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Video instruction with explanation to another person for intellectually disabled students

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Abstract

Intellectually disabled (ID) students in secondary education are often taught in an individual setting where video instruction is used. Especially, when the instruction is about complex assignments, many students may forget parts of it. In this study, we tried to find out if prompting ID students to explain video instruction would help them to improve their performance. Research with regular students indicated that explaining instructional materials can be effective (Roy & Chi, 2005).

In a first experiment with 41 ID students in Dutch secondary education, we varied the complexity of assignments and compared students who first watched and then explained video instruction of assignments (n=21) with students who watched twice but were not required to explain (n=20). It turned out that only for complex assignments, explaining to another person was more effective for students' task performance than just watch video instruction.

In the second experiment with 58 ID students, we repeated the study with complex assignments. The students in the experimental group (n=29) improved more after explaining video instructions than the students who only watched videos (n=29). The experimental group also had a more complete mental representation of an assignment and could better assess how well they had performed it.

Introduction

Instructional videos are often used in secondary and higher education to motivate students or briefly explain a process or procedure (Kay, 2012). In the Netherlands, intellectually disabled (ID) students (APA, 2013) aged 12 to 18 receive Practical Education (Dutch abbreviation is PrO). Instructional videos are often used to teach them how to perform practical assignments (example: trimming hedges, mopping floors, following a recipe or folding napkins). Students learn by observing. This observational learning can be very effective (Bandura et al., 1966, Paas, 2007; van Gog, 2013) especially when the instructional video meets certain conditions in presenting the information (Clark & Mayer, 2014).

Intellectually disabled students often have trouble absorbing instructional videos if the assignments are complex and involve a series of steps. In the case of complex assignments, just watching and listening to the instructional video may not be challenging enough for the students to actively process and remember the steps (Blik, Naayer, van Leeuwen & Hoekstra, 2016).

A method to stimulate students to consciously process the instruction for a complex assignment is to ask them to retell what they saw and heard. Prompting students to explain the instruction improves students' comprehension of a task more than no prompting or teacher explanation (Chi, 2009; Rosenberg et al., 2011). As yet, it is not fully understood why explaining to oneself or to another person improves one's understanding of new information. Supposedly, explaining helps learning because it requires the learner to recognize the main parts in written information or video instruction and relate them to a pattern or rule (Lombrozo, 2013; Roy & Chi, 2005).

Roscoe and Chi (2008) concluded from their research that it is often more effective to get students to explain the material to themselves than to a teacher or a

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classmate. This conclusion is, however, challenged by others. According to Hoogerheide et al. (2016) and Fiorella and Mayer (2013, 2014), explaining an assignment to another person is a more effective way of stimulating students to absorb video instruction. According to them, if students know that they have to explain an assignment to someone else, they not only focus on the main points in the instruction but also on details that are important to performing the assignment correctly. Telling the students upfront that they have to explain the instructional video to another person creates more *teaching expectancy* than asking them to explain it to themselves (Fiorella & Mayer, 2013).

The above studies were mainly conducted on procedural assignments (in mathematics and science, among others) in high school and college. Most studies examined whether students' explanations resulted in transfer of knowledge and no literature was found pertaining to ID students or practical assignments (see section 2).

This study focuses on practical procedural assignments that have to be performed as demonstrated (folding napkins). We chose to let the students explain the assignment to another person. It is probably easier for ID students to explain an assignment to another person than to themselves because it requires less self-control (Liu & Xin, 2016). In our study, the main question is: *What effect does explaining an instructional video to another person have on the task performance of ID students?*

Theoretical framework

Although there is ample research literature about the effect of students' explanations on students skills and transfer of knowledge, we are unaware of studies in which ID students were involved, despite a thorough literature search in the electronic databases: ERIC, PsycInfo, PsycArticles SmartCat, SocINDEX and Web of Science with the keywords *self-explanation, learning disability, intellectual disability* and *video instruction*. We did find publications about ID students self-regulation, self-determination and video modeling, but not about self-explanation.

In the next two sections, we will discuss research with students in high school and college on the effect of students' explanation after video instruction.

Instructional video and explanation to another person

When an instructional video demonstrates a complex assignment, students will need additional stimulation in order to remember it (de Koning et al., 2009; Renkl, 2005). Students are more likely to make an additional effort to remember what they see and hear in the video if they are told that they will be explaining it to another person after watching it (see section 1) and are asked to think about the steps in their own words while watching it (Humphrey & Underwood, 2011).

Several researchers have demonstrated that ID students are capable of verbalizing instructions (Montague, 2008; Short et al., 1991; Swanson, 2001). Verbalizing instructions helps students create a mental representation of an assignment, meaning that they can recall each of the steps and activities after the instruction (Montague, 2008; Nelson & Dunlosky, 1991). Students will generally not verbalize what they see and hear out loud without being prompted to do so. It benefits them to verbalize the instructions step by step in their own words.

