MASTER THESIS

Effect of Training Teachers in Stimulating Higher-Order Thinking on Teachers' Attitude and Students' Creativity

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Abstract

In a fast changing society, the question arises as to what children need to learn in school, and therefore what teachers need to teach, to prepare children for the society of the future. Skills needed for the society of the future are called 21st century skills, including among others, creative thinking, critical thinking, and problem solving. Most teachers have a negative attitude towards teaching these higher-order thinking skills, since they have low self-efficacy, are not aware of the relevance, and think not all students are able to engage in higher-order thinking (Al-Nouh, Abdul-Kareem, & Taqi, 2014; Lee et al., 2000, Tornero, 2017). As a result, 21st century skills are not gaining foothold in education. The goal of this research was twofold: first, to evaluate the effect of a teacher development programme (TDP), focused on stimulating higher-order thinking, on the attitudes and behaviours of primary school teachers. This is researched with a quasi-experimental multiple measurement control group design. Results of teacher attitude questionnaires are compared by conducting a repeated measurements analysis of variance. Second, to evaluate the effect of teacher-designed lessons aimed at stimulating higher-order thinking on the creativity of students. This is measured through a self-report questionnaire on creativity with a pre- and post-test. Results are compared by conducting a mixed analysis of variance. Outcomes of the study show a significant effect of the TDP on all aspects of teacher attitude and most aspects of teacher behaviour. Results show no significant effect of stimulating higher-order thinking on creativity of students.

Keywords: higher-order thinking skills, professional development, teacher attitude, student creativity

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Effect of Training Teachers in Stimulating Higher-Order Thinking on Teachers' Attitude and Students' Creativity

Teachers are asked to prepare children for a promising future, especially on the labour market, which is getting more and more challenging in a rapidly changing society. The question arises what children need to learn in school, and therefore what teachers need to teach, to prepare children for the society of the future. The skills needed for the society of the future are called 21st century skills, which are divided into thinking skills, social skills, and metacognition (Onderwijsraad, 2014). Unfortunately, teachers are not sufficiently prepared (Buisman, Van Loon-Dikkers, Boogaard, & Van Schooten, 2017), not used to teaching 21st century skills, and feel insecure about teaching these skills, which contributes to a negative teacher attitude towards teaching 21st century skills (Thijs, Fisser, & Hoeven, 2014). As a result, 21st century skills are not gaining foothold in education (Buisman et al., 2017).

A set of necessary thinking skills is covered by the concept of higher-order thinking, namely creative thinking, critical thinking, and problem solving. These are important qualities to be supported in all students (Chan & Yuen, 2013). Foremost, in the future more employees need to be able to go beyond the abilities of computers (Levy, 2010). Computers can calculate almost everything, but humans discern themselves from computers by being creative. Higher-order thinking involves generating and producing ideas through brainstorming, visualizing, associating relationships, making analogies, inventing, inferring, and generalizing (Fogarty & McTighe, 1993). Therefore, through higher-order thinking people will be able to handle and react effectively on change and go beyond existing ideas.

Even though the term '21st century skills' suggests higher-order thinking to be a new notion, it has been brought to our attention before. Learning to think and creativity have always been important and will always be. During the 1950s and 60s, learning to think and creativity were already mentioned as points of attention. For example, Karowe (1965) stated the importance of giving creative students autonomy and rewarding creative behaviour in order to foster "intellectual inventiveness" (p. 827). However, it was not acted upon and it did not receive any attention in teacher education. Nowadays, renewed attention is given to higher-order thinking that lets us hope it will gain foothold in education and emphasis will be placed on higher-order thinking in teacher training and education in the near future.

Fostering higher-order thinking in schools has been proven to have a positive effect on students. For example, the study of Zohar and Dori (2003) showed that students of all academic levels score higher on thinking when they engage in tasks that involve higher-order thinking. Also,

according to Chan and Yuen (2013), when teachers have creativity as a foundation in their teaching, it results in an increase of student creativity and positive learning habits. Chan and Yuen focused their study on primary school teachers, given that primary years are important for encouraging creativity in children without the external pressures of public examinations. Moreover, research has also shown benefits of higher-order thinking on achievement in language and the arts and language development (Teemant, Hausman, & Kigamwa, 2016).

In order to foster higher-order thinking, primary school teachers need to create a learning environment open to creative ideas and making mistakes (King, Goodson, & Rohani, 2011; Soh, 2000). Teachers should stimulate students in using higher-order thinking, for example by encouraging students to explain and discuss their ideas (Banaji, Burn, & Buckingham, 2010). To do so, teachers need to have a positive stand on teaching higher-order thinking. According to Timperley (2008), decisions teachers make in preparation of their lessons and during their lessons are shaped by multiple factors including teachers' knowledge and beliefs about what is important to teach and how students learn. This is in line with the theory of planned behaviour, which will be discussed later on. Briefly, the theory seeks to impose that behaviour is influenced by attitude (Ajzen, 1991).

Several studies showed positive effects of TDP's on teachers' attitude and behaviour. For example, results of the study of Porter, Garet, Desimone, Yoon, and Birman (2000) show that teachers' use of higher-order teaching strategies increased due to professional development focused on these specific strategies. However, there has been little research on teacher attitudes towards stimulating higher-order thinking (Wijnen, Walma van der Molen, & Voogt, in progress[a]). Hence, there also has been little research on the effect of a TDP that focuses specifically on teacher attitudes towards stimulating higher-order thinking. Therefore, this study will implement a training that focuses on teachers' attitude towards stimulating higher-order thinking by a novel professional development programme. Furthermore, the current study will measure the effect of stimulating higher-order thinking skills on the creativity of students. According to Buisman et al. (2017) and Allen and Van der Velden (2012), progress in students' creativity is rarely, if at all, measured.

Goal of the Study

The goal of this research is twofold: first, to evaluate the effect of a TDP, that is focused on stimulating higher-order thinking, on the attitude and behaviour of primary school teachers towards stimulating higher-order thinking. In the teacher training teachers learn what higher-order thinking skills are and how to implement them in their classroom activities. Second, to evaluate the effect of teacher-designed lessons aimed at stimulating higher-order thinking on the creativity of students. Therefore, this study is guided by two research questions. The first is focused on the teacher: What is

the effect of the TDP on the attitude and behaviour of teachers towards stimulating higher-order thinking? And the second question focuses on the students: What is the effect of the teacher-designed lessons aimed at higher-order thinking skills on the creativity of students?

Theoretical Framework

In order to reach the goal of the study, a literature study was performed on what higher-order thinking is, what concepts are reflected in teachers' attitude towards teaching in higher-order thinking, how teacher attitude influences teacher behaviour, and what makes a TDP effective.

Higher-order thinking. According to the taxonomy of Bloom, there are six levels of thinking, which can be divided into lower and higher-level thinking (Zohar & Dori, 2003). In the revised taxonomy the following levels of thinking, ranging from simple to complex, are described: remember, understand, apply, analyse, evaluate, and create (Krathwohl, 2002). The first three are considered lower-order thinking and the last three levels are higher-order thinking (Zohar & Dori, 2003).

Higher-order thinking is described in multiple studies building upon Bloom's Taxonomy, each with their own contribution. For example, King et al. (2011) explain higher-order thinking as applying a variety of thinking processes to complex situations. This is in line with the definition proposed by Lewis and Smith (1993), who state that "higher order thinking occurs when a person takes new information and information stored in memory and interrelates and/or rearranges and extends this information to achieve a purpose or find possible answers in perplexing situations" (p. 136). This study adopts the definition of Wijnen, Walma van der Molen, and Voogt (in progress[b]): "stimulating higher-order thinking in students means offering assignments, questions, problems or dilemmas where students need to use complex cognitive skills (such as analysing, evaluating and creating) in order to find a solution or make a decision, prediction, judgement or product" (p. 4).

As shown in all described definitions, not every problem or situation is suitable for higher-order thinking. One can only speak of a problem when there is no immediate solution or answer (King et al., 2011; Robertson, 2003). Therefore, problems should be unfamiliar or non-routine (King et al., 2011; Lewis & Smith, 1993). In addition, according to Zohar and Dori (2003), one can only speak of a higher-order activity when the problem solved is non-algorithmic and complex. In order to solve new, difficult situations, certain higher-order thinking skills are needed.

In order to solve a problem, one should be able to identify the problem, followed by a plan to solve that problem (Rothstein, in Lee et al., 2000; Thijs et al., 2014). Underlying skills of identifying a problem are to analyse and define a problem when you perceive one and asking meaningful questions (Thijs et al., 2014). This is in line with Schooler, Fallshore, and Fiore (1995), who state that one should examine all factors that could be causing a problem. Skills needed to plan a solution for

the problem are weighing possible strategies, for example in the form of hypotheses (Facione, 2011; Lee et al., 2000; Lewis & Smith, 1993; Schoolar et al., 1995; Thijs et al., 2014), and to analyse and evaluate the possible solutions to come to a reasoned decision (Facione, 2011; Lee et al., 2000; Thijs et al., 2014). In other words, multiple successive considered choices should be made, each depending on outcomes of the former choice (King et al., 2011). Furthermore, to come to the best solution, it is important to think critically about ideas and solutions of your own and others. Skills underlying critical thinking are: effectively formulating your own reasoned opinion (Facione, 2011; King et al., 2011; Paul et al., 1990; Thijs et al., 2014), signalling personal misconceptions (Cotton, 1991; Facione, 2011; Paul et al., 1990; Thijs et al., 2014), being open to alternative opinions of others (Cotton, 1991; Thijs et al., 2014), and reflecting on your own learning processes (Thijs et al., 2014)

Teacher attitude. Teachers are essential when it comes to the development of students' higher-order thinking. Teachers are expected to create a safe learning environment and offer appropriate learning opportunities that stimulate students to engage in cognitive challenges that ask for higher-order thinking (Chan & Yuen, 2013; Meintjes & Grosser, 2014; Tornero, 2017). Furthermore, teachers are role models for their students (Jeffrey & Craft, 2004). According to Wyse and Spendlove (2007), teachers' beliefs can influence learners' perception of their creative potential (Wyse & Spendlove, 2007). Moreover, intentional and unintentional behaviour of teachers can directly affect their classroom practices (Chan & Yuen, 2013) and learning climate (Soh, 2000). Therefore, teachers should be aware of their attitude towards higher-order thinking and how this reflects on their practice (Al-Nouh et al., 2014). However, whether teachers choose to implement and how they implement higher-order thinking skills is depend on the attitude of the teacher towards those skills.

The theory of planned behaviour proposes that behaviour is influenced by intention (Ajzen, 1991). Intention refers to what extent someone is willing to perform a certain behaviour and how much effort someone wants to spend in performing that behaviour. In turn, according to Ajzen (1991), intention is influenced by attitude towards a certain behaviour, subjective norm, and perceived behavioural control. First, attitude towards a certain behaviour "refers to the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question" (Ajzen, 1991, p. 188). Second, subjective norm is described by Ajzen as the perceived social pressure to perform a specific behaviour. Third, perceived behavioural control refers to the perception of one's own ability to perform a certain behaviour (Ajzen, 1991). Following the theory of planned behaviour, teacher attitude towards stimulating higher-order thinking has an important influence on the intention to stimulate higher-order thinking, and in turn this intention influences to what extent teachers actually stimulate higher-order thinking in the classroom.

Wijnen et al. (in progress[a,b]) used the theory of planned behaviour to map several attitude factors based on literature: perceived relevance, self-efficacy, perceived student ability, and context-dependency. The four attitude factors described by Wijnen et al. match the three dimensions described in the theory, where subjective norm and perceived behavioural control (self-efficacy) are mentioned as concepts reflecting in attitude and subjective norm is part of context-dependency.

Perceived relevance. This study adopts the definition of Wijnen et al. (in progress[a,b]), who describe perceived relevance as "teachers' beliefs about the importance of stimulating higher-order thinking for learners' personal development" (p. 6). According to Chan and Yuen (2013), all teachers should know that fostering creativity in students throughout the curriculum is important. However, in the study of Tornero (2017), none of the teachers mentioned the importance of creativity nor stimulating higher-order thinking. This might be due to the fact teachers are pressured to 'teach to the test' and therefore focus on prescribed subject-matter (Al-Nouh et al., 2014; Lee et al., 2000).

