# Supporting Self-regulated Learners by Providing Instructional Videos in a Dalton Setting

**Master thesis**

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## Abstract

This study aimed to investigate whether viewing instructional videos has a positive effect on students' mathematical domain knowledge and whether students' perceived usefulness has a positive effect on students' mathematical domain knowledge. The study was executed in a Dalton school in which 25 students of the fifth and sixth grade participated. In the context of a one group pre-test post-test design, quantitative data were collected by means of a survey and domain knowledge tests, and qualitative data were collected by means of interviews. Results showed a strong positive correlation between students' viewing behaviour and their perceived usefulness. Moreover, the influence of both students' viewing behaviour and perceived usefulness on their mathematical domain knowledge was found within some new topics. Other topics were not new but deepened; within these topics, no influence of both students' viewing behaviour and perceived usefulness on their mathematical domain knowledge was found. Therefore, it seems that the novelty of the teaching material influenced the results in this study. The results are useful in Dalton education because, with further research, instructional videos can be used as additional support for practising new topics on a daily basis.



Keywords: instructional videos, self-regulated learners, perceived usefulness, and help-seeking.

## Introduction

Our rapidly changing society has created an environment in which significant emphasis is placed on teaching 21st-century skills, including skills such as self-regulation (e.g., Berends & Wolthuis, 2014; Trilling & Fadel, 2009). However, teachers often struggle with how to implement these 21st-century skills in their daily educational practice (Van Dijk, 2017). Nevertheless, there are visionary programs in elementary education that already consider some of these 21st-century skills as their core values. One of these programs is Dalton education. This type of education applies a methodological approach to ensure a broader personal development of the child, which goes beyond the requirements of the academic curriculum (Berends & Wolthuis, 2014). The students are free to perform tasks at their discretion but are also responsible for their learning: they choose when activities are performed as long as they demonstrate that they have mastered certain skills and subjects. To achieve these skills, students set goals for themselves and work independently towards these goals by planning, monitoring, and evaluating their learning process. This type of education is in line with what is described as self-regulated learning: a process in which learners transform mental capacities into academic skills by setting goals, monitoring and regulating learning processes to reach these goals (Zimmerman, 2002). In Dalton education, this is accomplished by offering learners freedom of choice in which they can make their own decisions regarding their learning process.

No matter how characteristic self-regulation is for Dalton education, teachers must still look for ways to promote self-regulated learning among pupils (Vermeulen & Vrieling, 2017; Kistner, Rakoczy, Otto, Dignath-vanEwijk, Büttner, & Klieme, 2010; Spruce & Bol, 2015). Such stimulation of self-regulated learning by teachers is essential, especially in early school years (Trautwein & Köller, 2003; Zimmerman, 2002). This support includes instructing students on learning strategies and activating their metacognition to help them regulate their own learning process (Xiao & Yang, 2019). Teachers model how strategies are performed and help students to make connections between the strategies and at which moments they can be used. However, the teacher cannot provide help for every student at any given moment, due to the typical size of a Dalton class (i.e., 20 to 35 students) (PO Raad, 2017). Therefore, if students face difficulties and need help, they might have to wait before a teacher is available to provide that help. At the same time, however, it is essential that they receive immediate help from the teacher when needed, to ensure that the students make the best possible progress, it is essential that they receive immediate help from the teacher when needed (Sinha & Glassa, 2015). As such, and as a result of these large teacher workloads, the help that teachers provide to students is often delayed, which does not promote students' performances optimally (Lumthong, 2010).

To overcome this problem, Was and Warneken (2017) recommended tools that can bridge this gap and provide the immediate help that is needed. This study aims to explore one of these tools that can be used to provide help whenever it is needed: instructional videos. These videos allow students to follow instructions repetitively. The instructional videos can be requested by the students at any time, providing a continuous learning process and thereby improving learning outcomes (Sinha & Glassa, 2015).

## Theoretical framework

### Self-regulated learning

Self-regulated learning describes the process in which students achieve skills by setting goals, and monitoring and regulating learning processes to reach these goals, using their own initiative (Zimmerman, 2002; Pintrich, 2002; Seker, 2015). Self-regulated learning involves three cyclical phases (Xiao & Yang, 2019). The first phase is the forethought phase, wherein goals are set, and a schedule is made. The second phase is the performing phase, wherein students deploy their planned strategies. Students monitor learning events and experiment to achieve their goals. They observe whether their actions lead to proper progress and if not adjust their actions and look for ways and sources that will. The last phase is the self-reflection phase. In this phase, students compare their performances with the standards they have been aiming for and evaluate their own self-satisfaction and responses.

Dalton education applies self-regulated learning throughout all tasks performed by students (Sins, 2013). Ideally, in the Dalton environment, students plan their tasks, monitor their learning process, check whether the intended goal is achieved, and ultimately evaluate the learning process. Each day, students repeat these phases of self-regulated learning. Dalton teachers further stimulate self-regulated learning by modelling the aspects and providing feedback for students (Zimmerman, 2002). Furthermore, teachers create an engaging environment with opportunities for students to challenge themselves and help them take responsibility for their learning process and reflect on their progress (Boekaerts, 1997; Kistner et al., 2010; Paris & Paris, 2001; Perry, Phillips, & Dowler, 2004).

Various studies have shown that self-regulated learning leads to success in and beyond school (Artel, Baumert, MacElvany & Peschar, 2003; Pintrich, 2004; Schunk, 2005; Winne, 2005; Zimmerman, 2002). Specifically, self-regulated learners outperformed non-self-regulated learners in terms of a more successful academic career (Kistner et al.; Mega, Ronconi, & De Beni, 2014; Paloş, Munteanu, Costea, & Macsinga, 2011; Pintrich & De Groot, 1990). This advantage comes from the self-regulated students' positive behaviour towards learning (Boekaerts & Corno, 2005; Zimmerman, 2002). They develop a deep interest in learning and a proactive attitude in making efforts to learn (Zimmerman, 2002). These essential abilities at the heart of self-regulated learning help students and adults to create a lifelong learning process through their positive learning behaviour (Zimmerman, 2008). Moreover, self-regulated learners perform well in several other areas during their education. For example, self-regulated learning allows students to work efficiently and therefore increase the time on task, which is, in turn, beneficial for academic performance (Geller & Bamberger, 2012). Furthermore, by developing the ability to make considered decisions in their learning process, learners get optimal opportunities to develop themselves academically (Evers, Meier, Tack, Timmerman, Van der Burg, & Vos, 2009; Joyce & Hipkins, 2004).

**Help-seeking**

By definition, self-regulated learners must monitor their learning process (Zimmerman, 2002; Pintrich, 2002; Seker, 2015). Therefore, they must continuously reflect upon whether their actions have led to the desired goal, which is known as the monitoring phase of self-regulation (Pintrich, 2004). When insufficient progress has been made, students must decide whether they need to adjust their plan or ask for help (Berends & Wolthuis, 2014). This help-seeking, which involves the search for and employment of a strategy to achieve success, is itself considered an achievement (Chu, Palmer, & Persky, 2018). The help-seeking process consists of five steps. The student must: 1) become aware that they need help, 2) decide to seek help, 3) identify potential helpers, 4) find strategies to seek help, and 5) evaluate help-seeking. Finally, the student checks whether the help has led to progress; if not, the process starts over again.

Students can seek help in various ways (Was & Warneken, 2017). The most common form of help-seeking is simply requesting the teacher's assistance (Berends & Wolthuis, 2014); however, due to the aforementioned limited time per student that teachers have available due to large class sizes, it might be beneficial for students to actively search for help from sources that do not involve the teacher. Nevertheless, to stimulate optimal academic outcomes, immediate help is necessary (Sinha & Glassa, 2015; Lumthong, 2010), since a quick response helps students to continue their work quickly and thereby reduce the loss of time. In order for students to develop optimally, help must be available at all times. However, the teacher cannot always offer this help due to the size of the classes. Therefore, tools are needed to assist students besides the teacher (Was & Warneken, 2017).

**Instructional videos**

Instructional videos provide one solution to provide students with immediate help independent of teacher intervention. Instructional videos contain content- and strategy-related elaborations that students can access at all times and are designed to help students learn targeted material (Fiorella & Mayer, 2018). These videos often elaborate on a procedural skill, such as how to solve a math problem, and have been proven to lead to higher academic performances when used before or during the lessons (O'Flaherty & Phillips, 2015; Lopes & Soares, 2018; Tan, Yue, & Fu, 2017; Dove & Dove, 2015; He, Holton, Farkas, & Warschauer, 2016; Gundlach, Richards, Nelson, & Levesque-Bristol, 2015). Additionally, Mayer (2001) added that the attractiveness of the video format and the increased attention of students to the video instructions leads to improved recall of the content (namely, the combination of textual, graphical, and auditory information attracts more attention from students).

In Dalton settings, instructional videos can help self-regulated learners, during the monitoring phase of self-regulated learning, by supporting students with information how to perform certain actions/skills (Hartley, Kieley, & Slabach, 1990; Van Laer & Elen, 2019). These learners can use instructional videos when they determine that their actions do not lead to the intended goal. They adjust their plan and find sources of help: instructional videos. So, students can continue their learning process without interruption. Therefore, instructional videos could assist students in achieving objectives more effectively and preventing the loss of study time. This just-in-time assistance may indirectly result in better learning outcomes (Döş, 2013).