Various researchers have studied the effect of explaining video instructions to another person. Hoogerheide et al. (2014a, 2014b) demonstrated that students in college who study a text and then explain it to another person have a better understanding of the contents and are able to apply the acquired knowledge better to exercises and new assignments (knowledge transfer). In their study, self-explanation had less effect than explaining the instruction to another student. Fiorella and Mayer (2013) studied the effect of explaining an instructional video to a fictitious other student in a computer program. Explaining the instructions to a fictitious other student was considerably more effective (effect size d = .77). Roscoe and Chi (2008), on the other hand, observed that explaining something to a fictitious other person in the form of video fragments was not as effective as self-explanation. Hoogerheide et al. (2016) point out that there are a few methodology issues with Roscoe and Chi's study (Roscoe & Chi, 2008). For example, it is not clear how much time students spent in the study groups explaining something to themselves and to someone else and how much time they spent on exercises. For the time being, we will assume that explaining something to another person after watching an instructional video is more effective than explaining it to oneself.

Hoogerheide et al. (2016) concluded from their study that explaining an assignment to another person is not the only factor that activates the students' ability to process information consciously but that 'social presence' also plays a role. In other words, explaining an assignment to another person only really helps students remember what they see and hear if they have to explain it to another person whose presence they acknowledge and with whom they want to interact.

In summary, explanation to another person is probably more motivating and effective for students than self-explanation. We can contend that research findings show that actively explaining an instructional video to another person can be a good way of getting students to follow instructions more attentively and therefore retain them better. Students who have to explain an instructional video to another person create a better mental representation of an assignment.

Possible effects of 'explanation to another person' for intellectually disabled students

In this study, we examine whether the positive effects of explaining instructions to another person also apply if the explanation is given by ID students. In contrast to students in a normal classroom, ID students are mainly given practical assignments that they have to perform in the same way as they are shown and explained to them (observational learning by modeling). Our expectation is that explaining the instructions to another person will stimulate students more than if they just watched an instructional video. Explaining will be especially effective for ID students for complex practical assignments. The complexity of an assignment can be determined by the number of steps the assignment has in relation to the capacity of the working memory of the student who has to remember and perform the assignment (van Merriënboer et al., 2006). We assume that assignments for ID students are cognitively more complex when they contain five or more steps and if the steps contain subactivities. Intellectually disabled students often have difficulty remembering such complex assignments in their entirety (see also Harvey et al., 2009). Having to explain the instructions to another person will motivate students to pay more attention while watching the video and rehearse mentally what they see and hear (Fuchs et al., 1995).

Students who perform an assignment after explaining it first to another person will probably have a better mental representation of the assignment's steps than students who only watched the instructional video. We can measure the mental representation by the subsequent explanation of the steps the student has to perform to complete the assignment. Chi (2009) recommends letting students explain an assignment that is representative of a specific field in a one-on-one discussion. Our assumption is that the more completely the steps can be described, the more complete the mental representation of the assignment will be.

We would like to examine whether students, after explaining an instructional video to another person, are not only capable of performing the assignment better but are also able to better assess how they performed the assignment. This assessment is referred to by Nelson and Dunlosky (1991) as judgement of learning. A correct self-assessment of one's own performance indicates that the student has a good understanding of the steps required to perform an assignment and can compare them with the steps he or she performed. Good self-assessment is an essential metacognitive skill. It indicates how well a student can reflect on his or her own work (De Bruin & van Gog, 2012; Thiede et al., 2003; Schraw, 2009).

Research questions and expectations

To our knowledge, no research has been conducted on the effect of explaining an instructional video for practical assignments to another person by ID students. It is also not clear at which level of complexity of an assignment active explanation of the instructional video has more effect than passive observation of the video. Yet, demonstrating the effect of the explanation to another person is important for the further development of instructional videos for ID students.

We asked research questions about the complexity of the assignments (Study I) and about the different effects that explaining complex assignments to another person may have on task performance and self-assessment (Study II). In both studies, we compared two groups: one group that watched and listened to an instructional video twice and another group that watched and listened to it once and explained it the second time.

In Study I, the research question is: *'At which level of complexity does explaining an instructional video to* *another person have an effect on the execution of practical assignments by ID students?'.*

We had less and more complex assignments. We assumed that practical assignments with five or more steps, some with subactivities in some of the steps, are complex. These assignments would put a greater demand on the students' working memory than less complex assignments, which could be remembered by just watching the instructional video. We wanted to find out whether the effect of explaining to another person occurred with complex assignments and not with less complex assignments.

In Study II, the research question is: *'Which effect does explaining the instruction of complex assignments have on how ID students perform the assignment, on their mental representation and on their self-assessment?'.*

We assumed that explaining a complex assignment to another person stimulates the student to watch the instruction more closely and retain the assignments better. The student needs to ask himself or herself whether he or she will remember enough to explain the steps in the assignment clearly to another person who is not familiar with it. This will enhance the mental representation of the assignment. We expected that when a student explains a complex assignment to another person, the student will perform the assignment more completely than a student just watching the video (see section 2.2). It is likely that explaining an assignment to another person will also result in a better self-assessment of the number of correctly performed steps (see also Metcalfe et al., 2007).

Study I

The instructional video

In order to test the effect of complexity of the assignments, we created four instructional videos. The assignments consisted of four different napkin folding techniques used in the hospitality industry. The steps were pretty much the same, but we varied the number of sub-activities in the steps. A sub-activity can be folding a napkin and turning it at the same time. Subactivities make the instruction of a step harder to grasp and retain.

