because they were instructed to vlog while participants in the Choosing Condition chose their strategy (Ryan & Deci, 2020). Having more freedom for creativity when vlogging did not significantly contribute compared to choosing strategies.

Finally, this study found no significant difference in perceived relatedness between participants of both conditions. Initially, it was expected that participants in the Vlogging Condition would perceive more relatedness than participants in the Choosing Condition because they had to think about peers when explaining the content in a vlog while other participants used strategies without social components. One explanation for this insignificance is that the social context in the Vlogging Condition did not contribute to feelings of social inclusion, value, or belonging because there was no actual interaction or collaboration with peers. However, this is necessary to satisfy students' feelings of relatedness (Schmidt et al., 2020).

Limitations

First, the study had two important design flaws. Despite all efforts, 60 participants were recruited while the minimum sample size required to examine the research questions was 128. A post hoc power analysis showed an achieved statistical power of 48% suggesting insufficient power to detect significant effects (Field, 2018). So, although effects were found, this inadequate sample size and power can lead to inaccurate estimates and information on the effect, making evidence-based decisions difficult (Kang, 2021). In addition, the model fit of the posttest and motivation questionnaire had some flaws, such as low factor loadings and bad model fits. Therefore, the models were not empirically supported by the data (Knekta, 2019), meaning that future decisions may be difficult.

Second, the intended learning effects of vlogging were not achieved because participants may have experienced too much difficulty using this strategy. Participants could have been too challenged by generating explanations including retrieval practice (Sibley et al., 2022). Consistent, Roelle and

Berthold (2017) showed that the benefit of combining retrieval and generative activities is lower in high-complexity tasks compared to low-complexity tasks. Therefore, teacher instruction seems necessary to effectively implement vlogging, especially for young students who are still developing their (meta)cognitive abilities.

Finally, implementing a new study strategy may need a longer time because it requires a different learning approach than participants reportedly used. Although prior research did find positive effects of vlogging on learning and intrinsic motivation, this may be explained by the novelty effect. This refers to a positive effect on verbal recall relating to the newness of an innovation rather than the innovation itself (Elston, 2021). Observing the long-term effects of vlogging will provide more insight into the actual effects of vlogging.

Implications

This study is relevant for homework research because homework is not always effective and we do not really know why. These findings suggest that the problem occurs because primary school students mostly rely on ineffective strategies (perceived as effective). Future research should identify student considerations for using certain study strategies to better align interventions that help students improve their homework approach. Future research should also investigate if these findings are consistent when learning factual knowledge and whether there are any differences between young and older students. These findings are also relevant for teachers because they should make students aware of what works (not), motivate students to embrace the effort of desirably difficult learning strategies, and support them in implementing these strategies (Biwer & de Bruin, 2023). Direct instruction on cognitive, metacognitive, and resource management strategies and guided instruction proved essential (Biwer & de Bruin, 2023). For now, there is insufficient evidence that vlogging solves the homework problem. By contrast, vlogging seems to hinder students' perceived competence and relatedness compared to those who choose their study strategies. Currently, it may be better to use practice testing for text learning because this strategy proved to be effective for primary school students (Jaeger et al., 2014; Karpicke & Zaromb, 2010; Moreira et al., 2019).

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APPENDICES

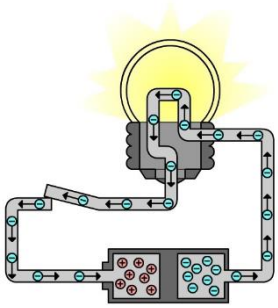
Appendix 1

Study Text (Translated from Dutch)