However, besides these possibilities, instructional videos might not always be perceived as helpful by users, which is a crucial variable in predicting the effect of these videos (Moshabab, 2017). Perceived usefulness is the primary measure to assess the acceptance and success of the instructional videos (Alsabawy, Carter-Steel, & Soar, 2016). This encompasses cognitive and behavioural reactions towards information (Tulis, Steuer, & Dresel, 2016) and determines the degree to which someone believes that viewing the video will benefit their learning outcomes (Hamid, 2016). As a result, students' perceived usefulness of the instructional video determines whether its information is accepted or not and, subsequently, whether this information is adopted or rejected by students (Mouratidis, Vansteenkiste, & Lens, 2010). However, students' perception of usefulness can be incorrect, restraining the growth of their performances (Blomstermo, Eriksson, Lindstrand, & Sharma, 2004). Namely, an instructional video could be proven to be useful. However, a student could think that it is not useful, and therefore, the intended growth cannot be achieved. Therefore, it is essential to investigate to what extent this perceived usefulness influences the decision of whether or not to consult the videos and thereby affects students' performances.

**This study**

In order for students to properly regulate their learning process, it is necessary to provide them with the right tools during their monitoring process. Hereby it is important that students receive immediate help when needed. However, teachers cannot provide this for every student at any time. Instructional videos are a promising solution for this problem but require more research. This study analysed the impact of students' perceived usefulness and subsequent viewing behaviour on their mathematical performances. The following two research questions are formulated: 1) To what extent does viewing of the instructional mathematics videos lead to an increase in mathematical knowledge of students and 2) to what extent does the students' perceived usefulness of the instructional videos determine whether those students view instructional mathematics videos when offered to them? Based on the abovementioned literature, the following hypotheses were formulated: H1) It was expected that viewing the instructional videos will positively influence students' mathematical knowledge. This is because instructional videos have been proven to lead to higher academic performances (O'Flaherty & Phillips, 2015; Lopes & Soares, 2018; Dove & Dove, 2015; He, Holton, Farkas, & Warschauer, 2016). H2) it was expected that a) students' perceived usefulness influenced their viewing behaviour, because students' viewing behaviour and their perception of usefulness are positively linked (Moshabab, 2017) and b) students' perceived usefulness of instructional videos will positively influence students' mathematical domain knowledge, because the perceived usefulness is the primary measure to assess the acceptance of the instructional videos (Alsabawy, Carter-Steel, & Soar, 2016), and thereby to predict academic outcomes. In addition to the research questions, this research explores whether the novelty of topics influences students' viewing behaviour, their perceived usefulness and their mathematical domain knowledge, since Van der Meij (2017) and Burke and James (2008) found that novelty positively influence the viewing behaviour and perceived usefulness of users. Because these two variables could influence students' mathematical domain knowledge, as aforementioned, it was expected that the novelty of the topics might influence students' mathematical domain knowledge positively.

The findings should make an essential contribution to the field of Dalton education, since the results of this study, if the hypotheses are confirmed, could be used by Dalton teachers to improve their teaching methods and promote self-regulated learning. The instructional videos could be used when help is needed, and teachers are not always able to assist personally at a set moment. By using instructional videos, students can seek help by themselves and whenever they need it. As a result, students are enabled to continue their learning process uninterrupted, which might  enhance students' academic performances.

# Method

## Research design

To determine the influence of the viewing behaviour on the mathematical domain knowledge of the students, a one group pre-test post-test with a mixed-method design was conducted. Both quantitative and qualitative data were collected during this study to assess students' viewing behaviour, the perceived usefulness of the videos, and mathematical domain knowledge. Mathematical domain knowledge was assessed by a pre-test post-test design measuring mathematical knowledge concerning the mathematical subtopics. A survey was used to assess the viewing behaviour and the perceived usefulness of the videos. Moreover, interviews were used to give insight into different patterns of viewing behaviour and corresponding perception of usefulness.

This study was executed in the context of Dalton education, where students work independently towards goals. In daily practice, this is realised by using a ‘task’, which is an overview of assignments students need to work on within a given time (Berends & Wolthuis, 2014). In this context, students can choose, plan, and monitor their individual learning process, as instructional needs differ between students. Nevertheless, this study responds to this variability, since students can use the instructional videos in their own way and at their own pace.

**Participants**

In total, 25 children from a Dutch elementary school participated in this study (15 fifth graders and 10 sixth graders; 12 girls and 13 boys). The age of the children ranged from 9 to 12 years old, with a mean age of 10.92 years old (SD = .855). Parents of the children gave written permission for participation in this study. As part of the qualitative analysis of this study, four students from each grade (n = 10.31) were selected to take part in the interviews. These students were selected based on their test score (high/low growth) and the outcomes of the viewing and usefulness survey (viewed or not).

**Instrumentation**

**Domain.** Within this study, children worked on five different topics in the field of mathematics. These topics differed per grade. Topics for the fifth grade covered addition and subtraction of fractions, multiplication, division, calculating volume, and multiplying fractions. Sixth-grade students studied symmetry, addition and subtraction of fractions, order of operations, multiplication and division of fractions, and prime numbers. All topics contain new parts. Five of these topics are completely new, such as addition and subtraction of fractions, multiplying fractions, symmetry, order of operations, and prime numbers. Other topics were deepened with new skills. To practise these topics, students had to complete three assignments per topic of the existing learning method ‘Alles telt’, resulting in a total of 15 assignments per grade.

**Instructional videos.** While working on the assignments, students had the option to view instructional videos. One video per topic was made available that explained the primary strategy that is applied in the topic. Students could view the instructional videos (i.e., one per topic, five in total) before and during their work on the assignments. The videos were composed of instructions from existing videos by ‘Alles telt’ or ‘Clipscool’. The instructional videos contain a drawn animation in which a calculation problem is central. In the videos, a male voice explains the solution to the problem and how it can be solved step by step. The mathematical steps are shown next to the diagram. The instructional videos have a length of two to three minutes. The instructional videos were available on ‘MOO’, an online learning environment for the students; children could find a link to the video on YouTube when logging into MOO. However, the videos were initially not fully in line with the guidelines of Van der Meij & Van der Meij (2013) for videos that support students’ learning processes. Therefore, the videos were edited to meet these guidelines. An example is the title of the instructional video. According to Van der Meij & Van der Meij (2013), guideline 1 states that easy access is important. For this study, the titles of the instructional videos needed to be reformulated. Easy access was achieved by making the titles of the instructional videos consistent with the instructions of the lesson given by the teacher. For example, the teacher gave the instruction of lesson 18. Then the students could find the instructional video under lesson 18. Guideline 4 is about previewing the task; this includes promoting the goal of the instruction. For this study, the goals of the instructions were added in the instructional videos, as shown in figure 1. Moreover, guideline 6 states that the task must be clear and simple. The following two adjustments contribute to this. Firstly, information has been added, stating for which assignments (called ‘lessen’) the students can use the instructional videos, as shown in figure 2. Secondly, each video contains a tip on how to best solve the mathematical assignments. Figure 3 shows an example of this, with an assignment that can be carried out more efficiently with a ratio table.


*Figure 1*. Additional information about the goal of the lesson

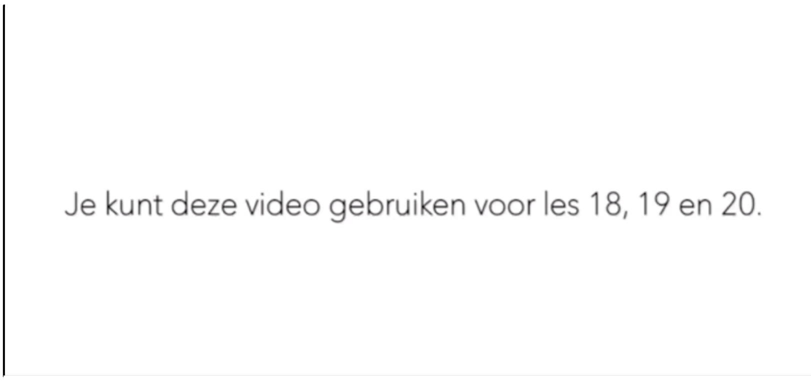


*Figure 2*. Additional information for which assignment the instructional video can be used


*Figure 3*. Additional information about how the assignment that can be carried out more efficiently

**Mathematical domain knowledge test.** To assess students' progress in mathematical domain knowledge concerning the five topics that were provided in their grade, mathematical domain knowledge tests were administered (see Appendix 1). The test contained 25 items in total, with five items per topic. These items were based on test items of Alles telt, (e.g., an example of a test item is: ‘1 kg strawberries cost €6,00. I buy 2 1/4 kg. How much do I have to pay?’; the parallel question is: ‘1 kg strawberries costs €10,00. I buy 3 1/4 kg. How much do I have to pay?’). Parallel tests for each grade were used for the pre-test and the post-test to prevent a test-retest effect. Reliability was calculated using Cronbach’s alpha. Tests for both grades were found to be reliable, ranging from 0.698 to 0.777.

**Viewing and usefulness survey.** A short digital survey determined students' viewing behaviour and perception of the usefulness of instructional videos. After viewing the instructional videos, students were asked to fill in the viewing and usefulness survey that inquired about their use of the accompanying instructional video. The survey included three items: one closed question about the viewing behaviour (e.g., ‘Did you view the instructional video?’) and two statements about the usefulness that could be answered on a five-point Likert scale (e.g., ‘I found the instructional video useful.’). The statements should be answered on a five-point Likert scale, varying from ‘totally agree’ to ‘totally disagree’. This survey was part of the same online environment as the instructional videos (see Appendix B).