The videos were all about the same length: 1.42 to 1.56 min. The number of steps was pretty much the same too: 5 or 6. But the assignments differed in the number of steps with subactivities (see Table 1).

We expect Assignment 2 and 4 to be the most difficult to remember and perform. Both assignments consist of two steps with subactivities. Assignment 3 is the next difficult assignment and has a step with two subactivities. We expect Assignment 1, which does not have any steps with subactivities, to be the easiest.

We applied multimedia principles to the composition of the instructional videos (Ibrahim et al., 2012). The following is a summary of our implementation.

Duration: The videos should not be too long. Students often stop paying attention after 5 or 6 min of video instruction (Hsin & Cigas, 2013; Guo et al., 2014).

We made videos that lasted about 2 min. We wanted to show each video twice.

Emphasizing the main points: The steps that are shown must be clearly separated and their relationship specified (Spanjers et al., 2010). In the videos, we showed how to fold napkins according to a number of techniques. Each assignment had a step-by-step plan with five or six steps. The video showed each step separately with a brief explanation of how a step relates to the previous step. There is a 2-s pause between two steps to give students time to process the new information and link it back to what they had already learned about the assignment. The camera was aimed at the steps that were key to performing the assignment. The video started with a brief introduction by the model who demonstrated the four assignments. The camera was focused on the model's hands (Figure 1) during the demonstration.

Synchronization of images and voice: The oral explanation in the video must be fully in sync with the images (Clark & Mayer, 2014). The explanation must

Table 1. List of Assignments in Study I

Folding assignments	Assignment 1	Assignment 2	Assignment 3	Assignment 4
	Fan 1	Fan 2	Envelope	Mitre
Duration	1.56 min	1.42 min	1.56 min	1.44 min
Steps	6	5	5	6
Steps with subactivities	0	2	1	2

Figure 1 Camera Aimed at the Right Place at the Right Time. [Colour figure can be viewed at wileyonlinelibrary.com]

clearly describe how a procedure is carried out in relation to the images without going into too much detail.

The videos demonstrate step-by-step how to fold a napkin using a technique, and the model explains the folding process at each step in a few sentences. Simple terms were used to explain straight, diagonal and back folding.

Personal approach: The video started with a model explaining in a clear voice what the students were going to do. The model also explained the assignment by describing the images in informal language (Clark & Mayer, 2014). Informal language and cues were used to show the students how to perform the steps in each assignment.

Random sample and procedure

The target group for our research were grade 7 ID students in the Netherlands. The students attended practical education in secondary schools. Between schools, the population of students in practical education does not differ much: the students have intelligence scores between 55 and 80 and the students' educational level is at least three years behind their peers in normal secondary education. We undertook two studies that had an experimental design. For each study, two schools from the north of the Netherlands were randomly chosen and the principal and teachers agreed to take part in our studies with their grade 7 students. In each school, we randomly assigned the students to two research conditions. The researchers manipulated the conditions and took care that within conditions each student received the same treatment. We expected effect sizes of about d = .80 and at least 40 students from the two participating schools per experiment. Given this amount of students, we estimated that the power of our t tests for independent cross sections of ID students for such a large effect would be around .80, which we deemed sufficiently high. Theoretically, the research design enabled us to draw causal conclusions about the effect of the conditions (Shadish et al., 2002).

In the first experiment, there were 41 ID students. The students were (as usual in grade 7 PrO) 12 to 14 years of age. Within schools, students were randomly assigned to an experimental or a control condition. The students of the same school were first grouped in pairs by sex and IQ scores, and then the students in each pair were distributed randomly between the two research conditions. As a result, in the first experiment, there were 21 students in the experimental condition and in the control condition 20 students.

The researchers visited the schools, and students were taken out of the classroom one by one during the study. The study was conducted in a separate room that was occupied only by the student and a researcher. The researcher told students in both groups that they would learn four napkin folding techniques that are used in restaurants: two assignments at that point in time and two at a later stage. The student and the researcher sat opposite each other at a table with a laptop with a 16-in screen that the researcher could not see (Figure 2). The 164 folding sessions (41 students × 4 sessions) were videotaped so that the researcher could later analyse them and give them a score.

The video instruction consisted of showing a video in which a folding task was performed. The student started the program by pressing a start button. Before the instructional video started, the student saw the teacher in the video. The teacher explained the goal of the folding assignment and that students had to pay attention during the instruction because they had to perform the assignments to the best of their ability after watching the video. For each assignment that was demonstrated and explained, the video showed how a napkin could be folded in a number of steps using a special technique. The instruction of an assignment lasted almost 2 min for each assignment (see Table 1).

In the *experimental group*, after the students had watched the instructional video once with sound, the researcher asked the students to verbalize the second viewing (without sound). The students gave the researcher an eyewitness account of what they saw in the video. When necessary, the researcher encouraged the students in the experimental group to say as much as possible when they watched the video for the second time. After the students had explained the instruction, they performed the folding assignment.