The energy of the sun

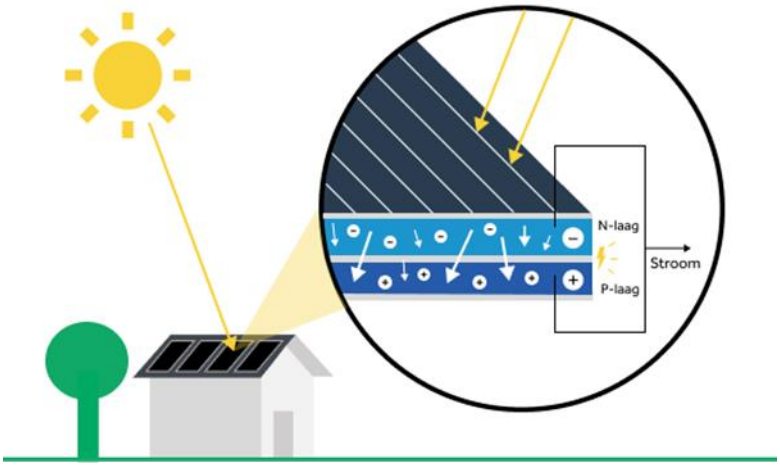
To generate green energy you can use windmills, as well as other means such as solar panels. Green energy is very important because it is more sustainable and environmentally friendly. This way, you can continually reuse sunlight to generate electricity to heat your home. When gas is used to heat a house, we eventually need to search for new gas because it cannot be reused. It takes years for gas to be created by the earth. Therefore, gas is not sustainable or environmentally conscious. Additionally, green energy also has financial benefits. That is why you see *solar panels* on the roofs of more and more houses. With them, people generate their electricity. This electricity then does not need to be purchased. But how do solar panels work?

To understand how solar panels work, you first need to know what electricity is. Electricity is the flow of electric charge through conductive materials, much like water flows through a pipe. Electricity consists of tiny, invisible particles called electrons. These electrons are full of energy. This energy is necessary to power devices such as a television or light bulb.



To generate electricity, all electrons must move in one direction. To ensure that electrons move easily in one direction, we use materials that conduct electricity well. By conductivity, we mean materials that allow electricity to flow easily. In this case, through wires of a cable or the layers of a solar panel. You can compare this movement to a water wheel that starts turning once all the water flows in one direction.

So, solar panels need to ensure that electrons move in one direction. This works as follows: a solar panel consists of two very thin layers. One layer has an excess of electrons and is called the N-layer. The other layer has a shortage of electrons and is called the P-layer. When the sun shines on the panel, the electrons start moving and flow from the N-layer to the P-layer via metal strips. This movement generates electricity. Because the electrons can also jump back from the P-layer to the N-layer, the electrons keep moving. At least, as long as there is light on the panel. Most electricity is generated when the sun shines directly onto the panel.



The amount of electricity that a solar panel can generate is measured in kilowatt-hours (kWh). A solar panel located in a favorable spot in the Netherlands can generate around 230 kWh per year. An average Dutch household uses 2,800 kWh of electricity per year. To generate all of that electricity independently, you would need at least 12 solar panels.

Appendix 2

Motivation Questionnaire (Translated from Dutch)

During the homework assignment, …

1. … I felt that I could decide for myself how I would complete the homework assignment.
2. … I was satisfied with how it went.
3. … I worked mostly independently.
4. … there was room for my own ideas and opinions.
5. … I learned new things.
6. … I felt connected to classmates who are important to me.
7. … I had to do what was asked of me.
8. … I had little chance to show how competent I am.
9. … I felt I could be myself.
10. … I felt like I belonged.
11. … I was able to finish the homework assignment well.
12. … I was able to achieve my goals.
13. … I felt connected to my classmates who care about me and whom I also care about.
14. … I was able to complete the homework assignment in a way that suited me.

Scoring information:

Competence items: 2, 5, 8, 11, 12.

Autonomy items: 1, 4, 7, 9, 14.

Relatedness items: 3, 6, 10, 13.

Retrieved from:

Deci et al. (2001), Ilardi et al. (1993), and Kasser et al. (1992): 1, 2, 3, 4, 5, 7, 8, 9, 11.

Chen et al. (2015): 6, 10, 12, 13, 14.

Appendix 3

Factor Analyses on the Motivation Questionnaire

The motivation questionnaire items can be found in Appendix 2. The structure of this questionnaire was expected to be sufficient because the items were based on the fundamental self-determination theory and equally covered all three basic psychological needs. In addition, the items and scale type aligned with the questionnaire's purpose to evaluate students' basic psychological need satisfaction in an educational context and matched with the participants' characteristics.