**Interview.** Semi-structured interviews with a subsample of the participating students were conducted to gain insight into students' perceived usefulness of the instructional videos. Four students per grade were selected based on their viewing behaviour, perceived usefulness and growth on the mathematical domain knowledge test. In both grades the following students were selected: a student with a positive perceived usefulness and a high mathematical growth, a student with a positive perceived usefulness and a low mathematical growth, a student with a negative perceived usefulness with a high mathematical growth and a student with a negative perceived usefulness with a low mathematical growth. The interview contained five open questions about students’ use and their usefulness of the instructional videos (e.g., ‘Did you find the instructional videos useful, and why?’). Students were also asked to indicate which instructional videos (or parts of videos) were useful and which aspect(s) they would like to change to make them more useful. Besides the standard questions, the interviewer posed follow-up questions to clarify students' answers or to clarify noticeable outcomes in this study.

## Procedure

Students’ participation spanned eight sessions. These sessions were spread over nine weeks. In the first session in the first week, students completed the mathematical domain knowledge pre-test. Participants completed the pre-test that corresponded to their grade and had one hour to complete this test. All participants were aware that this test was for research objectives and would, therefore, not be considered for semester grades.

The second session, also in the first week, informed students about the experiment. This session was a 15-minute oral instruction on how to use video instructions. It explained what instructional videos are, when children could use them, and where to find them. The teacher explained that during the upcoming sessions, students were not allowed to consult the teacher when they needed help, but that they had to view the instructional videos instead. Furthermore, it was explained that the children would need to complete a viewing and usefulness survey after viewing the instructional video and where to find the survey.

Consequently, in week two till seven, children worked on the assignment of the five different topics that were relevant for their grade. To start a new topic, the teacher provided regular mathematics instruction that explained the strategy and content of the topic. At the end of the instruction, students were reminded that there was an instructional video available about this topic that they could use to gain further instructions while working on their mathematical assignments. When students consulted the teacher, she encouraged the students to view the available instructional video.

In the final session, in week eight, children completed the post-test. In the same week and the week thereafter, individual interviews were conducted. Four students from each grade were interviewed individually. During these interviews, students explained why they viewed or did not view the instructional videos, what they would want to change about the videos, and whether they prefer other types of tools while working on mathematics assignments.

## Data analysis

**Viewing behaviour and perceived usefulness.** To address the influence of the perceived usefulness on students' viewing behaviour, viewing behaviour was first determined. Question one of the viewing and usefulness survey gave insight into students' viewing behaviour. Possible answers were yes and no, where yes means 1 and no means 0. These scores were added to determine how many instructional videos students viewed in total. Scores varied from 0 to a maximum of 5 videos. A high score means that the instructional videos were frequently viewed. The analysis targeted descriptive statistics (e.g. mean, standard deviation, and frequencies). Students' perceived usefulness was determined by questions 2 and 3 of the viewing and usefulness survey. The scores varied from 1 till 5. A high score on these questions means that students found the instructional videos highly useful. To determine the perceived usefulness per video, the average of questions 2 and 3 has been calculated. To determine the overall perceived usefulness, the average of students' perceived usefulness per video was calculated. This analysis targeted descriptive statistics (e.g. mean, standard deviation, and frequencies). The influence of the perceived usefulness on the viewing behaviour was tested with a correlation. Interviews were used to explain the outcomes of the test to provide a better comprehension of the results.

**Mathematical Domain knowledge.** The pre-test and post-test were used to gain insight into the students' mathematics performances. Scores of the pre-test and post-test were calculated as the sum of the number of correct answers. Each right answer per test item is two points, with a maximum score of 50 points per test. The means of the pre-test and post-test were compared by a paired t-test to check whether there was a significant difference. The relation between the viewing behaviour and the growth on the mathematical domain knowledge test was tested using linear regression. In addition, another linear regression analysis was used to gain insight into the relation between the perceived usefulness and the growth on the mathematical domain knowledge test. Descriptive statistics will give insight into the outcomes of these regressions. Interviews will be added to get a better comprehension of the results.

## Results

**Viewing behaviour.** Table 1 shows an overview of the viewing behaviour shown by the students of both grades. Overall, 73.9% of all students used the instructional videos, whereas 26.1% did not. Comparing the outcomes of the two grades, instructional videos were viewed more in the sixth grade (80.8%) in contrast to the fifth grade (72.4%).

Table 1

*Mean and standard deviation of students' viewing of the videos per grade*

| | N | Minimum | Maximum | M | SD |
|---|---|---|---|---|---|
| *Fifth grade* | 15 | .00 | 4.00 | 1.929 | 1.685 |
| *Sixth grade* | 10 | .00 | 3.00 | 1.444 | .992 |
| *Total* | 25 | .00 | 4.00 | 1.739 | 1.421 |

*Note:* This is an overview of the minimum and maximum viewed instructional videos. The mean shows how many instructional videos were viewed on average per student.

**Perceived usefulness.** Table 2 provides the results obtained from the usefulness survey. Most students found instructional videos useful (60.9%). There seems to be a difference in students' perceived usefulness between the fifth and the sixth grade. However, this difference was not significant: $t$ (26) = .035, $p$ = .972.

It was expected that the perceived usefulness would positively affect students' viewing behaviour. A Pearson's correlation analysis revealed that students' viewing behaviour is highly correlated to their perceived usefulness, r = .723, p <0.001.

The interviews also showed that usefulness determines whether or not a video was viewed. There seems to be a pattern that when students' perceived usefulness is high, students have also viewed many instructional videos. One high-scoring student of the sixth grade who viewed none of the instructional videos, did not find them useful, saying that he preferred the instruction of the teacher and did not need extra help during the assignments. A low-scoring student of the fifth grade said that she also did not need the instructional videos. She preferred to ask another student for help. However, some students did find the instructional videos useful and so viewed them. A low-scoring student from the sixth grade said that the instructional videos helped him to complete the assignments. He was pleased that he was able to view everything again at his own pace. A high-scoring student of the fifth-grade student said that she was pleased that she no longer had to wait for the teachers help.

Table 2

*Mean and standard deviation of the perceived usefulness of instructional videos per grade*

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| *Fifth grade* | 15 | 1.00 | 4.75 | 2.778 | 1.781 |
| *Sixth grade* | 10 | 1.00 | 5.00 | 2.944 | 1.878 |

| | | | | | |
|---|---|---|---|---|---|
| *Total* | 25 | 1.00 | 5.00 | 2.844 | 1.779 |

**Mathematical domain knowledge.** The instructional videos could be used by students to help them practice mathematical skills. The results indicated that students' scores on the post-test (*M* = 17.44; *SD* = 11.56) were higher than those on the pre-test (*M* = 27.17; *SD* = 11.25). This difference was significant: *t* (26) = -6.43, *p* = .000. It was expected that this difference was influenced by students' viewing of the instructional videos. To check this, a linear regression was calculated to predict students' mathematical domain knowledge based on their viewing behaviour. However, no significant influence was found, as shown in table 3. However, each video is about different mathematical skills. Therefore, results could differ per topic. That is why it is important to check the influence of students' viewing behaviour on their mathematical domain knowledge within each topic. To check this, a linear regression was calculated to predict students' mathematical domain knowledge based on their viewing behaviour per instructional video. Results showed that there were three topics across two grades for which students' mathematical domain knowledge increased significantly when instructional videos were viewed, as shown in table 4. These three topics were entirely new for the students. For the fifth grade, these improved topics were addition and subtraction of fractions and multiplication of fractions; for the sixth grade, the improved topic was order of operations. A total of five new topics were instructed, of which three were significantly improved.

A varying influence was also shown in the interviews. A pattern between students' high or low growth on the mathematical domain knowledge test and their viewing behaviour seems to be missing. A low-scoring student who viewed the instructional videos multiple times did not think the videos helped him in practising mathematical skills. He found the instructional video very confusing. Since he could not ask the teacher for help without first viewing the video, the only reason he viewed so many instructional videos, was as a necessary step to secure help from the teacher. A high-scoring student added that the instruction of the teacher was enough, and he could do the assignment without further help.

Table 3

*Influence of the viewing behaviour on students' learning outcomes*

| | | B | Std. Error | t | Sig. (2-tailed) |
|---|---|---|---|---|---|
| Total | (Constant) | 1.568 | .512 | 3.060 | .006 |
| | Viewed videos | .048 | .420 | .334 | .743 |
| Fifth grade | (Constant) | 2.034 | .854 | 2.381 | .035 |
| | Viewed videos | .011 | .073 | .148 | .885 |
| Sixth grade | (Constant) | 1.010 | .441 | 2.289 | .056 |
| | Viewed videos | .065 | .035 | 1.282 | .241 |

*Table 4*

*Influence of the viewing behaviour on students' learning outcomes per topic*

| | | B | Std. Error | t | Sig. (2-tailed) |
|---|---|---|---|---|---|
| Fifth grade | Addition and subtraction of fractions | .155 | .062 | 1.046 | .047 |
| | Multiplication | -.002 | .032 | .064 | .560 |
| | Division | .004 | .049 | .049 | .761 |
| | Calculate volume | .025 | .047 | .531 | .405 |
| | Multiplying fractions | .130 | .060 | 1.173 | .034 |
| Sixth grade | Symmetry | .128 | .055 | .370 | .322 |
| | Addition and subtraction of fractions | .036 | .049 | .734 | .487 |
| | Order of operations | .301 | .273 | 1.102 | .036 |
| | Multiplication and division of fractions | .041 | .062 | .580 | .580 |
| | Prime numbers | .110 | .048 | .228 | .268 |

Furthermore, a strong correlation was found between students' perceived usefulness and their viewing behaviour. Therefore, it was expected that when viewing instructional videos influence students' domain knowledge, students' perceived usefulness will also influence students' domain knowledge. However, the results of a linear regression to predict students' mathematical domain knowledge based on their perceived usefulness showed that no significant influence was found (see table 5). These results apply to both groups together and both groups separately. Nevertheless, promising results were found within individual topics. A linear regression was calculated to predict students' mathematical domain knowledge based on their perceived usefulness per instructional video. As shown in table 6, students' perceived usefulness had a significant influence on the following mathematical domain knowledge topics in the fifth grade: multiplication of fractions, and in the sixth grade: order of operations. These topics were both entirely new for students, as mentioned above. The findings of this linear regression and the findings of the linear regression of students' viewing behaviour on the mathematical domain knowledge within each topic, were almost similar. The variables perceived usefulness and viewing behaviour both influenced students' mathematical domain knowledge of the topics: order of operations and multiplication of fractions, were found significant. The influence of the perceived usefulness on domain knowledge of the topic of addition and subtraction of fractions was almost significant, while it was significant in the regression with students' viewing behaviour and mathematical domain knowledge.