After the program started, the *control group* was shown the same instructional video twice with sound. Between

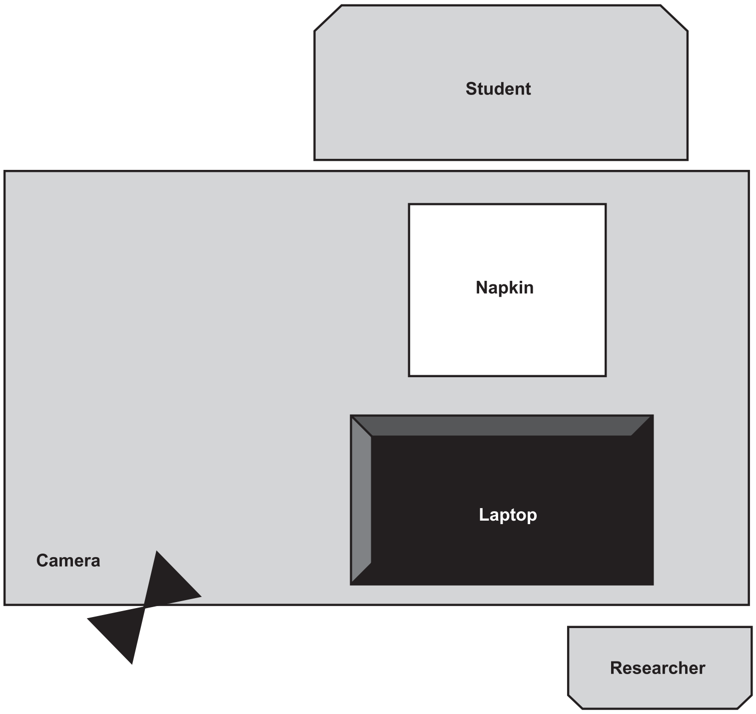

Figure 2 Setup for the Experiment

the first and the second viewing, the teacher told the students to think about the things they had not understood and to pay attention to them during the second viewing. The control group did not verbalize the folding assignment beforehand. The four folding assignments were spread over two sessions. Table 2 provides an overview.

Instruments

The execution of the folding assignments.

For each of the four assignments, the students received a score that varied from 0 to 3 (Table 3).

The four observations were made by two researchers. In order to optimize the inter-rater reliability, the execution of the four assignments was operationalized in a scoring system beforehand and the two researchers tested the system. The assignments were videotaped (Figure 2) and scored by a researcher. The 20 recorded assignments were used to measure the inter-rater reliability between the two researchers. The agreement was sufficiently high (Pearson's $r = 0.84$).

The students were in the first year of their training in PrO and had not done any hospitality-related activities or folded napkins. As a result of the matching and

Table 2. Design of Study I

Group	Session 1			Session 2		
	Instructional videos 1 and 2		Folding assignments 1 and 2	Instructional videos 3 and 4		Folding assignments 3 and 4
	First time	Second time		First time	Second time	
Experimental ($n = 21$)	Image and sound (Passive)	Image only, the student explains (Active)	Execution	Image and sound (Passive)	Image only, the student explains (Active)	Execution
Control ($n = 20$)	Image and sound (Passive)	Image and sound (Passive)	Execution	Image and sound (Passive)	Image and sound (Passive)	Execution

Table 3. Evaluation Schema for the Performance of the Assignments

Independence	Quality of the execution	Score
Did not work independently	Insufficient – the student did not work independently and asked for help.	0
Worked independently	Insufficient – one or more steps were skipped or executed incorrectly.	1
Worked independently	Sufficient – all of the steps were executed but the end product was not finished correctly.	2
Worked independently	Good – all of the steps were executed and the end product was finished correctly.	3

random assignment procedure (section 3.2) students' IQ scores and gender composition did not differ much between the two conditions. The control condition consisted of 9 boys and 11 girls, the experimental condition of 9 boys and 12 girls. The average IQ score in the control condition was 69.30 (SD = 8.97) and in the experimental condition 69.14 (SD = 6.52).

Implementation of the study conditions

The students in the experimental group were able to verbalize the assignments in all of the sessions. The explanation of the video instructions for the four assignments varied in completeness from very clear explanation with additional points that need attention to explanation in very short sentences and general references to the videos.

In the control group, most of the students were attentive and silent when they watched the video for the second time. Although some students indicated that they understood the assignment and did not think it necessary to watch the video again, all of the students watched the video twice.

The results

The four folding assignments were designed to have different degrees of difficulty. We expected differences between the two study groups in the execution of the assignments especially for the two most complex assignments (2 and 4). The average scores per study group for each of the four assignments are shown in Table 4.

Table 4 shows that the score for the more complex Assignment 4 shows the clearest difference between the two study groups (Cohen's d = 0.70). Forty-one ID students participated in the study as in control vs. experiment groups. For Assignment 4, Experimental group (M = 1.10, SD =1.14) vs. Control group (M = 0.40, SD = 0.82), t(40) = −2.25, p = 0.015, 95% CI [−1.32, 0.07].