Self-efficacy. Another concept influencing the attitude of teachers is self-efficacy. This study adopts the definition of Wijnen et al. (in progress[a,b]), who describe self-efficacy as "teachers' self-perceived capability to stimulate higher-order thinking in learners" (p. 7). Self-efficacy is a recurrent theme concerning the attitude of teachers in teaching higher-order thinking skills, including self-efficacy in content and pedagogical knowledge (Al-Nouh et al., 2014; Chan & Yuen, 2013; De Souza Fleith, 2000; Lee et al., 2000; Tornero, 2017). Self-efficacy in their own thinking skills is addressed and taught in the study of Tornero (2017), which showed no increase in their level of confidence in stimulating higher-order thinking in the classroom. However, self-efficacy concerning teaching strategies to stimulate higher-order thinking is an important factor influencing the implementation of higher-order thinking (Al-Nouh et al., 2014; Lee et al., 2000).

Shortage of self-efficacy could be caused by lack of training, since several studies show that teachers did not learn how to stimulate higher-order thinking skills in pre-service training (Al-Nouh et al., 2014; Tornero, 2017). Another explanation is shown by Lee et al. (2000), their study showed that many teachers felt insecure with the unpredictable outcomes and felt the need to control students' learning activities. This fits with the idea of Westby and Dawson (1995), who state that several creative traits in students, like impulsive behaviour, risk taking, and independence, do not match with the goal of teachers to maintain order in the classroom.

Perceived student ability. Furthermore, teachers' beliefs about student abilities, referred to as perceived student ability, greatly affects whether teachers stimulate higher-order thinking in their classroom. This study adopts the definition of Wijnen et al. (in progress[a,b]), who describe perceived

student ability as "teachers' beliefs about whether higher-order thinking is suitable for both low- and high-achieving students" (p. 6).

Several studies indicate that all students could benefit from higher-order thinking skills (Chan & Yuen, 2013; Lewis & Smith, 1993; Zohar & Dori, 2003), since higher-order thinking skills are activated whenever someone faces difficulties which cannot be resolved with standard learned solutions (Grainger & Barnes, 2006; Lewis & Smith, 1993). However, many teachers underestimate students' ability to engage in higher-order thinking, especially low-achieving students (Al-Nouh et al., 2014; Lee et al., 2000).

Context-dependency. Besides perceived relevance, self-efficacy, and perceived student ability, context-dependency also influences teachers' attitude. This study adopts the definition of Wijnen et al. (in progress[a,b]), who describe context-dependency as "teachers' perception that external factors . . . are a prerequisite for them to be able to stimulate higher-order thinking in learners" (p. 7). Examples of external factors are time constraints, lack of support from principals, and lack of resources (Al-Nouh et al., 2014; Lee et al., 2000).

Teachers professional development. Several studies showed positive effects of a TDP on teachers' attitude and behaviour in different contexts (e.g. Garet, Porter, Desimone, Birman, & Yoon, 2001; Porter et al., 2000; Skoretz & Childress, 2013; Tennill & Cohen, 2013; Xie, Kim, Cheng, & Luthy, 2017). A number of aspects have seemed to positively influence the success of a TDP. Desimone (2009) proposed a framework based on literature and Garet et al. (2001) examined the effect of several features of TDP's on teachers' outcomes, form both studies five different returning aspects of an effective TDP emerge: content focus, active learning, coherence, duration, and collective participation.

First of all, *content focus* refers to the focus on knowledge of subject matter and how students learn (Borko, 2004; Desimone, 2009; Garet et al., 2001). This is in line with Timperley (2008), who emphasises the need of a strong theoretical framework for teachers. Also, the presented content should be meaningful (Tennil & Cohen, 2013; Timperley, 2008). By introducing meaningful, new, and successful content and practices, teachers can augment their current knowledge and beliefs with new information (Timperley, 2008). In the current study this could be done by explaining what higher-order thinking is and what the benefits are of stimulating higher-order thinking in the classroom.

Second, the need for *active learning* in a successful TDP is pointed out by almost all studies on effective TDP's (Borko, 2004; Garet et al, 2001; Porter et al., 2000; Skoretz & Childress, 2013; Timperley, 2008; Wilson & Berne, 1999), for example by placing teachers in the role of their learners

(Borko, 2004). In the current study this could be done by letting teachers experience a challenging higher-order thinking assignment for themselves. Another form of active learning could be provided in their role as a teacher by experimenting with lesson materials (Tessmer & Harris, 1990) and preparing for implementation in the classroom (Garet et al., 2001; Tessmer & Harris, 1990).

Third, *coherence* refers to the content of the TDP being connected to what teachers already know and integrated with daily practice (Desimone, 2009; Garet et al., 2001). This is in line with Tessmer and Harris (1990) and Timperley (2008), who point out the importance of learning and practising the content of the TDP in their own environment. In the current study this could be done by giving practical examples and guiding teachers in designing their own lessons in stimulating higher-order thinking.

Fourth, *duration* is mentioned as a feature influencing the effectiveness of a TDP (Chong & Kong, 2017; Desimone, 2009; Garet et al., 2001; Xie et al., 2017). It seems that longer programs are more successful. According to Desimone (2009), development programmes should be spread over a longer period of time with 20 hours or more contact hours. Naturally, when a TDP has a longer duration, there will be more time for creating valuable learning opportunities and practising new skills in the classroom (Chong & Kong, 2017; Garet et al., 2001).

Lastly, several authors stressed the importance of *collective participation* for an effective TDP (Chong & Kong, 2017; Desimone, 2009; Garet et al., 2001; Tennill & Cohen, 2013; Timperley, 2008; Wilson & Berne, 1999). It is beneficial when teachers work at the same school, because they can easily connect and collaborate with each other, since they work in the same environment, use the same materials, and sometimes have the same students (Desimone, 2009; Garet et al., 2001). Furthermore, it is important to give teachers the opportunity to process new knowledge and skills together and discuss the impact of their actions on their students (Timperley, 2008). This is in line with Garet et al. (2001) and Tennill and Cohen (2013), who express the value of professional communication among teachers, and Chong and Kong (2017), who state that when teachers meet regularly, they share responsibility to critically examine and improve their practice.

Student creativity. There are several different and overlapping terms and definitions to describe creativity. However, there is no consensus on a universal conception of creativity due to the fact creativity is complex and multifaceted (Feist, 2010; Hosseini, 2014; Plucker & Makel, 2010; Rhodes, 1961; Treffinger, 2002; Wyse & Spendlove, 2007). The different components of creativity are described by Rhodes (1961) as the four P's: person, process, product, and press. This is in line with Treffinger et al. (2002), who describe creative productivity as an interaction between the following terms, which are more or less the same as Rhodes' components: characteristics (person), operations

(process), context (press), and outcomes (product). These components confirm the complexity and versatility of the concept of creativity. In this study the umbrella term 'creativity' of Lucas, Claxton, and Spencer (2014) is used, which entails that everything from *subject-specific* to *generalised* creativity and everything from *individual* to *collaborative creativity* is covered by their view of creativity.

Opinions are divided regarding whether creativity is domain-specific or not. However, all types of creativity, either inside or outside of school, fall under the umbrella term of Lucas et al. (2014). *Subject-specific* creativity is being creative in, as the name suggests, a subject, for example painting or music, or even mathematics. On the other hand, when someone is being creative independent of a specific subject, for example having good ideas, this is referred to as *generalised* creativity. This entails, among other things, divergent and convergent thinking (Chan & Yuen, 2013; Crowl et al., in King et al., 2011; Treffinger et al., 2002). Divergent thinking being generating ideas and convergent thinking as analysing and organising those ideas (Treffinger et al., 2002). According to Lucas et al. (2014), on the one hand imagination is needed to generate ideas and at the same time critical reflection is needed for analysing these ideas. This is in line with Crowl et al. (in King et al., 2011), who state that divergent and convergent thinking leads to new ideas. In turn, new and innovative ideas characterize output of creative thinking (Hosseini, 2014; Niu & Liu, 2009).

Furthermore, *individual* creativity involves personal characteristics suitable for a creative mindset, like an inquisitive and entrepreneurial attitude (Ennis, 1985; Thijs et al., 2014) and being curious, resourceful, and persevering (Chan & Yuen, 2013; Stubbé, Jetten, Paradies, & Veldhuis, 2015; Treffinger, Young, Selby, & Shepardson, 2002). However, in a certain way, creativity is always *collaborative*, since an individual is influenced by others and builds on existing ideas and creative output mostly derives from collaboration (Lucas et al., 2014). Thinking creatively can be stimulated when students interact with each other (Stubbé et al., 2015) and are open and able to see things from a different perspective (Chan & Yuen, 2013; Garaigordobil, 2006).

Components covered by the umbrella term creativity, as described by Lucas et al. (2014), intertwine with the higher-order thinking skills and behaviours expected to be reflected in students in our study. Most components are also manifested in definitions from other authors, but converge in the term creativity, as described by Lucas et al. Therefore, in this study, we chose to follow this broad view on creativity, due to the proper articulation with higher-order thinking skills. Hence, the questionnaire on creativity of TNO is used in the current study, since this questionnaire is based on the questionnaire and broad view on creativity of Lucas et al. This questionnaire measures students'

perception on whether they show certain attitudes and behaviours due to stimulating higher-order thinking in their classroom.

Operationalisation

Teacher attitude. Since attitude affects behaviour, attitudes of teachers towards stimulating higher-order thinking is addressed in the TDP. Perceived relevance and perceived student ability are addressed in the TDP by explaining the importance and the advantages of stimulating higher-order thinking for all students in the first meeting. Self-efficacy is addressed by (1) discussing what they already do and can do in class to stimulate higher-order thinking, (2) designing their own lessons aimed at stimulating higher-order thinking in pairs or small groups with guidance of the trainer when needed, (3) giving lessons in their own classroom after the first meeting, and (4) discussing experiences in the second and last meeting. Lastly, context-dependency is addressed in the TDP by giving examples and ideas for lessons aimed at stimulating higher-order thinking, providing the opportunity to design the first one or two lessons during the training, and stimulating teachers to work together. Since the four aspects of attitude discussed in the theoretical framework are addressed in the TDP, it is expected that the following hypotheses will be verified in the study:

H1a: The score on perceived relevance increases between before the training (T1) and after giving lessons (T3) for teachers in the experimental group.

H1b: The score on perceived relevance stays the same between T1 and T3 for teachers in the control group.

H2a: The score on self-efficacy increases between T1 and T3 for teachers in the experimental group.

H2b: The score on self-efficacy stays the same between T1 and T3 for teachers in the control group.

H3a: The score on perceived student ability decreases[1] between T1 and T3 for teachers in the experimental group.

H3b: The score on perceived student ability stays the same between T1 and T3 for teachers in the control group.

H4a: The score on context-dependency decreases[2] between T1 and T3 for teachers in the experimental group.

[1] Since the items for perceived student ability are formulated negatively the scores on perceived student ability are expected to decrease for teachers in the experimental group.
[2] Since the items for context dependency are formulated negatively the scores on context-dependency are expected to decrease for teachers in the experimental group.

H4b: The score on context-dependency stays the same between T1 and T3 for teachers in the control group.

H5a: The scores from behaviour measures (1) designing lessons, (2) conducting lessons, (3) giving assignments, (4) questioning, (5) problem solving, (6) perspective taking, (7) creative thinking, and (8) inquiry learning increases between T1 and T3 for teachers in the experimental group.

H5b: The scores from behaviour measures (1) designing lessons, (2) conducting lessons, (3) giving assignments, (4) questioning, (5) problem solving, (6) perspective taking, (7) creative thinking, and (8) inquiry learning stay the same between T1 and T3 for teachers in the control group.

Student creativity. Several aspects covered by the umbrella term creativity from Lucas et al. (2014) are addressed in the first meeting of the TDP as aspects from higher-order thinking. Furthermore, several creativity aspects are covered in the first meeting as focus areas for teachers, conditions of lessons aimed at stimulating higher-order thinking, and in the lesson examples. For example, stimulating student to ask questions, challenging students to solve a problem, and facilitate discussions. Since more or less all aspects of creativity are addressed in the TDP, it is expected that the following hypotheses will be verified in the study:

H6a: The scores from creativity measures (1) curiosity, (2) resourcefulness, (3) output-oriented, (4) proud of work, (5) daring to be different, (6) perseverance, and (7) interaction with others for students in the experimental group increases between before following lessons aimed at stimulating higher-order thinking (T1) and after following lessons aimed at stimulating higher-order thinking (T2).