The interviews also showed that there seems to be no pattern between the growth on the test and students' perceived usefulness. A student with high growth on the mathematical domain knowledge test who viewed one instructional video told that he did not like to receive instruction in this form. Instructions in this form did not help him, and if he needed help, he sought it in other ways. A student with a low growth and low perception of usefulness found the instructional video annoying. She did not like the way the narrator was talking, which distracted her from the instruction. However, a student with low growth did find the instructional videos highly useful. It helped him while working on the assignment, but it did not help him to remember the practised skills. Another student with a high growth replied that the instructional videos helped her practise mathematical skills, but she still had some questions afterwards, such that she still needed the teacher, but less often, thanks to the instructional videos.

*Table 5*

*Influence of students' perceived usefulness on students' learning outcomes*

| | B | Std. Error | t | Sig. (2-tailed) |
|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Total | (Constant) | 2.146 | .616 | 3.486 | .002 |
| | Perceived usefulness | .072 | .051 | 1.403 | .175 |
| Fifth grade | (Constant) | 2.371 | .893 | 2.656 | .021 |
| | Perceived usefulness | .042 | .076 | .547 | .594 |
| Sixth grade | (Constant) | 1.966 | .927 | 1.376 | .072 |
| | Perceived usefulness | .101 | .074 | 1.376 | .211 |

*Table 6*

*Influence of students' perceived usefulness on students' learning outcomes per topic*

| | | B | Std. Error | t | Sig. (2-tailed) |
|---|---|---|---|---|---|
| Fifth grade | Addition and subtraction of fractions | .538 | .248 | 2.170 | .053 |
| | Multiplication | -.044 | .210 | .212 | .836 |
| | Division | .040 | .173 | .230 | .822 |
| | Calculating volume | .044 | .081 | .544 | .597 |
| | Multiplication of fractions | .616 | .252 | 2.444 | .033 |
| Sixth grade | Symmetry | .179 | .197 | .906 | .395 |
| | Addition and subtraction of fractions | .051 | .138 | .370 | .522 |
| | Order of operations | .143 | .231 | 1.619 | .045 |
| | Multiplication and division of fractions | .006 | .202 | .029 | .777 |
| | Prime numbers | .171 | .674 | .254 | .807 |

## Discussion

The current study aimed to identify whether non-teacher sources of help, in this case instructional videos, could help students practising mathematical domain knowledge, and prevent students from waiting for their teacher for help by making such help available at any time (Was & Warneken, 2017). The goal of this study was to investigate whether viewing instructional videos has a positive effect on students' domain mathematical knowledge and whether students' perceived usefulness has a positive effect on students' domain mathematical knowledge. Results revealed, overall, no significant influence of either students’ viewing behaviour or perceived usefulness on mathematical domain knowledge. However, within new topics, an influence of both students’ viewing behaviour and perceived usefulness on mathematical domain knowledge was found.

**Viewing behaviour.** The first research question was focused on the influence of students’ viewing behaviour on their mathematical domain knowledge. Lopes and Soares (2018) investigated the perception and performance of students in mathematics classrooms and concluded that viewing instructional videos could improve students’ mathematical performances. Therefore, it was expected that students’ viewing behaviour would positively influence students’ mathematical domain knowledge. In contrast to the hypothesis, however, no significant influence of the viewing behaviour on students’ mathematical domain knowledge was found. Students in both grades showed significant improvement in the post-test as compared their performance in the pre-test. However, relating the test results with the students’ viewing behaviour towards the instructional videos revealed that the improvement was not due to viewing the videos.

However, promising findings were discovered when examining each topic separately, as students’ viewing behaviour significantly influenced the mathematical scores on tests of some topics. The chosen subjects in the study were a mix of totally new subjects and subjects that were already known, but were being studied in more depth. The topics which were significantly improved were entirely new topics for students. This indicated that the novelty of the topics might influence the improvement of students’ scores. The study of Van der Meij (2017) determined that novelty did indeed positively influence the viewing behaviour of users. If students experience the information in the instructional videos as new, they might use it more and this can perhaps lead to higher academic performance. In his study, the users’ engagement in some videos was poor due to the impression that nothing new was learned in the instructional videos. This may have led to participants not viewing the instructional video entirely or at all. In addition, Burke and James (2008) showed that the perception of novelty did indeed influence learning and behaviour in classrooms. They found that for students who perceived an instruction as highly novel, a higher degree of learning was reported. As such, the perception of the novelty of students might be essential in the success of instructional videos.

An alternative explanation might lie in the current study itself: the familiarisation time. Overall, students' individual viewing behaviours were very different, from not viewing at all to viewing videos several times. Several factors may have accounted for this variation. According to the interviews, one student even forgot that the instructional videos were there. Others added that they forgot where to find the instructional videos, needed the teacher's help, and still had to wait. One reason for this kind of viewing behaviour could be that the videos are new to these students, and they are still becoming acclimated to having the videos as an option and still have to discover a proper way to use them. This would suggest that a familiarisation time is important within the experiment. Several studies have provided participants with a short familiarisation time of the assignments and tools of the study (Beloufa, Cauchard, Vedrenne, Vailleau, Kemeny, Mérienne, & Boucheix, 2019; Chan, 2010; Ganier & De Vries, 2016), after which the task within the experiment will be performed. However, in the current study, the videos were viewed somewhere over the course of six weeks. Therefore, a short familiarisation time might not be enough. However, no research has been done about the required familiarisation time in a setting like this. Further research is needed to determine this.

**Perceived usefulness.** Regarding the second research question that focused on students' perceived usefulness of instructional videos, it was expected that students' perceived usefulness would positively influence students' mathematical domain knowledge. This was because the perceived usefulness is the primary measure to assess the acceptance and success of the instructional videos (Alsabawy, Carter-Steel, & Soar, 2016), and so influences students' domain knowledge. However, results revealed no significant influence of the perceived usefulness on students' mathematical domain knowledge. These results are in line with the influence of students' viewing behaviour on their mathematical domain knowledge. This could be due to the strong correlation between the viewing behaviour and the perceived usefulness (Moshabab, 2017). That is why it is reasonable that if students' mathematical domain knowledge is not influenced by the viewing behaviour, as mentioned above, it is also not found in the influence of students' perceived usefulness on their mathematical domain knowledge. However, this could also be due to the manner of collecting data. Specifically, the data of students’ viewing behaviour and their perceived usefulness was collected at the same time. Therefore, it is likely that when they viewed the videos, they immediately indicated the instructional videos as useful in the viewing and usefulness survey. When these variables were measured separately, it could be more objectively determined whether there is a link between viewing behaviour and the perceived usefulness.

Moreover, looking into the results per topic, students’ domain mathematical knowledge of some topics was influenced by the perceived usefulness. These topics were new topics for students. This indicated that, as mentioned above, the perception of novelty could also play a part (Van der Meij, 2017). However, according to Blomstermo, Eriksson, Lindstrand, and Sharma (2004), another explanation could be that the perceived usefulness does not have to be ‘correct’. This means that the instructional video could help students, but those students rated these videos as useless based on incorrect perceptions. In this case, students did not find the video instructions useful and therefore may not have viewed it, sometimes based on a single video. According to the interviews, one student said she found the narrators voice annoying, and therefore did not view the rest of the videos, although she did not know if the instructional videos could help her. Tarka (2019) found a variable that influences ‘incorrect’ perceptions of usefulness, namely that these wrong perceptions can be due to limited cognitive capabilities. In this case, it could be that students, due to the limited capacity, did not monitor that they needed help. Therefore, they thought they did not need the instructional videos and so perceived them as useless. Further research could reveal whether this is reasonable.

An alternative explanation for the missing influence of students’ perceived usefulness on mathematical domain knowledge in this study could be the lack of interaction in the instruction (Hung, Kinshuk, & Chen, 2018). Some students said they preferred the teacher above the instructional video even though the teacher was not always available and so they had to wait. These students had questions that were not clarified in the video, and so they needed the teacher to answer them. Moreover, some students wanted to check if they were doing well; this too was not possible with the use of instructional videos. These findings are in line with Johnson and Priest (2014), and Hattie, Gan, and Brooks (2014), who said that the level of feedback influenced the perception of usefulness and students’ performances. Therefore, feedback is broadly identified as an effective method during instructions.

Furthermore, practice without feedback is not effective. In this study, video instructions were used as an additional informational support system for students; however, video instructions cannot provide individual feedback for students the same way a teacher can. As such, video instructions may not always be effective in every setting. Thus, to use instructional videos effectively, a form of feedback must be developed to address this need for individualized attention. One option could be interactive videos, which have been proven to be effective (Hung, Kinshuk, & Chen, 2018). By using interactive videos, students are no longer passively absorbing an instruction, but actively engaged in understanding the teaching content, which is beneficial for learning performances. In this study, instructional videos could be strengthened with interactive activities. It would be best if the feedback is not person-dependent so that the use of instructional videos can stimulate self-regulated learning. An example could be adding assignments to the instructional video. The system could check the answers and even decide whether extra instruction is needed or can continue with the next step.