First conclusions on Study I

As expected, the effect of explaining the assignment to another person is clearly visible for the more complex assignments. The effect is less prominent for the simplest assignment. The findings are in line with earlier studies that show that verbalization is effective for complex assignments with a number of related steps and subactivities, but not for easier assignments (Harvey et al., 2009; Schunk, 1986). It seems that explanation to another person of video instruction only has effect with complex assignments that have at least six steps and several subactivities in some steps. Our next Study II was designed to tests this assumption.

Table 4. Comparison between the Study Groups in the Execution of the Assignments

Assignment	Condition	*n*	Mean (*SD*) (0–3)	Cohen's *d*	*t*	*p*-Value (one-tailed)	Confidence interval
1	Control	20	1.65 (0.93)	0.41	−1.30	0.101	[−1.02; 0.22]
	Exp.	21	2.05 (1.02)				
2	Control	20	0.85 (1.09)	0.58	−1.88	0.034	[−1.20; 0.04]
	Exp.	21	1.43 (0.87)				
3	Control	20	1.30 (1.08)	0.48	−1.55	0.065	[−1.18; 0.16]
	Exp.	21	1.81 (1.03)				
4	Control	20	0.40 (0.82)	0.70	−2.25	0.015	[−1.32; 0.07]
	Exp.	21	1.10 (1.14)				

Study II

In this study, we tested whether explaining an instructional video of a complex assignment to another person had a positive effect on ID students' task performance. To date, no research has been conducted on how explaining something to another person affects ID students' learning ability. This is why we also tried to establish if students had a more complete mental representation of the assignment and better self-assessment. There was an experimental group of 29 students who explained five videos to a researcher after watching them for the first time and a control group of 29 students who watched the videos twice. We used a one-on-one research setting in the same way we did in Study I. We started focused on the responses of individual students to their research group. We asked the following research question (see section 2.3): *'Which effect does explaining instructional videos for complex assignments have on how ID students perform practical assignments, on their mental representation and on their self-assessment?'*

The instructional video

In this experiment, five folding assignments were devised based on the two most complex assignments in Study 1. The complexity of the assignments was in the number of steps (6 to 9) and in the number of additional subactivities they contained. For example, the combination of folding the napkin, turning it over and turning it upside down. Appendix 1 shows Assignment 2: folding a napkin as a mitre. It has six steps and two steps with additional subactivities.

Random sample and procedure

The same sampling procedure as in Study 1 was used. From the target group of first-year students (grade 7) of schools for PrO in the north of the Netherlands, the students of two schools were selected at random. There principal and teachers agreed to participate in the research. There were 58 grade 7 students in the schools: 38 boys and 20 girls. Within schools, the students were first paired by sex and IQ. The IQ score was established by the Wechsler Intelligence Scale for Children (WISC-III-NL). The pairs of students were distributed randomly between the two research conditions: 29 in the experimental condition and 29 in the control condition. In Study II, we applied the same procedure as in Study I (section 3.2). Table 5 shows the design of Study II.

Instruments

Degree of completeness in the execution of an assignment.

The 240 folding sessions (58 students × 5 sessions) were videotaped so that the folding assignments could be later analysed and assigned a score. Students were given 1 point for every step that was performed correctly. The folding assignments increased in complexity, the purpose being to continue stimulating students to pay attention during the video. The researcher stopped assigning scores as soon as a step was performed incorrectly. However, in order to encourage students, they were allowed to continue folding if they made a mistake they did not notice. A session was not ended unless the student indicated that he or she was lost or

Table 5. Design of Study II

Condition	Five instructional videos shown twice		Folding assignments 1 to 5	After assignment 5	After self-assessment
	During three sessions: Assignment 1 + 2; 3 + 4 and 5				
	First time	Second time			
Experimental (*n* = 29)	Image and sound (Passive)	Image only Student explains to researcher (Active)	Execution	Self-assessment of Assignment 5	Verbalize Assignment 5 (mental representation)
Control (*n* = 29)	Image and sound (Passive)	Image and sound (Passive)	Execution	Self-assessment of Assignment 5	Verbalize Assignment 5 (mental representation)

unable to continue. The scores for the folding assignments varied from 0 to a maximum of 6 or 9. The scores were added to reach a total score for the completeness of the execution of the assignments (score 0–36). The internal consistency of this total score is sufficiently high to conclude that the individual scores measured the same concept (Cronbach's alpha = 0.71).

Self-assessment

After the completion of the last folding assignment (7 steps), the students in both conditions were asked the following question after a 1-min break: *'You followed the video as much as possible for this assignment. If I told you now that the video shows seven folding steps, how many do you think you did?'*

If the students answered the question, the number of steps the students thought they had done was their score (at least 0 and at the most 7 steps). Students who could not state the exact number of steps were asked to estimate how many they had done: 'Two or three', 'Four or five', 'Six or Seven'. The numbers were averaged (e.g., 2.5, 4.5 and 6.5, respectively). The accuracy of the self-assessment was calculated by taking the absolute difference between the self-assessment score (0–7) and the execution score (0–7). If the difference was 0, the accuracy was optimal. Bigger differences represented less accuracy in the self-assessment.