First, a three-factor CFA was conducted which yielded insufficient factor loadings of items 8, 12, and 14 (Table 7), and insufficient model fit, $\chi^2(74) = 145.91$, $p < .001$, CFI = 0.80, TLI = 0.76, RMSEA = 0.13 (Maximum Likelihood was used), SRMR = 0.11. Subsequently, a three-factor model was explored in which items 8, 12, and 14 were deleted. The factor loadings stayed quite similar (Table 8). The model fit improved, however, the model was still not sufficient, $\chi^2(41) = 60.57$, $p = .025$, CFI = 0.94, TLI = 0.92, RMSEA = 0.09 (Maximum Likelihood was used), SRMR = 0.08.

Table 7

Standardized Factor Loadings (Three-Factor Model)

Item	Factor Loadings
Item 1 (A)	0.81***
Item 2 (C)	0.62***
Item 3 (R)	0.25*
Item 4 (A)	0.91***
Item 5 (C)	0.73***
Item 6 (R)	0.86***
Item 7 (A)	0.86***
Item 8 (C)	0.15
Item 9 (A)	0.61***
Item 10 (R)	0.80***
Item 11 (C)	0.37**
Item 12 (C)	0.18
Item 13 (R)	0.66**
Item 14 (A)	0.15

Note. *** $p < .001$; ** $p < .01$; * $p < .05$; A = autonomy; C = competence; R = relatedness.

Table 8

Standardized Factor Loadings (Three-Factor Model Without Item 8, 12, 14)

Item	Factor Loadings
Item 1 (A)	0.81***
Item 2 (C)	0.61***
Item 3 (R)	0.25*
Item 4 (A)	0.92***
Item 5 (C)	0.72***
Item 6 (R)	0.85***
Item 7 (A)	0.86***
Item 9 (A)	0.61***
Item 10 (R)	0.79***
Item 11 (C)	0.33*
Item 13 (R)	0.53**

Note. *** p <.001; ** p <.01; * p <.05; A = autonomy; C = competence; R = relatedness.

Appendix 4

Posttest (Translated from Dutch)

Retention: (9 points in total)

1. Name two reasons mentioned in the text why it is important to use green energy.

Answers: more sustainable, environmentally friendly, financial benefits (1 point, 0.5 points per reason).

2. Name two means mentioned in the text by which people can generate green energy.

Answers: windmills, solar panels, water wheel (1 point, 0.5 points per mean).

3. Name an energy source from the text that does not fall under green energy.

Answer: gas (1 point).

4. Explain what electricity is.

Answer: Electricity or electric current is the movement of electrons (1 point).

5. What is the name of the tiny particles containing energy?

Answer: Electrons (1 point).

6. From which two layers does a solar panel consist?

Answer: one layer with an excess of electrons (N-layer) and one layer with a shortage of electrons (P-layer). Also acceptable: N-layer & P-layer (1 point, 0.5 points per layer).

7. Name the material of a solar panel through which electrons flow.

Answer: metal strips (1 point).

8. Fill in the word in the blank spot:

   Most electricity is generated when the sun shines _____ onto the panel.

Answer: directly (1 point).

9. What characteristic should material have to ensure that electricity moves easily in one direction? Use the information from the study text.

Answer: conducive material, such as wires (1 point, only an example is 0 points).

Comprehension: (5 points in total)

10. Explain what green energy is.

Answer: green energy is energy that is produced in a sustainable and environmentally conscious manner, for example, through solar panels or windmills (1 point).

11. Explain why there is an increasing use of solar panels on houses.

Answer: there is increasing use of solar panels on houses because it allows people to generate energy in a more sustainable and environmentally conscious way, while also potentially offering financial benefits (1 point).

12. Explain how a solar panel generates solar energy.

Answer: when sunlight shines on a solar panel, electrons start moving (0.5 points) *and flow from the N-layer to the P-layer via metal strips* (0.5 points). *This movement creates an electric current. Because electrons can also jump back from the P-layer to the N-layer, they keep flowing* (0.5 points). *At least as long as the sunlight shines on the solar panel* (1.5 points in total).