A strong point of this study was that the research is based on a practical problem that Dalton teachers are involved with. Teachers want to help students as well as possible, but they cannot offer this help for every student at any given time. As a result of this study, teachers can use instructional videos for new subjects, so that students can use them when necessary and can continue their learning uninterrupted. However, there are still some limitations in this study. Firstly, as mentioned above, some students had to get used to the instructional videos and therefore did not make optimal use of them. This unfamiliarity could also affect the perception of usefulness. A familiarisation time could be added to overcome this problem (Beloufa, Cauchard, Vedrenne, Vailleau, Kemeny, Mérienne, & Boucheix, 2019; Chan, 2010; Ganier & De Vries, 2016). Moreover, future research could be conducted over a longer period to help students acclimate to the instructional videos, and so make better use of them overall and perhaps report a perception of greater usefulness.

Secondly, another limitation is the lack of interaction within instructional videos, as mentioned above. When feedback is added to the instructional video, the perception of usefulness might be enhanced, and so its success. Further research could be focused on the combination of instructional videos and feedback.

Thirdly, further research could be focussed on students' perception of novelty of the teaching material. This variable might have influenced the results of this study, but little is known about it.

Fourthly, another limitation is the lack of testing of the instructional videos. As mentioned in the method, the instructional videos were edited to meet the guidelines of Van der Meij & Van der Meij (2013). However, after editing, the instructional videos were not tested to check if it fits the target group. As a result, it cannot be determined whether the videos were suitable for the target group and whether this influenced the results of this study.

The last limitation of this study is the objectiveness of students' viewing behaviour. In the current design, the viewing behaviour is not objectively measured. As a result, it is not clear how students viewed the videos (e.g. did they view the instructional videos completely, and when and how often did they view it?) If the viewing behaviour was objectively measured, a better analysis could be done on the influence of students' viewing behaviour on their mathematical domain knowledge. In addition, when objectively measured, it would be possible to analyse which elements within students' viewing behaviour might influence the mathematical domain knowledge. An objective measurement could be added by offering the instructional videos in a controlled environment, where all data regarding students' viewing behaviour can be gathered, stored and evaluated.

## Conclusion

In sum, this research analysed the impact of the perceived usefulness of instructional videos and students' subsequent viewing behaviour on students' mathematical performances in a Dalton setting. The findings indicate that influence of both students' viewing behaviour and perceived usefulness on their mathematical domain knowledge was found within some new topics. Other topics were not new but were deepened and here no influence of both students' viewing behaviour and perceived usefulness on their mathematical domain knowledge was found. Therefore, it seems that the novelty of the teaching material influenced the results in this study.

These are interesting findings in the field of Dalton education; instructional videos make it easier for students to regulate their own learning during the monitoring phase of self-regulated learning. When Dalton students, through self-monitoring, perceive that their actions are not leading to the intended goal, they adjust their plan and find sources of help. By using instructional videos, students can be supported with help at any time, even when teachers are unable to assist personally. In this way, students can continue their learning without interruption and achieve the desired goals. The findings of this current study are useful in Dalton education because, with further research, students can use instructional videos as additional support for practising new topics on a daily basis and help students regulate their learning uninterrupted.

## References


Alsabawy, A., Carter-Steel, A., & Soar, J. (2016). Determinants of perceived usefulness of e-learning systems. *Computers in Human Behavior*, *64*, 843-858. doi:10.1016/j.chb.2016.07.065

Artelt, C., Baumert, J., McElvany, N., & Peschar, J. (2003). *Student approaches to learning*. Results from PISA 2000. Paris: OECD.

Beloufa, S., Cauchard, F., Vedrenne, J., Vailleau, B., Kemeny, A., Mérienne, F., & Boucheix, J. (2019). Learning eco-driving in a driving simulator: contribution of instructional videos and interactive guidance system. *Transportation Research Part F: Traffic Psychology and Behaviour, 61*, 201-216. doi:10.1016/j.trf.2017.11.010

Berends, R., & Wolthuis, H. (2014). *Focus op Dalton.* Deventer: Saxion Dalton University Press.

Blomstermo, A., Eriksson, K., Lindstrand, A., & Sharma, D. (2004). The perceived usefulness of network experiential knowledge in the internationalizing firm. *Journal of international Management 10*(3), 355-373. doi:10.1016/j.intman.2004.05.004

Boekaerts, M. (1997). Self-regulated learning: a new concept embraced by researchers, policy makers, educators, teachers, and students. *Learning and Instruction, 7*, 161-186. doi:10.1016/S0959-4752(96)00015-1

Boekaerts, M., & Corno, L. (2005). Self-regulation in the classroom: A perspective on assessment and intervention. *Applied Psychology, 54*(2), 199-231. doi:10.1111/j.1464-0597.2005.00205.x

Burke, L., & James, K. (2008). Powerpoint-based lectures in business education: an empirical investigation of student-perceived novelty an effectiveness. *Business Communication Quarterly, 71*(3), 277-296. doi:10.1177/1080569908317151

Chan, Y. (2010). Video instructions as support for beyond classroom learning. *Procedia Social and Behavioural Science, 9*, 1313-1318. doi:10.1016/j.sbspro.2010.12.326

Chu, Y., Palmer, S., & Persky, A. (2018). Assessing metacognition in the classroom: student help-seeking behaviour. *Currents in Pharmacy Teaching and Learning, 10*(11), 1478-1487. doi:10.1016/j.cptl.2018.08.011

Döş, I. (2013). Some model suggestions for measuring effective schools. *Procedia – Social and Behavioral Sciences, 116*, 1454-1458. doi:10.1016/j.sbspro.2014.01.415

Dove, A., & Dove, E. (2015). Examining the influence of a flipped mathematics course on preservice elementary teachers' mathematics anxiety and achievement. *Electronic Journal of Mathematics & Technology, 9*(2), 166-179.

Evers, R., Meier, J., Tack, A., Timmerman, M., Van der Burg, S., & Vos, C. (2009). *Praktijkverbetering: Samenwerken binnen het speciaal onderwijs vanuit de onderwijsvorm Dalton* (Bachelorthesis). Rijksuniversiteit Groningen, Groningen.

Fiorella, L., & Mayer, R. (2018). What works and doesn't work with instructional video. *Computers in Human Behavior 89*, 465-470. doi:10.1016/j.chb.2018.07.015

Ganier, F., & De Vries, P. (2016). Are instructions in video format always better than photographs when learning manual techniques? The case of learning how to do sutures. *Learning and instruction, 44*, 87-96. doi:10.1016/j.learninstruc.2016.03.004

Geller, D., & Bamberger, P. (2012). The impact of help seeking on individual task performance: The moderating effect of help seekers' logics of action. *Journal of Applied Psychology, 97*(2), 487–497. doi:10.1037/a0026014

Gundlach, E., Richards, K., Nelson, D., & Levesque-Bristol, C. (2015). A comparison of student attitudes, statistical reasoning, performance, and perceptions for web-augmented traditional, fully online, and flipped sections of a statistical literacy class. *Journal of Statistics Education, 23*(1), 1-33. doi:10.1080/10691898.2015.11889723

Hartley, A., Kieley, J., & Slabach, E. (1990). Age differences and similarities in the effects of cues and prompts. *Journal of Experimental Psychology: Human Perception and Performance, 16*(3), 523-537. doi:10.1037/0096-1523.16.3.523

Hattie, J., Gan, M., & Brooks, C. (2014). *Instruction based on feedback*. New York: Routledge.

He, W., Holton, A., Farkas, G., & Warschauer, M. (2016). The effects of flipped instruction on out-of-class study time, exam performance, and student perceptions. *Learning and Instruction, 45*, 61-71. doi:10.1016/j.learninstruc.2016.07.001

Hung, I., Kinshuk, N., & Chen, N. (2018). Embodied interactive video lectures for improving learning comprehension and retention. *Computers & Education, 117*, 116-131. doi:10.1016/j.compedu.2017.10.005

Johnson, C., & Priest, H. (2014). *The feedback principle in multimedia learning.* New York: Cambridge University Press.

Kistner, S., Rakoczy, K., Otto, B., Dignath-van Ewijk, C., Büttner, G., & Klieme, E. (2010). Promotion of self-regulated learning in classrooms: Investigating frequency, quality, and consequences for student performance. *Metacognition and Learning, 5*(2), 157–171. doi:10.1007/s11409-010-9055-3

Lin, K., Lu, H. (2011). Why people use social networking sites: An empirical study integrating network externalities and motivation theory. *Computer Human Behaviour, 27*(3), 1152–1161. doi:10.1016/j.chb.2010.12.009

Lopes, A., & Soares, F. (2018). Perception and performance in a flipped Financial Mathematics classroom. *The International Journal of Management Education, 16*, 105–113. doi:10.1016/j.ijme.2018.01.001

Lumthong, D. (2010). The effects of feedback styles on visual art development: An application of feedback and feedforward approaches. Bangkok: Chulalongkorn University.

Mayer, R. (2001). *Multimedia Learning*. Cambridge, NY: Cambridge University Press.