Mental representation of the instructional video

One minute after the self-assessment, the students were asked the following question: *'Can you tell me which steps you saw in the video on how to execute the assignment?'*

If the students answered the question by describing a number of steps in the video and got the sequence right, the number of verbalized steps was their score. If a student answered: 'I cannot remember anymore' the student was asked the following question: *'What step did you start with?'* A student who could not remember or whose explanation of a step was unclear was then asked the following question: *'What was the step after ....? ' (The researcher repeats the step that the student mentioned last.)* A student who listed the steps in the wrong sequence or hesitated too long was asked the following question: *'What step did the assignment start with again?' or 'What was the step that came after the step to ....?'* (The last correct step that the student mentioned.) Scoring stopped if the student was not able to state a next step in the correct sequence. The scores for the verbalization were placed on a scale of 0–7 (correctly verbalized steps).

Analysis plan

Students performed five folding assignments during the intervention. The experimental group and the control group were compared in terms of (a) the number of steps completed in the execution of the five assignments, (b) the degree to which students were able to assess the number of steps they had performed correctly in Assignment 5 (self-assessment) and (c) the degree to which they were able to correctly repeat the steps in the same Assignment 5 (mental representation).

The analyses were done with *t*-tests for independent cross sections. The reliability intervals were studied and a significance level of 0.05 used for the assessment.

Study II results

Description of the study groups

At the beginning of the experiment, there was no reason to assume that there were differences between students in the knowledge of napkin folding. The students were all first-year students at two schools for PrO, and these techniques had not yet been taught. In terms of intelligence, both groups appeared to be very similar. The average IQ score in the experimental group was 72.46 (SD = 9.11) and in the control group 74.03 (SD = 8.35).

The two experimental conditions each had 29 students. There were 18 boys and 11 girls in the experimental condition and 20 boys and 9 girls in the control condition. We concluded that the two conditions were very similar in terms of the students' prior knowledge, sex and IQ scores.

Implementation of the study conditions

Sixty ID students took part in the study, and 58 students were able to attend all of the sessions. Over

Table 6. Overview of the Results of the Execution, Self-Assessment and Verbalization

	Condition	*n*	M (*SD*)	Cohen's *d*	t	*p*-Value (one tailed)	Confidence interval
Execution of folding assignments	Control	29	16.41 (6.48)				
(scale: 0–36)	Exp.	29	22.14 (5.38)	–0.97	–3.66	0.001	[–8.86; –2.59]
Self-assessment (scale: 7–0)	Control	29	1.02 (1.03)				
	Exp.	29	0.62 (0.70)	0.45	1.71	0.046	[–0.07; 0.86]
Mental representation (scale: 0–7)	Control	29	2.66 (2.22)				
	Exp.	29	4.52 (2.32)	–0.82	–3.12	0.002	[–3.06; –0.67]

a period of five weeks, these 58 students (29 in each condition) performed five folding assignments, the self-assessment and the verbalization assignment. Students performed the assignments independently in a separate room in which only the student and the researcher were present. The research procedure was the same as in Study 1 (section 3.2) and was followed successfully. The students in the experimental group were able to verbalize the five assignments. The verbalizations varied in completeness from extended explanations to explanations in short sentences referring to the main points in the video that was shown. In the control group, most of the students were attentive and silent when they watched the videos, also when they did it for the second time.

Results

Degree of execution of the five assignments

The scores for the execution of the five assignments were added into a total score ranging from 0 to 36. Table 6 shows that the students in the experimental group scored higher on average than the students in the control group. In the experimental group, the students scored on average 22.14 steps correctly (SD 5.38) and in the control group 16.41 steps (SD 6.48). The difference is statistically significant. The effect size of the total score for the degree of execution of the five assignments expressed in Cohen's *d* is –0.97. It confirms the assumption that explanation to another person helps ID students perform complex practical assignments.

Self-assessment

After finishing Assignment 5, students were asked to estimate how many steps in the instructional video they had performed correctly. Their estimate was compared with the steps that they had actually performed correctly. In the control group, the average difference between the estimated score for the execution of the assignment and the actual score for the assignment was 1.02 (SD = 1.03). The difference was smaller in the experimental group, namely 0.64 (SD = 0.73). The students in the experimental group were able to assess the steps they had performed better than the students in the control group (see Table 6). The difference is statistically significant. Explaining the instructional video to another

Table 7. Results of the Execution of the Five Assignments

Assignment	Condition	*n*	Mean (*SD*)	Cohen's *d*	*t*	*p*-Value (one tailed)	Confidence interval
1 (Scale 0–6)	Control	29	2.83 (1.67)				
	Exp.	29	3.21 (1.52)	–0.24	–0.90	0.185	[–1.22; –0.46]
2 (Scale 0–6)	Control	29	2.83 (1.54)				
	Exp.	29	3,79 (1.63)	–0.61	–2.32	0.012	[–1.80; –0.13]
3 (Scale 0–8)	Control	29	4.21 (2.41)				
	Exp.	29	6.28 (2.10)	–0.81	–3,48	0.001	[–3.26; –0.88]
4 (Scale 0–9)	Control	29	2.72 (1.98)				
	Exp.	29	3.83 (1.56)	–0.62	–2.36	0.011	[–2.04; –0.17]
5 (Scale 0–7)	Control	29	3.83 (2.04)				
	Exp.	29	5.03 (1.80)	–0.62	–2.39	0.010	[–2.22; –0.20]

person had a small but positive effect on the students' ability to accurately assess how they executed the assignment (Cohen's $d = 0.43$).