H6b: The scores from creativity measures (1) curiosity, (2) resourcefulness, (3) output-oriented, (4) proud of work, (5) daring to be different, (6) perseverance, and (7) interaction with others for students in the control group stay the same between T1 and T2.

Method

This section outlines the specific methods used within this research. A description of the research design, participants, measures, intervention, procedure, and data analysis is provided for both teachers' attitude and behaviour and students' creativity.

Research Design

The research is quantitative, since data is gathered through questionnaires with solely close-ended questions. The research question on the effect of the TDP on the attitude and behaviour of teachers concerning stimulating higher-order thinking skills is answered through a quasi-experimental multiple measurement control group design (Figure 1). The research question on the

effect of the teacher-designed lessons on creativity of students is answered through a quasi-experimental pre-test post-test control group design (Figure 2).

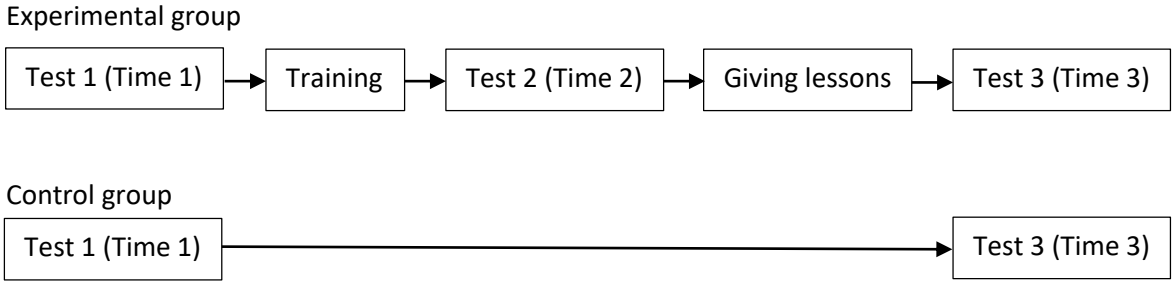

Figure 1. Research design for exploring teachers' attitude and behaviour

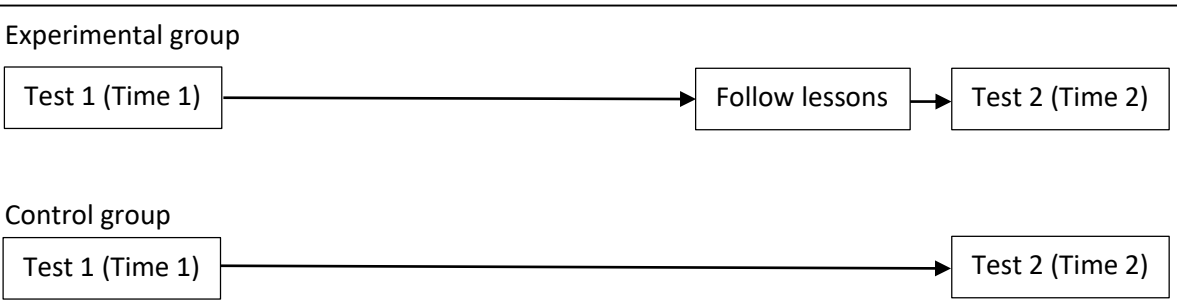

Figure 2. Research design for exploring students' creativity

Participants

60 schools in the region of Deventer and teacher trainers of Saxion University of Applied Sciences were approached and a message in a national educational newsletter was placed in order to reach schools to participate in the study. This resulted in three primary schools, three groups of pre-service teachers, and one group of teachers returning to the teaching profession participating in the study. The reason most schools refrained from participating in the study was lack of time and the current workload of teachers. In turn, students from participating teachers of groups 6, 7, and 8 (aged 9 to 12) were asked to participate in the study.

Teachers. The experimental group consisted of eight teachers from two schools, 14 pre-service teachers, and 19 teachers returning to the teacher profession (N = 41). From these 41 teachers, 39 completed the questionnaire at T2 and 20 at T3, only 19 teachers completed the questionnaire the required amount of three times (Table 1). The control group consisted of 18

teachers of one primary school, three teachers from three different primary schools, and nine pre-service teachers (N = 30). From these 30 teachers, 18 teachers completed the questionnaire the required amount of two times (Table 1). Resulting in a sample size of 71 participants.

Table 1

Total number of teachers on T1, T2, and T3 for both the experimental group and control group

Timepoint	Experimental group	Control group
T1	41	30
T2	39	
T3	20	18

A higher percentage of participants was female, in both the experimental group (85,4%) and the control group (86,7%). The average age in the experimental group was 41 years (*M* = 40.85; *SD* = 15.43) ranging from 19 to 65 years. The average age in the control group was 34 years (*M* = 34.07; *SD* = 13.46) ranging from 19 to 63 years. Teachers of all grades are represented in the study (Table 2).

Table 2

Frequencies of the group(s) participants teach for both the experimental and control group

	Experimental group		Control group	
Group	*f*	%	*f*	%
1 (4-5 year olds)	6	14.6	2	6.7
2 (5-6 year olds)	8	19.5	5	19.5
3 (6-7 year olds)	6	14.6	2	6.7
4 (7-8 year olds)	6	14.6	3	10.0
5 (8-9 year olds)	6	14.6	6	20.0
6 (9-10 year olds)	8	19.5	4	13.3
7 (10-11 year olds)	7	17.1	4	13.3
8 (11-12 year olds)	6	14.6	4	13.3
Other	3	7.3	0	0
Total	56	100	30	100

Note. 11 participants teach more than one group and therefore entered more than one response option, as a consequence there are more answers than teachers.

Students. The experimental group consisted of 48 students aged between 10 and 12 from three different teachers of two separate schools, of whom 43 students filled in the questionnaire the required amount of two times (Table 3). The control group consisted of 106 students aged between 9 and 12 from six different teachers of one school, of whom 86 students filled in the questionnaire the required amount of two times (Table 3). Resulting in a sample size of 175 participants.

Table 3

Distribution of students between teachers who teach group 6, 7, or 8 for both the experimental group and control group

	Experimental group		Control group	
Teacher	T1	T2	T1	T2
1	5	3	15	15
2	24	23	15	14
3	19	17	15	12
4			20	17
5			9	9
6			13	13
Unknown			6	6
N	48	43	93	86

Note. N = total number of students who completed the questionnaire respectively on T1 and T2.

A higher percentage of participants in the experimental group were group 8 students (11-12 year olds) (65,2%) (Figure 3). In the control group, group 6 (9-10 year olds), group 7 (10-11 year olds) and group 8 students were approximately equally represented (Figure 3). Furthermore, boys (49,1%) and girls (51,2%) were approximately equally represented across the study, with a slightly higher percentage of boys (56,5%) in the experimental group and a slightly higher percentage of girls (57%) in the control group.

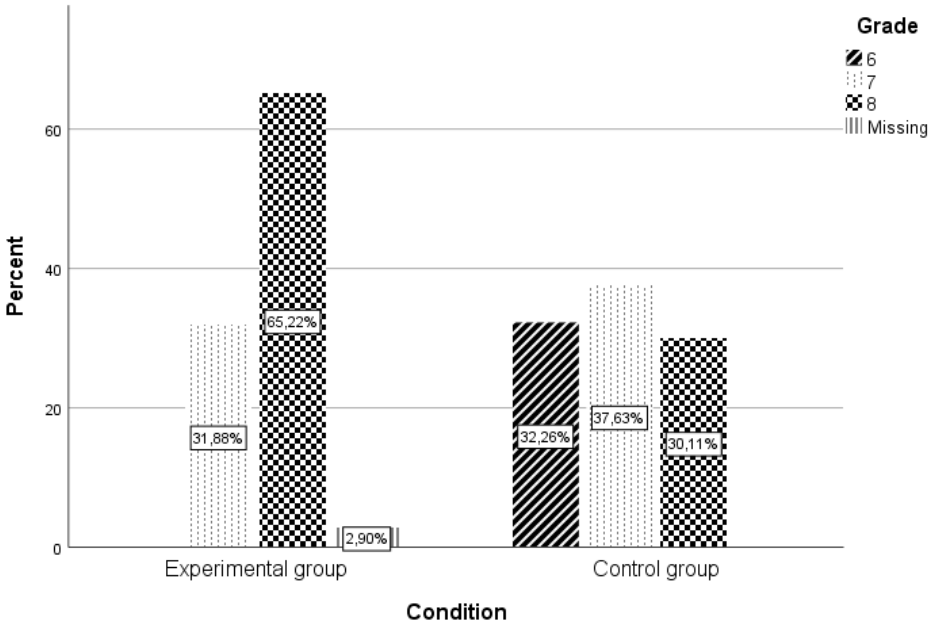

Figure 3. Distribution of students between group 6,7, and 8 for the experimental group and the control group.

Measures

Teacher attitude questionnaire. Teachers were asked to fill in a questionnaire concerning their attitude towards stimulating higher-order thinking at the start of the development programme, at the end of the training, and at the end of the development programme. The attitude questionnaire used in this study is designed by Wijnen et al. (in progress[b]) and based on literature. It consists of 18 items aimed to measure teachers' attitude towards higher-order thinking through a 5-point Likert scale varying from strongly disagree to strongly agree and 8 items aimed to measure teacher behaviour which is measured with a 7-point Likert scale ranging from never to every day (Appendix A).

Exploratory and confirmatory factor analyses were used to explore the criterion validity of the instrument (Wijnen et al., in progress[b]). The results indicate that the requirements for criterion validity were met. Exploratory analysis resulted in four factors: perceived relevance (eigenvalue 5.487), self-efficacy (eigenvalue 1.915), perceived student ability (eigenvalue 4.404), and context dependency (eigenvalue 1.169).

Within the questionnaire four items measure perceived relevance (Composite Reliability = .90). Higher scores on perceived relevance are better, since these questions are stated positively (e.g. 'I think it is essential for the learning of learners that they are encouraged to engage in higher-order

thinking'). Second, four items measure self-efficacy (Composite Reliability = .90). Higher scores on self-efficacy are better, since these questions are stated positively (e.g. 'I am well able to pose questions to my learners that stimulate higher-order thinking'). Third, six items measure perceived student ability (Composite Reliability = .81). Lower scores on perceived student ability are better, since these questions are stated negatively (e.g. 'I think that 'smart' learners are much better at higher-order thinking than 'weak' learners'). Lastly, four items measure context-dependency (Composite Reliability = .73). Lower scores on context dependency are better, since these questions are stated negatively (e.g. 'For me, extra time is decisive whether I will stimulate higher-order thinking in my learners'). Validity checks showed that the eight items measuring teacher behaviour (e.g. 'How often do you design a lesson that explicitly stimulates higher-order thinking in learners?') did not represent a single factor and were therefore treated separately.

Student creativity questionnaire. Students were asked to fill in a questionnaire before and after they received lessons aimed at stimulating higher-order thinking. The creativity questionnaire used in the study is designed by the Netherlands Organisation for applied scientific research (TNO), based on the instrument of Lucas et al. (2014). Since this questionnaire is based on the broad view of creativity by Lucas et al., all aspects included in the creativity questionnaire align with higher-order thinking skills and behaviours. The current questionnaire consists of 44 items aimed to measure self-reported creativity of students through a five point Likert-scale varying from strongly disagree to strongly agree (Stubbé et al., 2015) (Appendix B). Originally the questionnaire used a 7-point Likert scale, however, more intervals might reduce reliability when participants do not have the cognitive ability to process the meaning of all intervals (Cook, Heath, & Thompson, 2001). Therefore, a 5-point Likert scale seems more appropriate for children.

In order to check for validity and reliability, Stubbé et al. (2015) conducted an exploratory and confirmative factor analysis. The reported Cronbach's alpha originated from the factor analysis by Stubbé et al., since they were able to use a much larger sample than the sample in the current study. Eigenvalues were not included in the report of TNO and could therefore not be reported here. The factors measured in the questionnaire were mostly based on literature and some additional factors appeared from the factor analysis.