Mega, C., Ronconi, L., & De Beni, R. (2014). What makes a good student? How emotions, self-regulated learning, and motivation contribute to academic achievement. *Journal of Educational Psychology, 106*(1), 121-131. doi:10.1037/a0033546

Moshabab, A. (2017). Dental students' perception of an online learning. *The Saudi Dental Journal 29*(4), 167-170. doi:10.1016/j.sdentj.2017.03.005

Mouratidis, A., Vansteenkiste, M., & Lens, W. (2010). How you provide corrective feed-back makes a difference: The motivating role of communicating in an autonomy-supporting way. *Journal of Sport & Exercise Psychology 32*, 619–637. doi:10.1123/jsep.32.5.619

O'Bannon, B., & Thomas, K. (2014). Teacher perceptions of mobile phones in the classroom: Age matters! *Computer & Education, 74,* 15-25. doi:10.1016/j.compedu.2014.01.006

O'Flaherty, J., & Phillips, C. (2015). The use of flipped classrooms in higher education: A scoping review. *Internet and Higher Education, 25*, 85-95. doi:10.1016/j.iheduc.2015.02.002

Paloş, R., Munteanu, A., Costea, I., & Macsinga, I. (2011). Motivational and cognitive variables with impact on academic performance – Preliminary study. *Procedia-Social and Behavioural Sciences, 15,* 138–142. doi:10.1016/j.sbspro.2011.03.063

Paris, S., & Paris, A. (2001). Classroom Applications of Research on Self-Regulated Learning. *Educational Psychologist*, *36*, 89-101. doi:10.1207/S15326985EP3602_4

Perry, N., Phillips, L., & Dowler, J. (2004). Examining Features of Tasks and Their Potential to Promote Self- Regulated learning. *Teachers College Record*, *106*, 1854-1878. doi:10.1111/j.1467-9620.2004.00408.x

Pintrich, P. (2002). *The role of goal orientation in self-regulated learning.* In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.). Handbook of self-regulation (pp. 451–502). San Diego: CA: Academic Press.

Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review, 16*, 385–407. doi:10.1007/s10648-004-0006-x

Pintrich, P., & De Groot, E. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*(1), 33–40. doi:10.1037/0022-0663.82.1.33

PO Raad. (2017). *Op de formatietafel: kleinere klassen.* Retrieved from: https://www.poraad.nl/nieuws-en-achtergronden/op-de-formatietafel-kleinere-klassen

Richardson, J., & Swan, K. (2003). Examining social presence in online courses in relation to students' perceived learning and satisfaction. *Journal of Asynchronous Learning Networks, 7*(1), 68-88. doi:10.4236/ce.2014.58072

Schunk, D. (2005). Self-regulated learning: The educational legacy of Paul R. Pintrich. *Educational psychologist, 40*, 85–94. doi:10.1207/s15326985ep4002_3

Seker, M. (2015). The use of self-regulation strategies by foreign language learners and its role in language achievement. *Language Teaching Research, 20*(5), 600-618. doi:10.1177/1362168815578550

Shah, R., & Gupta, R. (2017). Video instruction is more effective than written instruction in improving inhaler technique. *Pulmonary Pharmacology & Therapeutics*, *46*, 16-19. doi:10.1016/j.pupt.2017.08.005

Sinha, N., & Glassa, A. (2015). Delayed but not immediate, feedback after multiple-choice questions increases performance on a subsequent short-answer but not multiple-choice, exam: evidence for the dual-process theory of memory. *Journal of General Psychology 142*, 118-134. doi:10.1080/00221309.2015.1024600

Sins, P. (2014). De effectiviteit van Reflectie. In R.F. Berends & P.H.M. Sins (red). *Reflectie in het daltononderwijs: geschiedenis, praktijk en onderzoek.* Deventer: Saxion Dalton University Press.

Spruce, R., & Bol, L. (2015). Teacher beliefs, knowledge, and practice of self-regulated learning. *Metacognition and Learning, 10*(2), 245-277. doi:10.1007/s11409-014-9124-0

Stevens, L. (1997). *Over denken en doen. Een pedagogische bijdrage aan adaptief onderwijs.* Den Haag: Procesmanagement WSNS.

Tan, C., Yue, W., & Fu, Y. (2017). Effectiveness of flipped classrooms in nursing education: systematic review and meta-analysis. *Chinese Nursing Research 4*, 192-200. doi:10.1016/j.cnre.2017.10.006

Tarka, P. (2019). Manager' cognitive capabilities and perception of market research usefulness. *Information Processing and Management, 56*, 541-553. doi:10.1016/j.ipm.2018.11.005

Trautwein, U., & Koller, O. (2003). The relationship between homework and achievement-still much of a mystery. *Educational Psychology Review, 15*, 115–145. doi:10.1023/A:1023460414243

Trilling, B., & Fadel, C. (2009). *21st century skills.* San Francisco: Jossy-Bass.

Tulis, M., Steuer, G., & Dresel, M. (2016). Learning from errors: A model of individual processes. *Frontline Learning Research, 4*(2), 12-26. doi:10.14786/flr.v4i2.168

Van der Meij, H. (2017). Reviews in instructional video. *Computer & Education, 114*, 164-174. doi:10.1016/j.compedu.2017.07.002

Van der Meij, H., & Van der Meij, J. (2013). Eight guidelines for the design of instructional videos for software training. *Technical Communication 60*, 205-228.

Van Dijk, A. (2017). *Learning together in mixed-ability elementary classrooms*. Enschede: University of Twente.

Van Lear, S., & Elen, J. (2019). The effect of cues for calibration on learners' self-regulated learning through changes in learners' learning behaviour and outcomes. *Computers & Education, 135*, 30-48. doi:10.1016/j.compedu.2019.02.016

Vermeulen, M., & Vrieling, E. (2017). *21e-eeuwse vaardigheden: Achtergronden en onderwijsimplicaties in 17 vragen en antwoorden*. Heerlen: Open Universiteit.

Vredenburgh, C., & Kushnir, T. (2015). Young children's help-seeking as active information gathering. *Cognitive Science 40*(3), 697-722. doi:10.1111/cogs.12245

Was, A., & Warneken, F. (2017). Proactive help-seeking: Preschoolers know when they need help, but do not always ask for it. *Cognitive Development 43*, 91–105. doi:10.1016/j.cogdev.2017.02.010

Weinstein C., & Mignano, A. (2007). *Elementary classroom management: lessons from research and practice.* New York: McGraw-Hill.

Winne, P. (2005). A perspective on state-of-the-art research on self-regulated learning. *Instructional Science, 33*, 559–565. doi:10.1007/s11251-005-1280-9

Xiao, Y. & Yang, M. (2019). Formative assessment and self-regulated learning: How formative assessment supports students' self-regulation in English language learning. *System, 81*, 39-49. doi:10.1016/j.system.2019.01.004

Zimmerman, B. (2002). Becoming a self-regulated learner: an overview. *Theory into practice, 41*(2), 64-70. doi:10.1207/s15430421tip4102_2

Zimmerman, B. (2008). Investigating self-regulation and motivation: Historical back-ground, methodological developments, and future prospects. *American Educational Research Journal, 45*(1), 166–183. doi:10.3102/0002831207312909

## Appendix

**Appendix 1:**

### Pre-test video instructions 5th grade

Naam: ………………………………………………….                                    Groep: 7

**Opdracht 1:**
Maak de volgende sommen.

$\frac{3}{8} + \frac{1}{4} =$

$\frac{3}{5} + \frac{7}{10} =$

$\frac{5}{14} + \frac{5}{7} =$

$\frac{5}{6} - \frac{1}{3} =$

$1\frac{1}{6} - \frac{2}{3} =$

**Opdracht 2:**

a) Loes bezorgt elke week 354 kranten. Hoeveel bezorgd Loes in 5 weken?

b) Tim fietst elke dag 17 kilometer. Hoeveel kilometer fietst hij in een jaar?

c) Rik koopt elke week voor 162 euro aan boodschappen. Hoeveel moet hij voor 29 weken betalen?

d) Een trui kost 33.65 euro. Op een drukke dag zijn er 37 van verkocht. Hoeveel euro ontvangt de winkel hiervoor?

e) Een groep van 63 mensen gaat naar de film. Een kaartje kost 7.95 euro. Hoeveel moet deze groep betalen?

**Opdracht 3:**

a) Een concert verdient 912 aan de kaartverkoop. De kaartjes zijn 24 euro per stuk. Hoeveel kaartjes zijn er die avond verkocht?

| H | T | E |
|---|---|---|
| 9 | 1 | 2 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

b) Een school gaat op schoolreisje met bussen. De school heeft 988 kinderen. In elke bus passen 26 kinderen. Hoeveel bussen moeten er worden gehuurd om iedereen mee te nemen?

| H | T | E |
|---|---|---|
| 9 | 8 | 8 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

c) Sharon heeft 3038 foto's gemaakt. Ze kan er 46 op elke pagina plakken. Hoeveel pagina's heeft ze nodig?

| D | H | T | E |
|---|---|---|---|
| 3 | 0 | 3 | 6 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

d) Een stuk grond van 6877 $m^2$ wordt in 23 gelijke stukken verdeeld. Hoe groot is elk stuk?

| D | H | T | E |
|---|---|---|---|
| 6 | 8 | 7 | 7 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

e) Een theater heeft 6270 euro voor kostuums. De kostuums kosten 38 per stuk. Hoeveel kostuums kan het theater halen?

| D | H | T | E |
|---|---|---|---|
| 6 | 2 | 7 | 0 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**Opdracht 4:**

a) Een zwembad is 25m lang, 20 m breed en 2 m diep. Wat is de inhoud van dit zwembad?

_____________________________ $m^3$

b) Een luciferdoosje is 4 centimeter lang, 5,5 centimeter breed en 2 centimeter hoog. Wat is de inhoud van het luciferdoosje?

___________________ $cm^3$

c) De doos is 7 decimeter lang, 20 centimeter breed en 5 centimeter hoog. Wat is de inhoud van deze doos?