Mental representation of the video

The students were asked to verbalize the instructional video after Assignment 5. This took place about 3 min after the student finished the folding assignment.

The control group was able to verbalize 2.66 of the 7 steps. The experimental group was able to verbalize an average of 4.52 of the steps. The difference between the two conditions is statistically significant. Explaining the video to another person has a large effect on the students' mental representation of the video and enables students to better verbalize the instruction at a later stage (Cohen's $d = 0.82$).

Explorative analysis

In this explorative analysis, we first want to find out if the students who explained video instruction performed all assignments better than their counterparts in the control condition who did not explain. This assumption could be derived from theory (Roy & Chi, 2005). In Table 7 are the results.

The results in Table 7 show that in all but the first assignment, the assumption that the experimental group would outscore the control group could be supported. The first assignment was not different in complexity from the other assignments. It might be that the students had to get used to applying their explanation to the execution of their assignment.

Conclusions and recommendations

Conclusion

In Study I, we explored at which level of complexity of practical assignments explaining to another person has an effect on students' performance. Several researchers (Harvey et al., 2009; Schunk, 1986) indicated that the task to be observed during instruction should not be too easy to remember. In that case explaining has no extra value for understanding and remembering. We assumed that instruction in practical assignments would be more difficult to remember for students if there were five or more steps and if the steps contained extra subactivities. The study results show that explaining the instructional video to another person has effect. Cohen's d ranged from 0.41 and 0.48 for the simpler assignments to 0.58 and 0.70 for the complex assignments. Especially explaining the complex assignments, with five or more steps and extra subactivities in the steps, had great effect on students' performance.

The results of the study are in line with research on cognitive load (van Merriënboer et al., 2006) which shows that students learn more from complex assignments. The complexity of assignments depends on students' prior knowledge. If instruction has several new elements or novel relationships between elements, then the complexity of the task will suffice and students must pay attention in order to understand it (de Koning et al., 2009). The effects of the complex assignments were in the range we expected from previous research (Fiorella & Mayer, 2013, 2014), and we assumed that explaining videos of complex assignments had led to better student performance than just watching the video twice. In the next study, we wanted to seek support for this assumption but we also looked for more information as to how explaining a video led to better performance.

Study II confirmed the results of study I: ID students in the experimental group who explained the five instructional videos of complex assignments achieved a clearly higher score for the execution of the assignment than the ID students in the control group who only watched and listened. Only the first assignment was not completed at a higher level. But, this may be due to the lack of training the students had in applying their explanation to the execution of an assignment. In general, active explanation of the images shown in the video had a big and positive effect on the execution of the assignments (Cohen's $d = 0.97$).

Theory claims that the main reason for students to improve their completion of an assignment after explaining will be that students have a better mental representation of the assignment and remember it better when they start to perform it (Roy & Chi, 2005; Fiorella & Mayer, 2014). We determined that students who explained to another person were much more capable of a mental representation of the steps in the video than students who had only watched the video (Cohen's $d = 0.82$). This outcome seems to support the theory mentioned earlier. The analysis indicates that if students are cued to explain the video instruction then this leads to better mental representation, and in turn this may result into better performance. But, we could not test this assumption. In our study, better understanding and remembering of the assignment (mental representation) are also displayed by another effect: After the fifth assignment, students in the experimental group were better at assessing the number of steps they had performed correctly than students in the control group. Several researchers (de Bruin & van Gog, 2012; Thiede et al., 2003; Schraw, 2009) have indicated that the ability to self-assess one's performance is an important metacognitive skill. Our study shows that the experimental group of students was more capable of determining how far they got with an assignment after explaining the instructional video. They had improved insight into their execution of the assignment more than their peers in the control group. The results are in line with other research in which self-explanation and self-regulation are studied (e.g., Bielaczyc et al., 1995; McNamara et al., 2004). Explanation of instruction not only deepens understanding but also improves the monitoring skills of ID student in how well they execute their tasks.

Discussion

The aim of this study is to improve the video instruction students receive and add self-explanation to make learning from video more active and constructive for students. Although we used an experimental design to test the effects of self-explanation, our research did not show how explanation to others influences the task performance of students. There are some indications from literature that 'teaching expectancy' increases a student's attention to video instruction (Fiorella & Mayer, 2013) and that explanation to someone else increases a student's mental representation of the execution of the task (study 2), but we have no firm evidence that these two factors are the causal links between 'explanation' and 'task performance'. In this section, we will further discuss constraints for effective use of explanation as an instructional tool (de Koning et al., 2011). The aim is to put forward information to design a multimedia learning environment with video instructions. The constraints we investigated so far are: the necessity of complex assignments and the ways students can be cued to effectively explain video instruction.