Within the questionnaire, eight items measure curiosity, which refers to a creativity trait of having an inquisitive and explorative attitude (Stubbé et al., 2015, p. 34) (e.g. 'I wonder how something is discovered') (Cronbach's α = .83). Second, seven items measure resourcefulness, which refers to a creativity trait of divergent thinking, make new connections, and following intuition (Stubbé et al., 2015, p. 34) (e.g. 'I come up with different ways to work out an assignment')

(Cronbach's α = .83). Third, eight items measure output-oriented, which refers to reflecting on the process and product, convergent thinking, and being thorough (Stubbé et al., 2015, p.34) (e.g. 'I make sure I'll understand the assignment before I start working on it') (Cronbach's α = .79). Fourth, six items measure proud of work, which refers to a creativity trait of being able to explain work and choices and trusting your own ideas (Stubbé et al., 2015, p. 34) (e.g. 'I know how to explain my idea so others understand what I mean') (Cronbach's α = .78). Fifth, three items measure daring to be different, which refers to a creativity trait of persisting to explore in a certain direction regardless of opinions of others (Stubbé et al., 2015, p. 34) (e.g. 'I'll continue in my own way, even if others think it should be done differently') (Cronbach's α = .84). The description of Stubbé et al. (2015) is more like an example, therefore we like to add two aspects of creative thinking out of the theoretical framework to the description of daring to be different: restructuring reality into different and original ideas (Garaigordobil (2006) and daring to take risks and think outside the box (Thijs et al., 2014). Sixth, five items measure perseverance, which refers to a creativity trait of being persistent and being able to deal with uncertainties (Stubbé et al., 2015, p. 34) and, in addition, seeing mistakes as learning opportunities (Thijs et al, 2014) (e.g. 'I'll continue to work even if I face temporary difficulties') (Cronbach's α = .74). Lastly, seven items measure interacting with others, which refers to asking and giving feedback and sharing ideas (Stubbé et al., 2015, p. 34) (e.g. 'I give others feedback on their work, even if they don't ask for it') (Cronbach's α = .78).

Pilot. The student questionnaire was tested twice on four students aged 7, 9, 11, and 13 years in order to find out the duration and feasibility of the questionnaire. The students needed 13.7 minutes on average to fill in the questionnaire and had difficulty understanding the words 'vanzelfsprekend' (taking for granted) and 'feedback'. As a result of the pilot, a teacher instruction to administer the questionnaire was drawn up (Appendix C). The teacher instruction was discussed with an individual teacher and adjusted.

Intervention

Key elements. Several key elements of an effective TDP were taken into account in the design of the current TDP. First of all, content focus (Desimone, 2009; Garet et al., 2001) and development of a strong theoretical framework (Timperley, 2008) are part of the current design since information on higher-order thinking is provided. Second, active learning (Desimone, 2009; Garet et al., 2001; Porter et al., 2000) and integration of theory and practice (Timperley, 2008) are incorporated in the programme, since teachers get to experience a higher-order thinking assignment and design a lesson themselves. Moreover, experiencing a higher-order thinking assignment taught by the trainer gives teachers insight in how students learn, which is another characteristic of an effective TDP (Garet et al., 2001; Tessmer & Harris, 1990; Timperley, 2008). Furthermore, since

teachers design their own lessons based on the curriculum and in pairs or small groups of the same grade or department, the characteristics coherence (Desimone, 2009; Garet et al., 2001; Tessmer & Harris, 1990), classroom implementation (Garet et al., 2001; Timperley, 2008), and collective participation (Desimone, 2009; Garet et al., 2001; Timerley, 2009) are reflected in the current TDP. Collective participation is also encouraged in the evaluation meeting at the end of the TDP by discussing their experiences and how they are going to continue stimulating higher-order thinking.

Detailed description. The intervention is a professional development programme consisting of two meetings. At the beginning of the first meeting teachers filled in the attitude-questionnaire (T1). Then, the training started with an explanation of what higher-order thinking is and why it is important, followed by a practical instruction on how to implement higher-order thinking in the classroom (Appendix D). Next, teachers received an assignment on creating their own lesson, which consisted of choosing a subject and a specific lesson to implement a higher-order thinking assignment for their students (Appendix D13). During the meeting, teachers designed a lesson aimed at stimulating higher-order thinking in groups of two or three. When needed, they could ask help from the trainer and from each other in designing the lesson. Subsequently, teachers shared the lessons they had designed. Directly at the end of the meeting, teachers filled in the questionnaire for the second time (T2). The total duration of the first meeting was between one and a half hours and two hours.

In three to six weeks following the first meeting, teachers performed three or more personally designed lessons aimed at higher-order thinking skills, which meant they had to design one or two lessons on their own. After this period, the second meeting took place in which teachers reflected together on the lessons they performed by discussing what they did, why they chose this particular lesson and higher-order activity, how they experienced stimulating higher-order thinking, and how their students reacted (Appendix E). Directly at the end of the meeting, teachers filled in the questionnaire for the third time (T3). The total duration of the second meeting was between one hour and one hour and a half.

Procedure

A description of the study was sent to and approved by the ethics commission of the University of Twente. Participating schools and their teachers were approached and informed about the purposes of the study. Teachers and parents of the students confirmed participation through informed consent. All participants were thanked for their participation after completing each questionnaire.

Teachers in the experimental group received a training at their own school. On all three occasions, teachers filled in the questionnaire in the same (class)room as where the meetings took place. Teachers had three to six weeks to teach the designed lessons. Teachers in the control group filled in the questionnaire two times digitally with a period of three to six weeks in between.

Students filled in the student questionnaire on creativity before they received any lessons aimed at stimulating higher-order thinking. After two or three teacher-designed lessons, students filled in the student questionnaires on creativity for the second time. In the experimental group, students filled in the questionnaire on paper, all at the same time and in their own classroom. In the control group, students filled in the questionnaire digitally, all at the same time and in their own classroom with a period of three to six weeks in between.

Data Analysis

Teacher attitude. In order to explore differences between the experimental group and control group on four constructs of teacher attitude and eight questions on teacher behaviour over time and test whether the intervention is effective, a mixed ANOVA was conducted using SPSS version 25. Since the eight questions on behaviour did not represent a single factor, calculations are conducted on each question separately. For each construct of attitude and each question on behaviour, separate mixed ANOVA's were conducted with condition as between-subject variable (2 levels) and time as within-subject variable (2 levels). In case of an interaction effect of time on condition, planned comparisons in the form of a paired *t*-test was conducted.

In order to discern , in case of an effect, where the effect of the intervention is most present and whether there was continued growth after the intervention, separate paired *t*-tests were conducted to compare differences over time for the experimental group. Several teachers failed to give as many lessons as intended and sometimes failed to give any lessons at all. Consequently, they did not fill in the questionnaire for the third time (T3) and would therefore be excluded from a repeated measures ANOVA. Therefore, paired *t*-tests are used to compare T1 and T2 and T2 and T3 for the experimental group. A paired *t*-test to compare T1 and T3 was conducted through planned comparisons after the mixed ANOVA in case of an interaction effect, if not, a paired *t*-test for T1 and T3 was conducted in this step of the analysis.

Furthermore, in order to check for normality a Shapiro Wilk's test is conducted, and to check homogeneity of variance a Levene's test is performed. Lastly, to check the assumption of sphericity Mauchly's Test of Sphericity is conducted.

In total 152 teacher attitude questionnaires were completed either online or on paper. Four questionnaires were deleted from the dataset due to: some participants filling in the questionnaire

more often than required (2), not being a primary school teacher (1), and not being able to link pre- and post-test to one person (1).

Student creativity. In order to explore differences between the experimental group and control group on the seven constructs on student creativity between the pre- and post-test a mixed ANOVA was conducted using SPSS version 25. For each construct a separate mixed ANOVA is conducted with condition as between-subject variable and time as within-subject variable. In case of an interaction effect of time on condition, planned comparisons in the form of a paired *t*-test was conducted. Furthermore, in order to check for normality a Shapiro Wilk's test was conducted. Also, to check homogeneity of variance a Levene's test was performed. Lastly, to check the assumption of sphericity, Mauchly's Test of Sphericity was conducted.

In total 238 questionnaire were sent in online and 110 were filled in on paper. One whole class of 21 students of the experimental group could not be included in the mixed ANOVA since they only filled in the questionnaire once and were therefore deleted from the dataset. Furthermore, 57 questionnaires were deleted from the dataset due to: being empty (18), students being absent during T1 (13), a teacher carrying out the questionnaire at the wrong moment (10), having no consent (10), filling in the questionnaire more often than required (5), and missing an identification code (1). Furthermore, one question on 'proud of work' was missing in the online questionnaire and therefore marked as a missing value for all online participants.

Results

This section comprises of two subsections. Firstly, an overview of the results on teacher attitude and behaviour is provided, followed by details of the results on student creativity.

Teacher Attitude

In order to test the hypotheses that the TDP will enhance the perceived relevance (H1), self-efficacy (H2), perceived student ability (H3), and context dependency (H4) of teachers, mixed ANOVA's and paired *t*-tests are conducted.

A Shapiro Wilk's test showed that two out of four constructs on T1, two out of four constructs on T2, and two out of four constructs on T3 for the experimental group and three out of four constructs on T1 and all four constructs on T3 for the control group are approximately normally distributed (Table 4). Since the majority of constructs is approximately normally distributed and the sample size is at least 18 in both conditions, the assumption of normality is reasonably met. Furthermore, Levene's test for equality of variances showed that the assumption of homogeneity of

variance is met (Table 5). The mean scores on the separate constructs of teacher attitude on the three timepoints for both the experimental group and control group are included in Table 6.

Table 4

Shapiro-Wilk's tests of normality for the four constructs of teacher attitude on T1, T2, and T3 for both the experimental group and control group

	Experimental group			Control group		
Construct	Shapiro-Wilk	df	*p*	Shapiro-Wilk	df	*p*
Perceived relevance						
T1	.821	41	**.000**	.923	30	**.033**
T2	.873	39	**.000**			
T3	.858	20	**.007**	.925	18	.159
Self-efficacy						
T1	.968	41	.296	.949	30	.161
T2	.969	39	.358			
T3	.942	20	.260	.929	18	.188
Perceived student ability						
T1	.972	41	.413	.978	30	.758
T2	.870	39	**.000**			
T3	.847	20	**.005**	.976	18	.901
Context-dependency						
T1	.934	41	**.019**	.971	30	.570
T2	.962	39	.206			
T3	.951	20	.379	.947	18	.386

Note. p values < .05 are in boldface.

Table 5

Levene's tests for equality of variance for the four constructs on T1, T2, and T3

Construct	T1				T3			
	Levene	df1	df2	*p*	Levene	df1	df2	*p*
Perceived relevance	0.11	1	69	.747	0.21	1	36	.650
Self-efficacy	2.89	1	69	.094	0.05	1	36	.818
Perceived student ability	<0.01	1	69	.959	1.47	1	36	.223
Context-dependency	0.40	1	69	.528	0.20	1	36	.658

Note. Levene's tests for T2 could not be conducted since only the experimental group filled in the questionnaire on that time point.

Table 6

Mean scores of all constructs on T1, T2, and T3 for both the experimental and control group

Construct	Experimental group			Control group		
	n	*M*	*SD*	*n*	*M*	*SD*
Perceived relevance						
T1	41	3.98	0.68	30	4.23	0.54
T2	39	4.40	0.58			
T3	20	4.41	0.44	18	4.10	0.46
Self-efficacy						
T1	41	3.03	0.74	30	2.97	0.52
T2	39	3.55	0.63			
T3	20	3.84	0.69	18	2.82	0.63
Perceived student ability						
T1	41	2.32	0.73	30	2.63	0.72
T2	39	1.62	0.63			
T3	20	1.60	0.64	18	2.81	0.82
Context-dependency						
T1	41	2.42	0.68	30	2.81	0.71
T2	39	2.10	0.58			
T3	20	2.04	0.68	18	2.83	0.78

Perceived relevance. Since there is no non-parametric alternative, a mixed ANOVA was conducted to test the hypotheses for perceived relevance (H1a-b), even though data for perceived relevance are not normally distributed. There is a non-parametric alternative for the paired *t*-test, therefore Wilcoxon signed-rank tests were used to compare scores for the experimental group. However, data for the control group are normally distributed, therefore for planned comparisons for the control group a paired *t*-test was used.

Experimental group versus control group T1 – T3. Results show a significant main effect of time on perceived relevance, $F(1, 36) = 7.68$, $p = .009$, $\eta^2 = .18$, with a higher score on perceived relevance at T3 than at T1. There was no significant main effect of condition on perceived relevance, $F(1, 36) = 0.06$, $p = .802$.