______________________________ $cm^3$

d) Een rechthoekige doos heeft de inhoud van 240 $dm^3$. Wat zouden de afmetingen kunnen zijn?

______________ dm x __________________dm x ___________________dm

e) Een rechthoekige doos heeft de inhoud van 600 $dm^3$. Wat zouden de afmetingen kunnen zijn?

______________ dm x __________________dm x ___________________dm

**Opdracht 5:**

a) Een lint is $1\frac{1}{2}$ meter lang. Ik heb 18 van deze linten gekocht. Hoeveel meter heb ik in totaal?

____________________________ m

b) In een zak zand zit $3\frac{1}{4}$ kilogram. Ik heb 4 zakken gekocht. Hoeveel kilogram zand heb ik?

____________________________ kg

c) Gijs heeft $2\frac{1}{2}$ keer zoveel geld als Tom. Tom heeft 5 euro. Hoeveel euro heeft Gijs dan?

____________________________ euro

d) Een zwembad is $4\frac{1}{5}$ bij 15 meter. Wat is de oppervlakte van het zwembad?

____________________________ $m^3$

e) Een kilo aardbeien kost €6,00. Ik koop $2\frac{1}{4}$ kilo? Hoeveel moet ik betalen?

____________________________ euro

## Post-test video instructions 5th grade

Naam: ………………………………………………………. Groep: 7

**Opdracht 1:**
Maak de volgende sommen.

$\frac{2}{9} + \frac{2}{3} =$

$\frac{5}{6} + \frac{7}{12} =$

$\frac{7}{15} + \frac{3}{5} =$

$\frac{11}{12} - \frac{1}{6} =$

$1\frac{1}{8} - \frac{1}{2} =$

**Opdracht 2:**

a) Loes bezorgt elke week 278 kranten. Hoeveel bezorgd Loes in 5 weken?

b) Tim fietst elke dag 19 kilometer. Hoeveel kilometer fietst hij in een jaar?

c) Rik koopt elke week voor 143 euro aan boodschappen. Hoeveel moet hij voor 27 weken betalen?

d) Een trui kost 42.35 euro. Op een drukke dag zijn er 34 van verkocht. Hoeveel euro ontvangt de winkel hiervoor?

e) Een groep van 54 mensen gaat naar de film. Een kaartje kost 8.95 euro. Hoeveel moet deze groep betalen?

**Opdracht 3:**

a) Een concert verdient 924 aan de kaartverkoop. De kaartjes zijn 22 euro per stuk. Hoeveel kaartjes zijn er die avond verkocht?

| H | T | E |
| --- | --- | --- |
| 9 | 2 | 4 |
| | | |
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| | | |
| | | |

b) Een school gaat op schoolreisje met bussen. De school heeft 962 kinderen. In elke bus passen 26 kinderen. Hoeveel bussen moeten er worden gehuurd om iedereen mee te nemen?

| H | T | E |
| --- | --- | --- |
| 9 | 6 | 2 |
| | | |
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| | | |
| | | |

c) Sharon heeft 4089 foto’s gemaakt. Ze kan er 47 op elke pagina plakken. Hoeveel pagina’s heeft ze nodig?

| D | H | T | E |
|---|---|---|---|
| 4 | 0 | 8 | 9 |
| | | | |
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d) Een stuk grond van 6291 $m^2$ wordt in 27 gelijke stukken verdeeld. Hoe groot is elk stuk?

| D | H | T | E |
|---|---|---|---|
| 6 | 2 | 9 | 1 |
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e) Een theater heeft 6698 euro voor kostuums. De kostuums kosten 34 per stuk. Hoeveel kostuums kan het theater halen?

| D | H | T | E |
|---|---|---|---|
| 6 | 6 | 9 | 8 |
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**Opdracht 4:**

a) Een zwembad is 20m lang, 15 m breed en 3 m diep. Wat is de inhoud van dit zwembad?

____________________________ $m^3$

b) Een luciferdoosje is 3 centimeter lang, 6,5 centimeter breed en 1 centimeter hoog. Wat is de inhoud van het luciferdoosje?

___________________ $cm^3$

c) De doos is 6 decimeter lang, 30 centimeter breed en 5 centimeter hoog. Wat is de inhoud van deze doos?

_____________________________ $cm^3$

d) Een rechthoekige doos heeft de inhoud van 300 $dm^3$. Wat zouden de afmetingen kunnen zijn?

______________ dm x __________________dm x ___________________dm

e) Een rechthoekige doos heeft de inhoud van 800 $dm^3$. Wat zouden de afmetingen kunnen zijn?

______________ dm x __________________dm x ___________________dm

**Opdracht 5:**

a) Een lint is $1\frac{1}{2}$ meter lang. Ik heb 16 van deze linten gekocht. Hoeveel meter heb ik in totaal?

___________________________ m

b) In een zak zand zit $2\frac{1}{3}$ kilogram. Ik heb 6 zakken gekocht. Hoeveel kilogram zand heb ik?

___________________________ kg

c) Gijs heeft $3\frac{1}{2}$ keer zoveel geld als Tom. Tom heeft 7 euro. Hoeveel euro heeft Gijs dan?

______________________________ euro

d) Een zwembad is $2\frac{1}{6}$ bij 18 meter. Wat is de oppervlakte van het zwembad?

______________________________ $m^3$

e) Een kilo aardbeien kost €10,00. Ik koop $3\frac{1}{4}$ kilo? Hoeveel moet ik betalen?

______________________________ euro

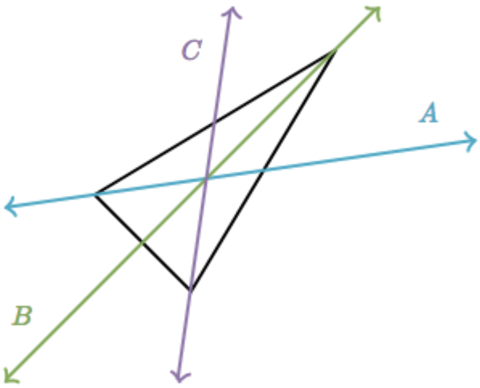
**Pre-test video instructions 6th grade**

Naam: …………………………………………………. Groep: 8

**Opdracht 1:**

a) Welk figuur is niet symmetrisch? Zet er een kruis door.

b) Welke lijn is symmetrieas?




Lijn: ___________________

c) Teken een symmetrieas in het onderstaande figuur.

d) Op hoeveel symmetrieassen heeft dit figuur?

Op _______________________ manier(en)

e) Op hoeveel manieren is dit figuur punt symmetrisch?

Op ________________ manier(en)

**Opdracht 2:**
Gebruik je rekenmachine bij deze opdracht.

54 : 6 + 8 x 6 =

44 - 2 - 4 x (8 - 5) =

5 x 4 + (12 + 36) : 6 - 4 =

(52 - 3) : 7 - 32 : 8 =

26 - (11 - 3) x 2 + (28 - 1) : 3 =

**Opdracht 3:**

$1\frac{1}{7} + 1\frac{9}{10} =$

$\frac{3}{8} \times 48 =$

$1\frac{1}{6} - \frac{2}{3} =$

$6 : \frac{1}{4} =$

$\frac{1}{7} \times 630 =$

**Opdracht 4:**

a) Een theater heeft 7952 euro voor kostuums. De kostuums kosten 56 euro per stuk. Hoeveel kostuums kan het theater halen?

| D | H | T | E |
|---|---|---|---|
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b) Sharon heeft 9486 foto's gemaakt. Ze kan 62 foto's per boekje afdrukken. Hoeveel boekjes heeft ze nodig?

| D | H | T | E |
|---|---|---|---|
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c) Een weg van 991,8 meter wordt opgedeeld in blokken van 38 meter. Hoeveel blokken heeft de weg?

| D | H | T | E |
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d) Een groep van 32 mensen moet € 78,72 betalen. Hoeveel is dat per persoon?

| D | H | T | E |
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e) Een pizza kost €3,90. Er wordt €19,50 betaalt. Hoeveel pizza's zijn er gehaald?

| D | H | T | E |
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**Opdracht 5:**
Bij de volgende opdrachten zijn meerdere antwoorden goed.

a) Welke getallen zijn deelbaar door 2? Kies uit: 28 – 456 – 101 – 56 – 93.

________________________________________

b) Welke getallen zijn deelbaar door 5? Kies uit: 205 – 43 – 98 – 60 – 86.

________________________________________

c) Welke getallen zijn deelbaar door 3? Kies uit: 45 – 129 – 25 – 102 – 136.

________________________________________

d) Door welke getallen is 72 deelbaar? Kies uit: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

________________________________________

e) Welke getallen zijn priemgetallen? Kies uit: 13, 15, 19, 23, 26.

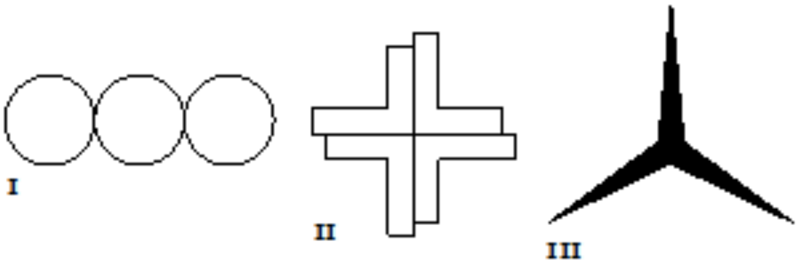
________________________________________

## Post-test video instructions 6th grade

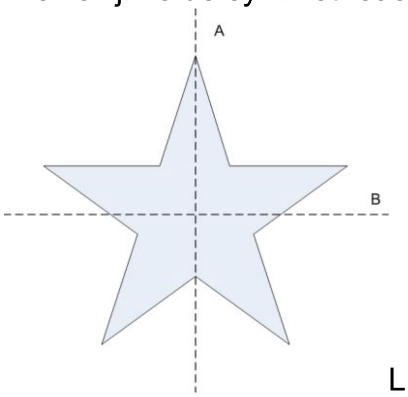
Naam: …………………………………………………….                                        Groep: 8

**Opdracht 1:**

a) Welk figuur is niet symmetrisch? Zet er een kruis door.