Complexity of assignments

Study I indicates that practical assignments that are sufficiently complex to illicit effective explanation from students consist of five or more steps with subactivities in some of the steps. For simpler assignments with fewer steps and without subactivities, actively explaining the video instruction will not show an effect. This study does not show the maximum complexity at which an assignment becomes too difficult for ID students to explain to other persons and remember. In order to generalize our findings to other domains of practical assignments in the curriculum for secondary education for ID students, it is important to find out if the complexity of assignments can be determined in the same way. As stated by Roy and Chi (2005) and Wylie and Chi (2014) complexity of tasks depends on the students' prior learning.

In education for ID students' acquisition of skills in cleaning, cooking, technical training and the maintenance of public green spaces are important. The application of the skills is trained with practical assignments that often have a fixed sequence of steps and with extra subactivities in the steps. It is important to determine for which group of students (e.g., grade 7 to 10) which degree of complexity of assignments *explaining instructions to another person* can have a positive effect compared to repeating the instruction.

Cueing for student explanation

In study II, we examined the effect of cueing for the explaining an instructional video to another person mainly as a cognitive process. The cueing was done by a researcher who asked the student to explain and who was the one the student explained to. Literature suggests that the person who gives the cue and the person receiving the explanation from the student are probably important for the students' motivation. Hoogerheide et al. (2016) studied with pre-university students the difference in effect of explaining a study text to another person on paper as opposed to explaining it orally to a virtual person in a computer program. They found an effect to the advantage of explaining something to a virtual person. They concluded that explaining something to another person will motivate students more to study a learning task if the person is present rather than absent. But, Hoogerheide et al. did not take the difference between oral (person present) and written (person absent) into account. There seems to be more effect of explaining if the student can do this in a natural fashion, this is mostly orally and not written (Wylie & Chi, 2014). For ID students, oral explanation will take less effort than written explanation.

Still, the 'social presence' of a person may be an important motivating factor for students to explain something to another person (Fiorella & Mayer, 2013) There is the choice to let the student explain to a fellow student or a teacher sitting next to him or a virtual person in a multimedia environment. Probably, for ID student, who are greatly in need of a structured learning environment, the teacher will be an important person (Kroesbergen & van Luit, 2003).

In a follow-up study for ID students, three versions of a computer program can be used to test the difference in effect between explaining something to a virtual person (less 'social presence') and explaining something to an actually present person (more 'social presence'). In the third version of the program, students can be asked to explain the steps in an instructional video to themselves (no social presence, but self-explanation). In all three versions, the students are asked to record their explanation. In this way, the quality of the explanations in the three versions can be investigated. The structuring of the cues (Wylie & Chi, 2014) can be the same in all conditions: the student is asked to explain the video fragments of the steps in a complex task.

Such a study is not only interesting in terms of the theoretical question of what causes the effect (see Fiorella & Mayer, 2014), but also in terms of the practical question of which form of explanation is achievable and will be effective in teaching ID students the application of practical skills.

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Appendix 1: Steps for a complex assignment: mitre

A. Duration: 1.44 min. Steps: 5. Additional subactivities: 2 (Fold outward and turn over).

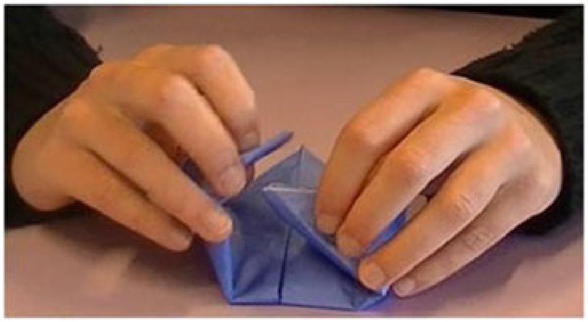
Step 1:
Fold the napkin diagonally. [Colour figure can be viewed at wileyonlinelibrary.com]

Step 2:
Place the napkin so you have a straight edge at the top and on one side.

Fold the two sides toward the top. [Colour figure can be viewed at wileyonlinelibrary.com]

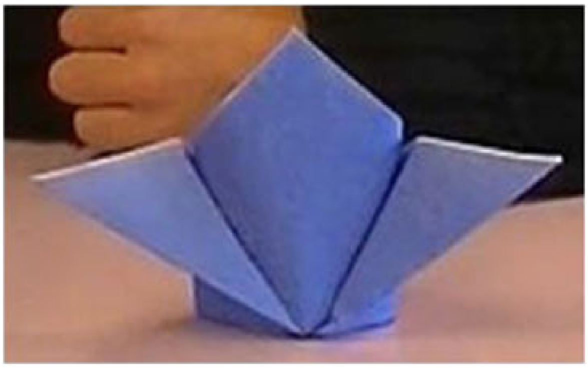
Step 3:
Fold the napkin in two. Fold on the outside (extra activity). [Colour figure can be viewed at wileyonlinelibrary.com]

Step 4:
Turn the napkin upside down (extra activity). Slide the two outer points into each other. [Colour figure can be viewed at wileyonlinelibrary.com]



Step 5:
Fold the outer layers outward. [Colour figure can be viewed at wileyonlinelibrary.com]

Step 6:
Shape the napkin so it stands. [Colour figure can be viewed at wileyonlinelibrary.com]



End Product