There was a significant interaction effect between time and condition, $F(1, 36) = 21.04$, $p < .001$, $\eta^2 = .37$, which means that the effect of time on condition is different for participants in the experimental group compared to the control group (Figure 4a). Planned comparisons, through conducting a Wilcoxon signed-rank test for the experimental group, revealed that participants in the experimental group scored significantly higher on perceived relevance on T3 than on T1, $Z = -3.29$, $p = .001$, $r = -.52$. Planned comparisons, through conducting a paired *t*-test for the control group, showed that there is no significant difference between the score on perceived relevance on T3 compared to T1 in the control group, $t(17) = 1.57$, $p = .134$.

Experimental group T1 – T2 – T3. In order to check where the effect of the intervention is most present, scores on perceived relevance between T1 and T2 and T2 and T3 for the experimental group were compared with separate Wilcoxon signed-rank tests (Table 7). Results show that participants scored significantly higher on perceived relevance directly after the training (T2) than before the training (T1), $Z = -4.19$, $p < .001$, $r = -.47$. There is no significant difference in scores on perceived relevance between directly after the training (T2) and after giving lessons (T3), $Z = -0.11$, $p = .913$.

To conclude, the results support hypotheses H1a and H1b that the score on perceived relevance increases between T1 and T3 for teachers in the experimental group and stays the same for teachers in the control group.

Table 7

Results of the Wilcoxon signed-rank on perceived relevance between the three measurement moments for the experimental group

Timepoint	*N*	*Z*	*p*	*r*
T1 → T3	20	-3.29	**.001**	-.52
T1 → T2	39	-4.19	**< .001**	-.47
T2 → T3	19	-0.11	.913	

Note. p values < .05 are in boldface. Effect sizes are only calculated for significant results.

Self-efficacy.

Experimental group versus control group T1 – T3. Results of the mixed ANOVA show a significant main effect of time on self-efficacy, $F(1, 36) = 11.84$, $p = .001$, $\eta^2 = .25$, with a higher score on self-efficacy at T3 than at T1. Furthermore, there is a significant main effect of condition on self-efficacy, $F(1,36) = 11.30$, $p = .002$, $\eta^2 = .24$, with a higher score on self-efficacy for the experimental condition.

Results show a significant interaction effect between time and condition, $F(1, 36) = 15.60$, $p < .001$, $\eta^2 = .30$, which means that the effect of time on condition is different for participants in the experimental group compared to the control group (Figure 4b). Planned comparisons, through conducting a paired *t*-test, revealed that participants in the experimental group scored significantly higher on self-efficacy on T3 than on T1, $t(19) = -4.62$, $p < .001$, $d = -1.03$. There is however no significant difference between the score on self-efficacy on T3 compared to T1 in the control group, $t(17) = 0.45$, $p = .659$.

Experimental group T1 – T2 – T3. In order to check where the effect of the intervention is most present, scores on self-efficacy between T1 and T2 and T2 and T3 for the experimental group were compared with separate paired *t*-tests (Table 8). Results show that participants scored significantly higher on self-efficacy directly after the training (T2) than before the training (T1), $t(38) = -5.43$, $p < .001$, $d = -0.87$. Furthermore, participants scored significantly higher on self-efficacy after giving lessons (T3) than directly after the training (T2), $t(18) = -2.37$, $p = .029$, $d = -0.54$.

To conclude, the results support hypotheses H2a and H2b that the score on self-efficacy increases between T1 and T3 for teachers in the experimental group and stays the same for teachers in the control group.

Table 8

Results of the paired t-tests on self-efficacy between the three measurement moments for the experimental group

Timepoint	*N*	*t*	*df*	*p*	*d*
T1 → T3	20	-4.62	19	**< .001**	-1.03
T1 → T2	39	-5.43	38	**< .001**	-0.87
T2 → T3	19	-2.37	18	**.029**	-0.54

Note. P values < .05 are in boldface.

Perceived student ability.

Experimental group versus control group T1 – T3. Results of the mixed ANOVA show a significant main effect of time on perceived student ability, $F(1, 36) = 4.16$, $p = .049$, $\eta^2 = .10$, with a lower score on perceived student ability at T3 than at T1. Furthermore, there is a significant main effect of condition on perceived student ability, $F(1, 36) = 16.88$, $p < .001$, $\eta^2 = .32$, with a lower score on perceived student ability for the experimental condition.

There is a significant interaction effect between time and condition, $F(1, 36) = 9.32$, $p = .004$, $\eta^2 = .21$, which means that the effect of time on condition is different for participants in the experimental group compared to the control group (Figure 4c). Planned comparisons, through conducting a paired *t*-test, revealed that participants in the experimental group scored significantly lower on perceived student ability on T3 than on T1, $t(19) = 4.11$, $p = .001$, $d = 0.92$. There is however no significant difference between the score on perceived student ability on T3 compared to T1 for the control group, $t(17) = -0.63$, $p = .534$.

Experimental group T1 – T2 – T3. In order to check where the effect of the intervention is most present, scores on perceived student ability for the experimental group between T1 and T2 was compared with a paired *t*-test and between T2 and T3 with a Wilcoxon signed-rank test (since data on perceived student ability for the experimental group on T2 and T3 are not normally distributed) (Table 9). Results show that participants scored significantly lower on perceived student ability directly after the training (T2) than before the training (T1), $t(38) = 7.00$, $p < .001$, $d = 1.12$. There is no significant difference in scores on perceived student ability between directly after the training (T2) and after giving lessons (T3), $Z = -1.56$, $p = .118$.

To conclude, the results support hypotheses H3a and H3b that the score on perceived student ability decreases between T1 and T3 for teachers in the experimental group and stays the same for teachers in the control group.

Table 9

Results of the paired t-tests and Wilcoxon signed-rank test on perceived student ability between the three measurement moments for the experimental group

Timepoint	*N*	*t*	*df*	*Z*	*p*	*d*
T1 → T3	20	4.11	19		**.001**	0.92
T1 → T2	39	7.00	38		**< .001**	1.12
T2 → T3	19			-1.56	.118	

Note. P values < .05 are in boldface. Since two separate tests were used, cells with values not part of the used test remain empty. Effect sizes are only calculated for significant results.

Context dependency.

Experimental group versus control group T1 – T3. Results of the mixed ANOVA show there is no significant main effect of time on context dependency, $F(1, 36) = 1.09$, $p = .303$. However, there is a significant main effect of condition on context dependency, $F(1, 36) = 6.87$, $p = .013$, $\eta^2 = .16$, with a lower score on context dependency for the experimental condition. There is no significant interaction effect between time and condition on context dependency, $F(1, 36) = 3.38$, $p = .074$ (Figure 4d).

Experimental group T1 – T2 – T3. In order to check if there was an effect of the training or of giving lessons, scores on context-dependency at the three timepoints for the experimental group were compared with separate paired *t*-tests (Table 10). Results show that participants scored significantly lower on context dependency after giving lessons (T3), than before the training (T1), $t(19) = 1.82$, $p = .048$, $d = 0.41$. Participants scored significantly lower on context-dependency directly after the training (T2) than before the training (T1), $t(38) = 3.10$, $p = .004$, $d = 0.50$. There is no significant difference between directly after the training (T2) and after giving lessons (T3), $t(18) = 0.29$, $p = .772$.

To conclude, the results support hypotheses H4a and H4b that the score on context-dependency decreases between T1 and T3 for teachers in the experimental group and stays the same for teachers in the control group.

Table 10

Results of the paired t-tests on context-dependency between the three measurement moments for the experimental group

Timepoint	*N*	*t*	*df*	*p*	*d*
T1 → T3	20	1.82	19	**.048**	0.41
T1 → T2	39	3.10	38	**.004**	0.50
T2 → T3	19	0.29	18	.772	

Note. p values < .05 are in boldface. Effect sizes are only calculated for significant results.

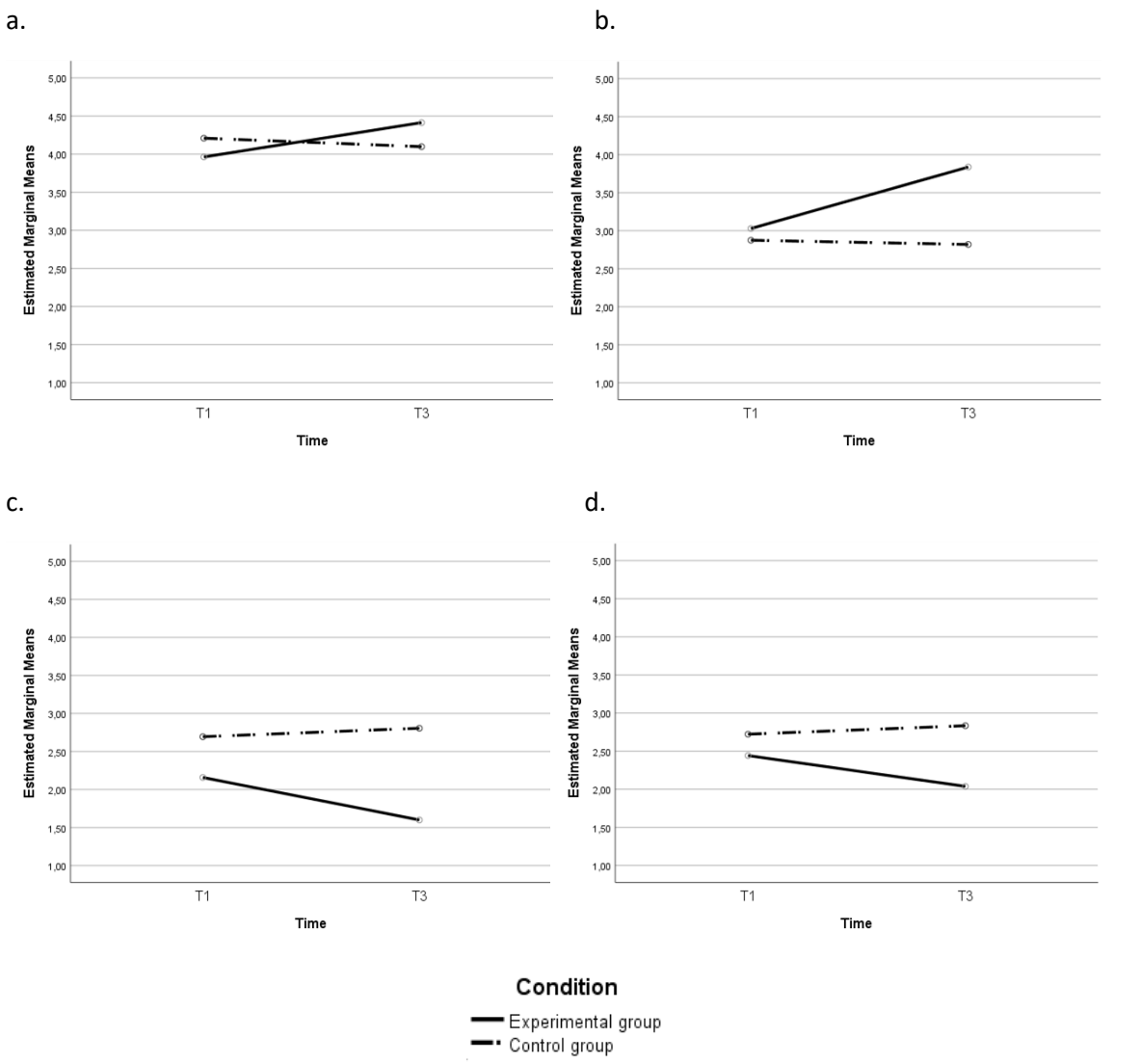

Figure 4. Profile plots of mean scores on perceived relevance (a), self-efficacy (b), perceived student ability (c), and context-dependency (d) on timepoints T1 and T3 for both the experimental group and the control group.

Teacher Behaviour

In order to test the hypotheses that the TDP will enhance teacher behaviour (H5a), a mixed ANOVA and paired *t*-tests were conducted on the frequency of designing lessons (H5a-1), conducting lessons (H5a-2), giving assignments (H5a-3), and questioning (H5a-4) in order to stimulate students' higher-order thinking, and the frequency of stimulating problem solving (H5a-5), perspective taking (H5a-6), creative thinking (H5a-7), and inquiry learning (H5a-8). The items belonging to each question on teacher behaviour are included in Table 11.