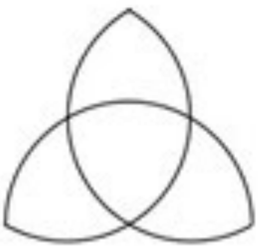

b) Welke lijn is de symmetrieas?




Lijn: __________________

c) Teken een symmetrieas in het onderstaande figuur.

d) Hoeveel symmetrieassen heeft dit figuur?



______________________ symmetrieassen

e) Op hoeveel manieren is dit figuur punt symmetrisch?

Op __________________ manier(en)

**Opdracht 2:**
Gebruik je rekenmachine bij deze opdracht.

4 x 9 - 27 : 3 =

58 - 54 : 9 x (7 - 6) - 5 =

8 x 7 + (16 + 19) : 5 - 4 =

(10 - 8) x (5 + 6) - 15 : 5 =

52 - (9 - 7) x 2 + (103 - 47) : 7 =

**Opdracht 3:**

$1\frac{4}{9} + 1\frac{3}{5} =$

$\frac{6}{8} \times 32 =$

$1\frac{2}{3} - \frac{13}{15} =$

$5 : \frac{1}{3} =$

$\frac{1}{8} \times 640 =$

**Opdracht 4:**

a) Een theater heeft 8294 euro voor kostuums. De kostuums kosten 58 euro per stuk. Hoeveel kostuums kan het theater halen?

| D | H | T | E |
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b) Sharon heeft 9016 foto's gemaakt. Ze kan 49 foto's per boekje afdrukken.
Hoeveel boekjes heeft ze nodig?

| D | H | T | E |
| --- | --- | --- | --- |
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c) Een weg van 801,9 meter wordt opgedeeld in blokken van 33 meter. Hoeveel blokken heeft de weg?

| D | H | T | E |
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d) Een groep van 36 mensen moet € 78,84 betalen. Hoeveel is dat per persoon?

| D | H | T | E |
|---|---|---|---|
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e) Een pizza kost €4,40. Er wordt €26,40 betaalt. Hoeveel pizza’s zijn er gehaald?

| D | H | T | E |
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**Opdracht 5:**

Bij de volgende opdrachten zijn meerdere antwoorden goed.

a) Welke getallen zijn deelbaar door 2? Kies uit: 26 – 378 – 143 – 80 – 95.

__________________________________________

b) Welke getallen zijn deelbaar door 5? Kies uit: 315 – 54 – 99 – 70 – 103.

__________________________________________

c) Welke getallen zijn deelbaar door 3? Kies uit: 48 – 138 – 28 – 93 – 127.

__________________________________________

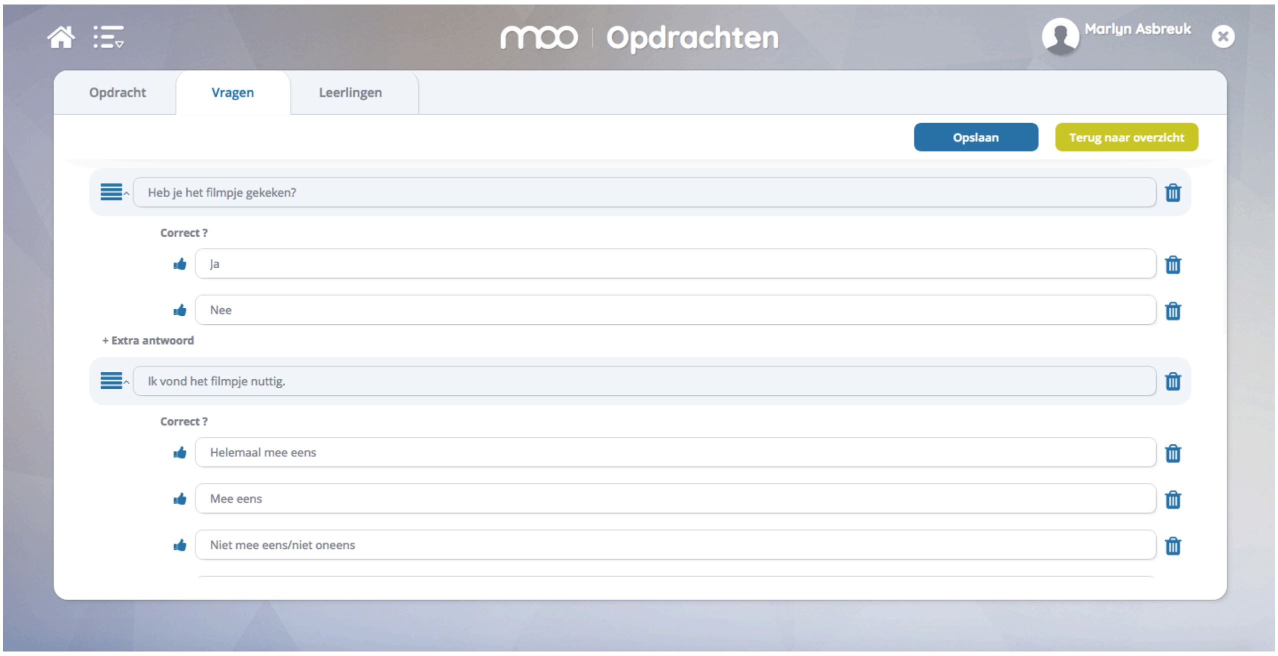
d) Door welke getallen is 48 deelbaar? Kies uit: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

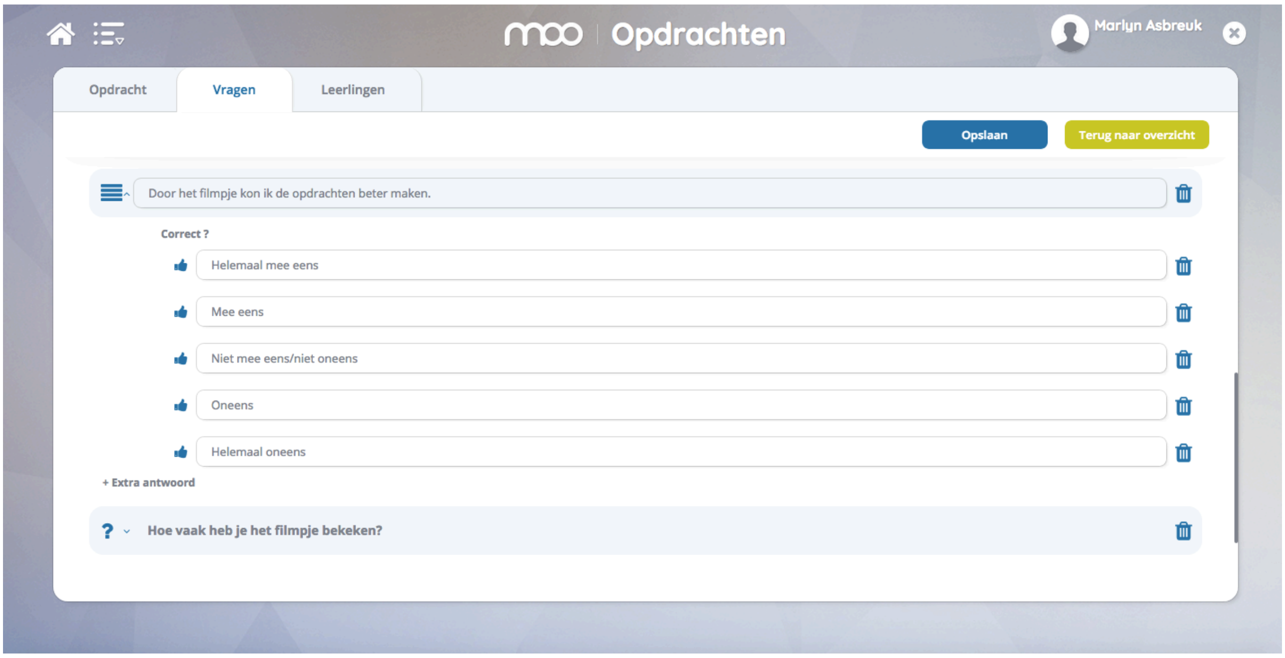
__________________________________________

e) Welke getallen zijn priemgetallen? Kies uit: 11, 14, 21, 25, 29.

__________________________________________

## Appendix B:


Opdrachten
Marlyn Asbreuk
Opdracht
Vragen
Leerlingen
Opslaan
Terug naar overzicht
Heb je het filmpje gekeken?
Correct ?
Ja
Nee
+ Extra antwoord
Ik vond het filmpje nuttig.
Correct ?
Helemaal mee eens
Mee eens
Niet mee eens/niet oneens


Opdrachten
Marlyn Asbreuk
Opdracht
Vragen
Leerlingen
Opslaan
Terug naar overzicht
Door het filmpje kon ik de opdrachten beter maken.
Correct ?
Helemaal mee eens
Mee eens
Niet mee eens/niet oneens
Oneens
Helemaal oneens
+ Extra antwoord
Hoe vaak heb je het filmpje bekeken?