13. Name the term used to measure the amount of generated electricity and explain what this term means.

Answer: electric current is measured in kilowatt-hours (kWh) (0.5 points). *Kilo means 1000* (0.3 points). *One Watt is the energy required to lift one hundred grams one meter off the ground for one second* (0.3 points). *An hour means simply an hour* (0.3 points) (total: 1.5 points).

Appendix 5

Factor Analyses on the Posttest

The posttest items can be found in Appendix 4. The structure of the posttest was expected to be sufficient because the items matched with the posttest's purpose to evaluate participants' retention and comprehension. Answers to the retention items could be derived directly from the study text, while answers to the comprehension items required elaboration and processing of the text's content. In addition, the formulation of the items aligned with the participants' characteristics.

First, a two-factor CFA was conducted which yielded insufficient factor loadings of items 7, 9, 10, and 11 (Table 9), and insufficient model fit, $\chi 2(64) = 172.76$, $p < .001$, CFI = 0.48, TLI = 0.36, RMSEA = 0.19 (Maximum Likelihood was used), SRMR = 0.14. Subsequently, a two-factor model was explored in which items 7, 9, 10, and 11 were deleted. The factor loadings (Table 10) and model fit did not improve. The model was still not sufficient, $\chi^2(68) = 186.94$, $p < .001$, CFI = 0.43, TLI = 0.34, RMSEA = 0.17 (Maximum Likelihood was used), SRMR = 0.14.

Table 9

Standardized Factor Loadings (Three-Factor Model)

Item	Factor Loadings
Item 1 (R)	0.42***
Item 2 (R)	-1.24***
Item 3 (R)	0.40***
Item 4 (R)	-0.31**
Item 5 (R)	0.22*
Item 6 (R)	-0.26**
Item 7 (R)	-0.16
Item 8 (R)	-0.19*
Item 9 (R)	-0.17
Item 10 (C)	0.08
Item 11 (C)	0.22
Item 12 (C)	-1.43*
Item 13 (C)	0.40*

Note. *** $p < .001$; ** $p < .01$; * $p < .05$; R = retention; C = comprehension.

Table 10

Standardized Factor Loadings (Three-Factor Model Without Item 7, 9, 10, 11)

Item	Factor Loadings
Item 1 (R)	0.45***
Item 2 (R)	-1.16***
Item 3 (R)	0.42***
Item 4 (R)	-0.38**
Item 5 (R)	0.23
Item 6 (R)	-0.30**
Item 8 (R)	-0.18
Item 12 (C)	1.61
Item 13 (C)	-0.37

Note. *** p <.001; ** p <.01; * p <.05; R = retention; C = comprehension.

Appendix 6

Assumptions Checking Parametric Analyses

First, the original plan was to analyze whether creating a vlog positively affects students' learning outcomes (retention and comprehension) compared to students who choose their study strategy using independent sample *t*-tests for each subscale. However, a Kolmogorov-Smirnov test indicated that scores on the retention subscale did not follow a normal distribution, $D(60) = 0.15$, $p = .002$. Another Kolmogorov-Smirnov test indicated that also the scores on the comprehension subscale did not follow a normal distribution, $D(60) = 0.19$, $p < .001$. In addition, a MANOVA was intended to analyze whether creating a vlog positively affects students' intrinsic motivation (perceived competence, autonomy, and relatedness) compared to students who determine their study strategy. Again, the assumption of normal distribution was checked. A Kolmogorov-Smirnov test indicated that the scores for the perceived competence subscale were normally distributed, $D(60) = 0.09$, $p = .200$, while the scores for the perceived autonomy subscale were not, $D(60) = 0.15$, $p = .001$. A nonnormal distribution of scores was also found with a Kolmogorov-Smirnov test for the perceived relatedness subscale, $D(60) = 0.13$, $p = .016$. Due to violations of normal distribution in almost all analyses, it was chosen to test nonparametrically. Therefore, these questions were analyzed using a Mann-Whitney test (cf. Field, 2018).

ACKNOWLEDGEMENT

During the master's thesis, no generative AI was used to produce information for the content of this thesis.