Table 11

Items belonging to each question on teacher behaviour

Question	Item
Designing lessons	'How often do you design a lesson that explicitly stimulates higher-order thinking in learners?'
Conducting lessons	'How often do you teach a lesson (self-designed or based on a teaching method) that explicitly stimulates higher-order thinking in learners?'
Giving assignments	'How often do you give assignments to your learners that require higher-order thinking?'
Questioning	'How often do you pose questions to your learners that stimulate higher-order thinking?'
Problem solving	'How often do you encourage your learners to find more than one solution for a problem?'
Perspective taking	'How often do you encourage your learners to approach a subject from different perspectives (such as suggesting pro and counterarguments)?'
Creative thinking	'How often do you encourage your learners to think creatively (such as designing a new product?'
Inquiry learning	'How often do you motivate your learners to study a phenomenon (such as how can an airplane fly)?'

A Shapiro Wilk's test showed that two out of eight items on T1, one out of eight items on T2, and four out of eight items on T3 for the experimental group and four out of eight items on T1 and six out of eight items on T3 for the control group are approximately normally distributed. (Table 12). Since the almost half of the questions is approximately normally distributed and the sample size is at least 16 in both conditions, the assumption of normality is reasonably met. Furthermore, Levene's test for equality of variances showed that the assumption of homogeneity of variance is met (Table

13). The mean scores on teacher behaviour on the tree timepoints for both the experimental and control group are included in Table 14.

Table 12

Shapiro-Wilk's tests of normality for the eight questions on teacher behaviour on T1, T2, and T3 for both the experimental group and control group

	Experimental group			Control group		
Questions	Shapiro-Wilk	df	*p*	Shapiro-Wilk	df	*p*
Designing lessons						
T1	.885	19	**.026**	.783	15	**.002**
T2	.901	19	.050			
T3	.915	19	.092	.885	15	.056
Conducting lessons						
T1	.933	19	.200	.828	15	**.009**
T2	.892	19	**.034**			
T3	.927	19	.154	.925	15	.230
Giving assignments						
T1	.892	19	**.034**	.771	15	**.002**
T2	.900	19	**.049**			
T3	.888	19	**.030**	.845	15	**.015**
Questioning						
T1	.862	19	**.011**	.882	15	.051
T2	.875	19	**.018**			
T3	.771	19	**.000**	.924	15	.224
Problem solving						
T1	.949	19	.376	.932	15	.288
T2	.804	19	**.001**			
T3	.918	19	.103	.941	15	.396
Perspective taking						
T1	.871	19	**.015**	.919	15	.183
T2	.882	19	**.023**			
T3	.880	19	**.021**	.929	15	.266
Creative thinking						

T1	.838	19	**.004**	.771	15	**.002**
T2	.799	19	**.001**			
T3	.927	19	**.151**	.931	15	.279
Inquiry learning						
T1	.780	19	**.001**	.899	15	.092
T2	.888	19	**.030**			
T3	.924	19	.132	.798	15	**.003**

Note. p values < .05 are in boldface.

Table 13

Levene's tests for equality of variance for the eight questions on teacher behaviour on T1, T2, and T3

	T1				T3			
Construct	Levene	df1	df2	*p*	Levene	df1	df2	*p*
Designing lessons	0.42	1	34	.524	1.24	1	34	.274
Conducting lessons	1.04	1	35	.315	0.44	1	35	.511
Giving assignments	0.21	1	36	.648	0.07	1	36	.790
Questioning	2.78	1	36	.104	0.00	1	36	.956
Problem solving	2.91	1	36	.593	0.26	1	36	.614
Perspective taking	1.09	1	36	.304	0.35	1	36	.556
Creative thinking	0.11	1	36	.737	0.03	1	36	.848
Inquiry learning	0.23	1	35	.636	0.46	1	35	.503

Note. Levene's tests for T2 could not be conducted since only the experimental group filled in the questionnaire on that time point.

Table 14

Mean scores of questions on teacher behaviour on T1, T2, and T3 for both experimental and control group

	Experimental group			Control group		
Question	*n*	*M*	*SD*	*n*	*M*	*SD*
Designing lessons						
T1	33	2.82	1.49	30	2.47	0.86
T2	30	2.90	1.23			
T3	20	3.55	1.32	16	2.19	1.05

Conducting lessons						
T1	32	2.97	1.33	30	3.00	1.20
T2	30	3.27	1.23			
T3	20	3.80	1.40	17	2.65	1.17
Giving assignments						
T1	32	3.19	1.38	30	3.40	1.19
T2	30	3.83	1.46			
T3	20	4.35	0.93	18	3.06	0.94
Questioning						
T1	32	4.06	1.41	30	4.40	1.67
T2	30	4.53	1.43			
T3	20	5.25	1.21	18	4.11	1.28
Problem solving						
T1	32	4.47	1.68	30	4.77	1.68
T2	30	4.57	1.63			
T3	20	5.30	1.38	18	4.72	1.23
Perspective taking						
T1	32	3.91	1.82	30	4.17	1.90
T2	30	3.80	1.69			
T3	20	4.80	1.40	18	3.94	1.31
Creative thinking						
T1	32	3.06	1.70	30	3.17	1.46
T2	30	3.13	1.59			
T3	20	4.05	1.40	18	3.11	1.23
Inquiry learning						
T1	32	2.78	1.34	30	2.73	1.29
T2	30	3.10	1.52			
T3	20	3.10	1.25	17	2.59	1.06

Note. n varies because several teachers failed to complete the questions on teacher behaviour.

Designing lessons.

Experimental group versus control group T1 – T3. Results of the mixed ANOVA show there is no significant main effect of time on frequency of designing lessons, $F(1, 34) = 3.14$, $p = .085$. However, there is a significant main effect of condition on frequency of designing lessons, $F(1, 34) =$

9.18, p = .005, η^2 = .21, with a higher score on frequency of designing lessons for the experimental condition.

Results show a significant interaction effect between time and condition, $F(1, 34) = 4.49$, p = .041, η^2 = .12, which means that the effect of time on condition is different for participants in the experimental group compared to the control group (Figure 5a). Planned comparisons, through conducting a paired *t*-test, revealed that participants in the experimental group scored significantly higher on frequency of designing lessons on T3 than on T1, $t(19) = -2.67$, p = .015, d = -0.60. There is however no significant difference between the score on frequency of designing lessons on T3 compared to T1 in the control group, $t(15) = 0.27$, p = .791.

Experimental group T1 – T2 – T3. In order to check where the effect of the intervention is most present, scores on frequency of designing lessons between T1 and T2 and T2 and T3 for the experimental group were compared with separate paired *t*-tests (Table 15). Results show there is no significant difference in scores on frequency of designing lessons between directly after the training (T2) and before the training (T1), $t(28) = -1.16$, p = .255. However, participants did score significantly higher on frequency of designing lessons after giving lessons (T3), than directly after the training (T2), $t(18) = -2.51$, p = .022, d = 0.58.

To conclude, the results support hypotheses H5a-1 and H5b-1 that the scores from behaviour measure designing lessons increases between T1 and T3 for teachers in the experimental group and stay the same for teachers in the control group.

Table 15

Results of the paired t-tests on designing lessons between the three measurement moments for the experimental group

Timepoint	*N*	*t*	*df*	*p*	*d*
T1 → T3	20	-2.67	19	**.015**	-0.60
T1 → T2	29	-1.16	28	.255	
T2 → T3	19	-2.51	18	**.022**	-0.58

Note. p values < .05 are in boldface. Effect sizes are only calculated for significant results.

Conducting lessons.

Experimental group versus control group T1 – T3. Results of the mixed ANOVA show there is no significant main effect of time on frequency of conducting lessons, $F(1, 35) = 1.59$, p = .216.

However, there is a significant main effect of condition on frequency of conducting lessons, $F(1, 35) = 9.18$, $p = .005$, $\eta^2 = .21$, with a higher score on frequency of conducting lessons for the experimental condition. There is no significant interaction effect between time and condition, $F(1, 35) = 1.07$, $p = .307$ (Figure 5b).

Experimental group T1 – T2 – T3. In order to check if there was an effect of the training or of giving lessons, scores on conducting lessons between the three timepoints for the experimental group were compared with separate paired *t*-tests (Table 16). Results show there is no significant difference in scores on frequency of conducting lessons between after giving lessons (T3) and before the training (T1), $t(19) = -1.45$, $p = .163$, no significant difference between directly after the training (T2) and before the training (T1), $t(28) = -1.32$, $p = .199$, and no significant difference between after giving lessons (T3) and directly after the training (T2), $t(18) = -1.02$, $p = .320$.

To conclude, the hypothesis H5a-2 that the scores from the behaviour measure conducting lessons increases between T1 and T3 for teachers in the experimental group is rejected. The results support the hypothesis that the scores stay the same for teachers in the control group (H5b-2).

Table 16

Results of the paired t-tests on conducting lessons between the three measurement moments for the experimental group

Timepoint	*N*	*t*	*df*	*p*
T1 → T3	20	-1.45	19	.163
T1 → T2	29	-1.32	28	.199
T2 → T3	19	-1.02	18	.320

Note. p values < .05 are in boldface.

Giving assignments. Since there is no non-parametric alternative, a mixed ANOVA was conducted to test the hypotheses for giving assignments (H5a-b-3), even though data for giving assignments are not normally distributed. For follow-up analysis and to compare scores for the experimental group there is a non-parametric alternative and therefore Wilcoxon signed-rank tests were used.

Experimental group versus control group T1 – T3. Results of the mixed ANOVA show a significant main effect of time on frequency of giving assignments, $F(1, 36) = 5.82$, $p = .021$, $\eta^2 = .14$, with a higher score on frequency of giving assignments at T3 than at T1. Furthermore, there is a

significant main effect of condition on frequency of giving assignments, $F(1, 36) = 7.55$, $p = .009$, $\eta^2 = .17$, with a higher score on frequency of giving assignments for the experimental condition.

There is a significant interaction effect between time and condition, $F(1, 36) = 15.96$, $p < .001$, $\eta^2 = .31$, which means that the effect of time on condition is different for participants in the experimental group compared to the control group (Figure 5c). Planned comparisons, through conducting a Wilcoxon signed-rank test, revealed that participants in the experimental group scored significantly higher on frequency of giving assignments on T3 than on T1, $Z = -3.02$, $p = .003$, $r = .48$. There is however no significant difference between the score on frequency of giving assignments on T3 compared to T1 in the control group, $Z = -1.27$, $p = .206$.

Experimental group T1 – T2 – T3. In order to check where the effect of the intervention is most present, scores on frequency of giving assignments between T1 and T2 and T2 and T3 for the experimental group were compared with separate paired *t*-tests (Table 17). Results show that participants scored significantly higher on frequency of giving assignments between directly after the training (T2) and before the training (T1), $Z = -2.17$, $p = .030$, $r = -.29$. However, there is no significant difference in scores on frequency of giving assignments after giving lessons (T3) and directly after the training (T2), $Z = -1.87$, $p = .061$.

To conclude, the results support hypotheses H5a-3 and H5b-3 that the scores from the behaviour measure giving assignments increases between T1 and T3 for teachers in the experimental group and stay the same for teachers in the control group.

Table 17

Results of the Wilcoxon signed-rank tests on giving assignments between the three measurement moments for the experimental group

Timepoint	*N*	*Z*	*p*	*r*
T1 → T3	20	-3.02	**.003**	-.48
T1 → T2	29	-2.17	**.030**	-.29
T2 → T3	19	-1.87	.061	

Note. p values < .05 are in boldface. Effect sizes are only calculated for significant results.

Questioning. Since there is no non-parametric alternative, a mixed ANOVA was conducted to test the hypotheses for questioning (H5a-b-4), even though data for questioning are not normally distributed. There is a non-parametric alternative for the paired *t*-test, therefore Wilcoxon signed-

rank tests were used to compare scores for the experimental group. However, scores for the control group are normally distributed, therefore for planned comparisons for the control group a paired *t*-test was used.

Experimental group versus control group T1 – T3. Results of the mixed ANOVA show there is no significant main effect of time on frequency of questioning, $F(1, 36) = 3.74$, $p = .061$. Furthermore, there is no significant main effect of condition on frequency of questioning, $F(1, 36) = 2.17$, $p = .150$.

However, there is a significant interaction effect between time and condition, $F(1, 36) = 9.24$, $p = .004$, $\eta^2 = .20$, which means that the effect of time on condition is different for participants in the experimental group compared to the control group (Figure 5d). Planned comparisons, through conducting a Wilcoxon signed-rank test, revealed that participants in the experimental group scored significantly higher on frequency of questioning on T3 than on T1, $Z = -2.91$, $p = .004$, $r = -.46$. Planned comparisons, through conducting a paired *t*-test, showed that there is however no significant difference between the score on frequency of questioning on T3 compared to T1 in the control group, $t(17) = 0.75$, $p = .466$.

Experimental group T1 – T2 – T3. In order to check where the effect of the intervention is most present, scores on frequency of questioning between T1 and T2 and T2 and T3 for the experimental group were compared with separate Wilcoxon signed-rank tests (Table 18). Results show, that participants scored significantly higher on frequency of questioning at T2 than at T1, $Z = -2.36$, $p = .018$, $r = -.31$. Also, participants scored significantly higher on frequency of questioning after giving lessons (T3) and directly after the training (T2), $Z = -1.97$, $p = .049$, $r = -.32$.

To conclude, the results support hypotheses H5a-4 and H5b-4 that the scores from the behaviour measure questioning increases between T1 and T3 for teachers in the experimental group and stay the same for teachers in the control group.

Table 18

Results of the Wilcoxon signed-rank on questioning between the three measurement moments for the experimental group

Timepoint	*N*	*Z*	*p*	*r*
T1 → T3	20	-2.91	**.004**	-.46
T1 → T2	29	-2.36	**.018**	-.31
T2 → T3	19	-1.97	**.049**	-.32

Note. p values < .05 are in boldface.

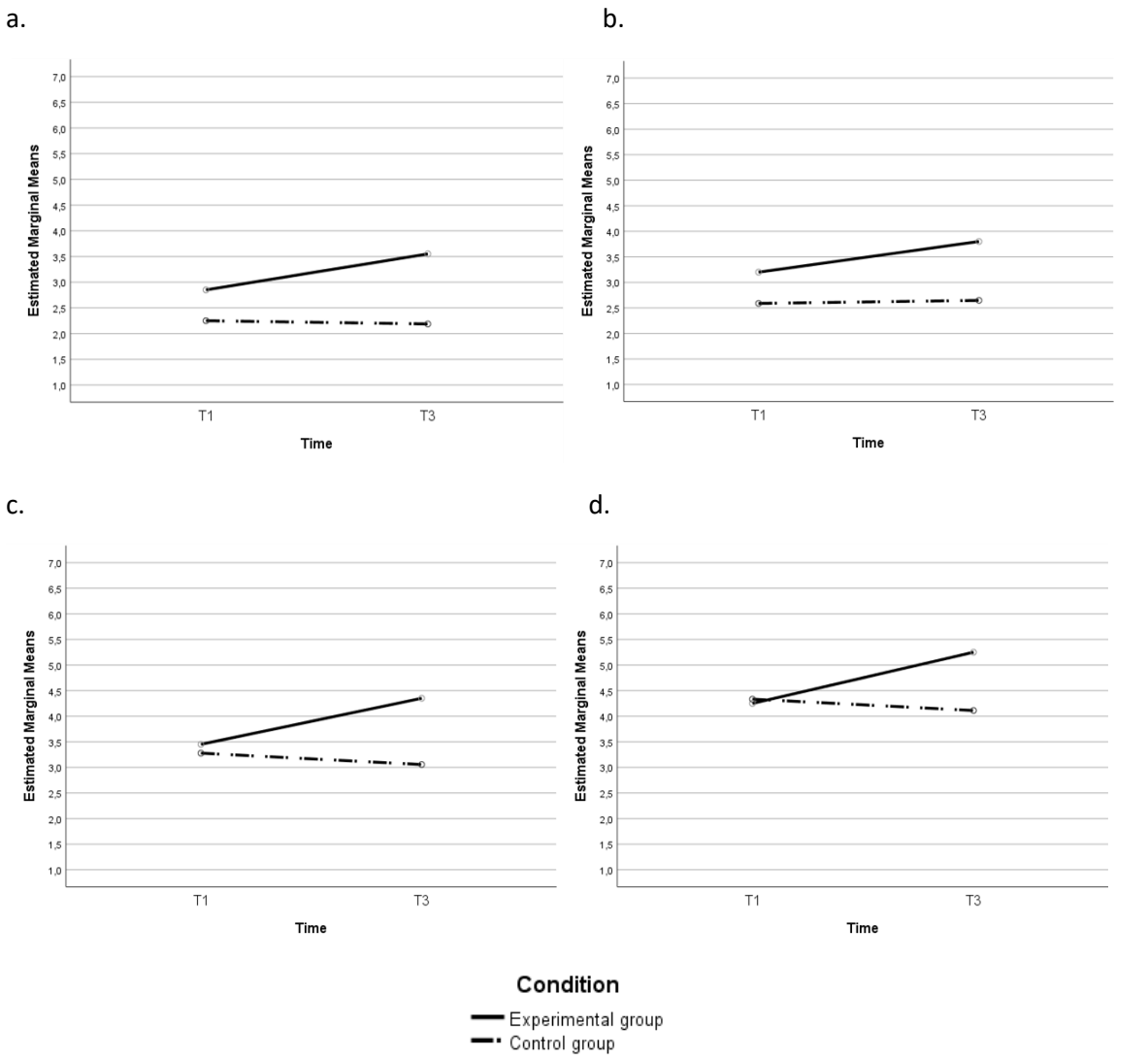

Figure 5. Profile plots of mean scores on frequency of designing lessons (a), conducting lessons (b), giving assignments (c), and questioning (d) on timepoints T1 and T3 for both the experimental group and the control group.

Problem solving.

Experimental group versus control group T1 – T3. Results of the mixed ANOVA show there is no significant main effect of time on frequency of stimulating problem solving, $F(1, 36) = 2.62$, $p = .114$, and also no significant main effect of condition on frequency of stimulating problem solving, $F(1, 36) = 0.20$, $p = .661$. Furthermore, there is no significant interaction effect between time and condition, $F(1, 36) = 3.53$, $p = .068$ (Figure 6a).

Experimental group T1 – T2 – T3. In order to check if there was an effect of the training or of giving lessons, scores on frequency of stimulating problem solving between the three timepoints for the experimental group were compared with separate paired *t*-tests (Table 19). Results show that

participants scored significantly higher on frequency of stimulating problem solving after giving lessons (T3), than before the training (T1), $t(19) = -2.12$, $p = .048$, $d = -0.47$. There is practically no difference in scores on frequency of stimulating problem solving between directly after the training (T2) and before the training (T1), $t(28) = 0$, $p = 1.000$ ($M = 4.47$, SD (T1) = 1.54; SD (T2) = 1.58). Participants scored significantly higher on frequency of stimulating problem solving after giving lessons (T3), than directly after the training (T2), $t(18) = -2.46$, $p = .024$, $d = -0.56$.

To conclude, the results support hypotheses H5a-5 and H5b-5 that the scores from the behaviour measure problem solving increases between T1 and T3 for teachers in the experimental group and stay the same for teachers in the control group.

Table 19

Results of the paired t-tests on stimulating problem solving between the three measurement moments for the experimental group

Timepoint	*N*	*t*	*df*	*p*	*d*
T1 → T3	20	-2.12	19	**.048**	-0.47
T1 → T2	29	0.00	28	1	
T2 → T3	19	-2.46	18	**.024**	-0.56

Note. p values < .05 are in boldface. Effect sizes are only calculated for significant results.

Perspective taking. Since there is no non-parametric alternative, a mixed ANOVA was conducted to test the hypotheses for perspective taking (H5a-b-6), even though data for perspective taking are not normally distributed. There is a non-parametric alternative for the paired *t*-test, therefore Wilcoxon signed-rank tests were used to compare scores for the experimental group.

Experimental group versus control group T1 – T3. Results of the mixed ANOVA show there is no significant main effect of time on frequency of stimulating perspective taking, $F(1, 36) = 0.08$, $p = .784$, and also no significant main effect of condition on frequency of stimulating perspective taking, $F(1, 36) = 1.02$, $p = .319$. Furthermore, there is no significant interaction effect between time and condition, $F(1, 36) = 3.43$, $p = .072$ (Figure 6b).

Experimental group T1 – T2 – T3. In order to check if there was an effect of the training or of giving lessons, scores on frequency of stimulating perspective taking on the three timepoints for the experimental group were compared with separate Wilcoxon signed-rank tests (Table 20). Results show there is no significant difference in scores on frequency of stimulating perspective taking

between after giving lessons (T3) and before the training (T1), Z = -1.27, p = .205, and no significant difference between directly after the training (T2) than before the training (T1), Z = -0.93, p = .354. However, participants scored significantly higher on frequency of stimulating perspective taking after giving lessons (T3), than directly after the training (T2), Z = -2.99, p = .003, r = -.49.

To conclude, hypothesis H5a-6 that the scores from the behaviour measure perspective taking increases between T1 and T3 for teachers in the experimental group is rejected. However, the results support hypothesis H5b-6 that the scores from the behaviour measure perspective taking stay the same for the control group.

Table 20

Results of the Wilcoxon signed-rank on stimulating perspective taking between the three measurement moments for the experimental group

Timepoint	*N*	*Z*	*p*	*r*
T1 → T3	20	-1.27	.205	
T1 → T2	29	-0.93	.354	
T2 → T3	19	-2.99	**.003**	-.49

Note. p values < .05 are in boldface. Effect sizes are only calculated for significant results.

Creative thinking. Since there is no non-parametric alternative, a mixed ANOVA was conducted to test the hypotheses for creative thinking (H5a-b-7), even though data for creative thinking are not normally distributed. There is a non-parametric alternative for the paired *t*-test, therefore Wilcoxon signed-rank tests were used to compare scores for the experimental group.

Experimental group versus control group T1 – T3. Results of the mixed ANOVA show a significant main effect of time on frequency of stimulating creative thinking, $F(1, 36) = 4.75$, $p = .036$, $\eta^2 = .12$, with a higher score on frequency of stimulating creative thinking at T3 than at T1. However, there is no significant main effect of condition on frequency of stimulating creative thinking, $F(1, 36) = 1.74$, $p = .195$. Also, results show no significant interaction effect between time and condition, $F(1, 36) = 3.11$, $p = .086$ (Figure 6c).

Experimental group T1 – T2 – T3. In order to check if there was an effect of the training or of giving lessons, scores on frequency of stimulating creative thinking on the three timepoints for the experimental group were compared with separate Wilcoxon signed-rank tests (Table 21).

Results show that participants scored significantly higher on frequency of stimulating creative thinking after giving lessons (T3), than before the training (T1), Z = -2.34, p = .019, r = -.37. There is no significant difference in scores on frequency of stimulating creative thinking between directly after the training (T2) and before the training (T1), Z = -0.21, p = .833. However, participants scored significantly higher on frequency of stimulating creative thinking after giving lessons (T3), than directly after the training (T2), Z = -2.81, p = .005, r = -.46.

To conclude, the results support hypotheses H5a-7 and H5b-7 that the scores from the behaviour measure creative thinking increases between T1 and T3 for teachers in the experimental group and stay the same for teachers in the control group.

Table 21

Results of the Wilcoxon signed-rank tests on stimulating creative thinking between the three measurement moments for the experimental group

Timepoint	*N*	*Z*	*p*	*r*
T1 → T3	20	-2.34	**.019**	-.37
T1 → T2	29	-0.21	.833	
T2 → T3	19	-2.81	**.005**	-.46

Note. p values < .05 are in boldface. Effect sizes are only calculated for significant results.

Inquiry learning. Since there is no non-parametric alternative, a mixed ANOVA was conducted to test the hypotheses for inquiry learning (H5a-b-8), even though data for inquiry learning are not normally distributed. There is a non-parametric alternative for the paired *t*-test, therefore Wilcoxon signed-rank tests was used to compare scores for the experimental group between T1 and T2. Since data for creative thinking on T3 for the experimental group are normally distributed, comparisons between T1 and T3 and T2 and T3 were conducted by using paired *t*-tests.

Experimental group versus control group T1 – T3. Results of the mixed ANOVA show there is no significant main effect of time on frequency of stimulating inquiry learning, $F(1, 35) = 0.03$, p = .872, and also no significant main effect of condition on frequency of stimulating inquiry learning, $F(1, 35) = 1.26$, p = .270. Furthermore, there is no significant interaction effect between time and condition, $F(1, 35) = 0.39$, p = .536 (Figure 6d).

Experimental group T1 – T2 – T3. In order to check if there was an effect of the training or of giving lessons, scores on frequency of stimulating inquiry learning on the three timepoints for the experimental group were compared with a Wilcoxon signed-rank test and paired *t*-tests (Table 22). Results show there is no significant difference in scores on frequency of stimulating inquiry learning between after giving lessons (T3) and before the training (T1), $t(19) = -0.53$, $p = .606$. Also, there is no significant difference directly after the training (T2) and before the training (T1), $Z = -1.62$, $p = .106$, and no significant difference between after giving lessons (T3) and directly after the training (T2), $t(18) = -0.42$, $p = .680$.

To conclude, hypothesis H5a-8 that the scores from behaviour measure inquiry learning increases between T1 and T3 for teachers in the experimental group is rejected. However, the results support hypothesis H5b-8 that the scores from behaviour measure inquiry learning stay the same for the control group.

Table 22

Results of the paired t-tests and Wilcoxon signed-rank tests on stimulating inquiry learning between the three measurement moments for the experimental group

Timepoint	*N*	*t*	*df*	*Z*	*p*
T1 → T3	20	-0.53	19		.606
T1 → T2	29			-1.62	.106
T2 → T3	19	-0.42	18		.680

Note. p values < .05 are in boldface. Since two separate tests were used, cells with values not part of the used test remain empty.

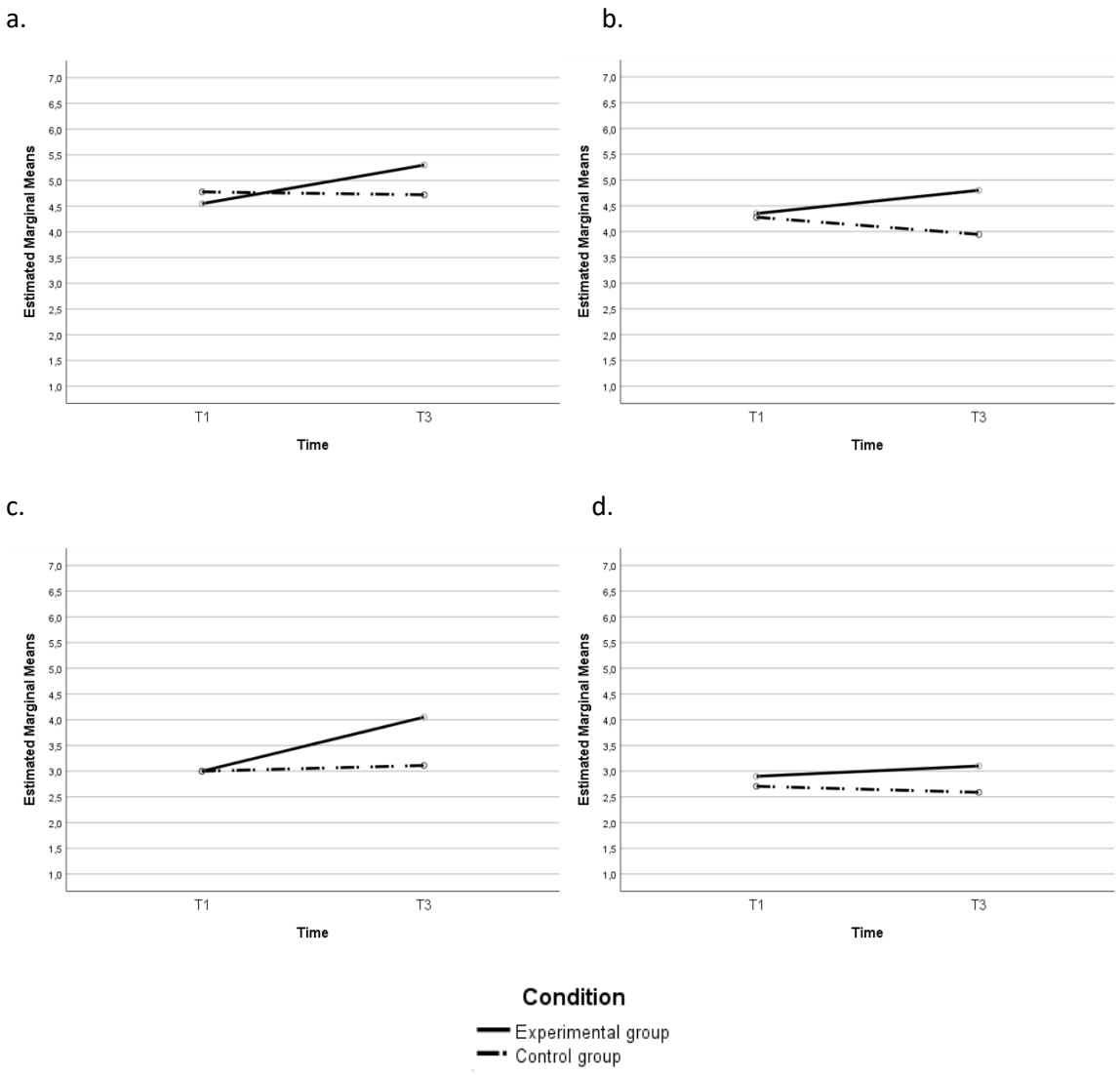

Figure 6. Profile plots of mean scores on frequency of stimulating problem solving (a), perspective taking (b), creative thinking (c), and inquiry learning (d) on timepoints T1 and T3 for both the experimental group and the control group.

Student Creativity

In order to test the hypotheses that teachers stimulating higher-order thinking will enhance curiosity (H6a-1), resourcefulness (H6a-2), output-oriented (H6a-3), proud of work (H6a-4), daring to be different (H6a-5), perseverance (H6a-6), and interacting with others (H6a-7) of student creativity, mixed ANOVA's were conducted.

A Shapiro Wilk's test showed that four out of seven constructs on T1 and two out of seven constructs on T2 for the experimental group and five out of seven constructs on T1 and three out of seven on T2 for the control group are approximately normally distributed (Table 23). Furthermore, Levene's test for equality of variances showed that the assumption of homogeneity of variance is

met for 11 out of 14 constructs on T1 an T2 (Table 24). The mean scores on student creativity on the two timepoints for both the experimental-, and control group are included in Table 25.

Table 23

Shapiro-Wilk's tests of normality for the seven constructs of student creativity on T1 and T2 for both experimental and control group

	Experimental group			Control group		
Construct	Shapiro-Wilk	df	*p*	Shapiro-Wilk	df	*p*
Curiosity						
T1	.973	43	.394	.985	86	.414
T2	.958	43	.119	.982	86	.273
Resourcefulness						
T1	.984	43	.789	.983	86	.307
T2	.960	43	.143	.955	86	**.004**
Output-oriented						
T1	.936	43	**.019**	.954	86	**.004**
T2	.932	43	**.014**	.970	86	**.044**
Proud of work						
T1	.953	43	.075	.977	86	.128
T2	.915	43	**.004**	.969	86	**.039**
Daring to be different						
T1	.946	43	**.043**	.969	86	**.037**
T2	.943	43	**.034**	.906	86	**.016**
Perseverance						
T1	.973	43	.403	.977	86	.129
T2	.906	43	**.002**	.971	86	.051
Interacting with others						
T1	.943	43	**.035**	.986	86	.514
T2	.947	43	**.047**	.989	86	.662

Note. p values < .05 are in boldface.

Table 24

Levene's tests for equality of variance for the seven constructs on T1 and T2

Construct	T1				T2			
	Levene	df1	df2	*p*	Levene	df1	df2	*p*
Curiosity	6.18	1	127	**.014**	3.54	1	127	.062
Resourcefulness	<0.01	1	127	.993	0.03	1	127	.861
Output-oriented	2.45	1	127	.120	1.24	1	127	.268
Proud of work	5.04	1	127	**.026**	4.03	1	127	**.047**
Daring to be different	0.11	1	127	.739	2.29	1	127	.133
Perseverance	0.45	1	127	.505	0.10	1	127	.748
Interacting with others	1.60	1	127	.208	0.69	1	127	.409

Note. p values < .05 are in boldface.

Table 25

Mean scores of all constructs of student creativity on T1 and T2 for both experimental and control group

Construct	Experimental group			Control group		
	n	*M*	*SD*	*n*	*M*	*SD*
Curiosity						
T1	43	3.77	0.66	93	3.91	0.48
T2	43	3.83	0.71	86	3.79	0.54
Resourcefulness						
T1	43	3.57	0.62	93	3.68	0.61
T2	43	3.61	0.67	86	3.50	0.63
Output-oriented						
T1	43	3.68	0.67	93	3.96	0.54
T2	43	3.73	0.73	86	3.82	0.59
Proud of work						
T1	43	3.73	0.79	93	3.80	0.59
T2	43	3.82	0.77	99	3.81	0.52
Daring to be different						
T1	43	3.90	0.73	93	3.54	0.67

T2	43	3.92	0.67	99	3.38	0.83
Perseverance						
T1	43	3.71	0.69	93	3.79	0.65
T2	43	3.75	0.73	99	3.60	0.69
Interaction with others						
T1	43	2.72	0.66	93	3.08	0.60
T2	43	2.82	0.74	99	2.92	0.66

Curiosity. Results of the mixed ANOVA show no significant main effect of time on curiosity, $F(1, 127) = 0.54$, $p = .464$. Also, there is no significant main effect of condition on curiosity, $F(1, 127) = 0.20$, $p = .653$.

There is a significant interaction effect between time and condition, $F(1, 127) = 5.56$, $p = .020$, $\eta^2 = .04$, which means that the effect of time on condition is different for participants in the experimental group compared to the control group (Figure 7a). Planned comparisons, through conducting a paired *t*-test, revealed that participants in the control group scored significantly lower on curiosity on T2 than on T1, $t(85) = 2.53$, $p = .013$, $d = 0.27$. However, there is no significant difference between the score on curiosity on T2 compared to T1 in the experimental group, $t(42) = -1.15$, $p = .258$.

To conclude, hypotheses H6a-1 and H6b-1 that scores from the creativity measure curiosity increases between T1 and T2 for students in the experimental group and stay the same for students in the control group are both rejected.

Resourcefulness. Results of the mixed ANOVA show no significant main effect of time on resourcefulness, $F(1, 127) = 1.12$, $p = .291$. Also, there is no significant main effect of condition on resourcefulness, $F(1, 127) = 0.03$, $p = .870$.

There is a significant interaction effect between time and condition, $F(1, 127) = 4.22$, $p = .042$, $\eta^2 = .03$, which means that the effect of time on condition was different for participants in the experimental group compared to the control group (Figure 7b). Planned comparisons, through conducting a paired *t*-test, revealed that participants in the control group scored significantly lower on resourcefulness on T2 than on T1, $t(85) = 2.62$, $p = .010$, $d = 0.28$. However, there is no significant difference between the score on resourcefulness on T2 compared to T1 in the experimental group, $t(42) = -0.65$, $p = .519$.

To conclude, hypotheses H6a-2 and H6b-2 that scores from the creativity measure resourcefulness increases between T1 and T2 for students in the experimental group and stay the same for students in the control group are both rejected.

Output-oriented. Since there is no non-parametric alternative, a mixed ANOVA was conducted to test the hypotheses for output-oriented (H6a-b-3), even though data for output-oriented are not normally distributed. There is a non-parametric alternative for the paired *t*-test, therefore Wilcoxon signed-rank tests were used to compare scores in the follow-up analysis.

Results show no significant main effect of time on output-oriented, $F(1, 127) = 1.45$, $p = .231$. Also, there is no significant main effect of condition on output-oriented, $F(1, 127) = 3.73$, $p = .056$. There is a significant interaction effect between time and condition, $F(1, 127) = 5.74$, $p = .018$, $\eta^2 = .04$, which means that the effect of time on condition is different for participants in the experimental group compared to the control group (Figure 7c). As a follow-up analysis a Wilcoxon Signed-rank test was conducted, which indicated that participants in the control group scored significantly lower on output-oriented at T2 than at T1, $Z = 2.51$, $p = .012$, $r = .22$. However, there is no significant difference between the score on output-oriented on T2 compared to T1 in the experimental group, $Z = 1.05$, $p = .292$.

To conclude, hypotheses H6a-3 and H6b-3 that scores from the creativity measure output-oriented increases between T1 and T2 for students in the experimental group and stay the same for students in the control group are both rejected.

Proud of work. Results of the mixed ANOVA show no significant main effect of time on proud of work, $F(1, 127) = 0.99$, $p = .321$. Also, there is no significant main effect of condition on proud of work, $F(1, 127) = 0.05$, $p = .816$. Results show no significant interaction effect between time and condition on proud of work, $F(1, 127) = 0.63$, $p = .429$ (Figure 7d).

To conclude, hypothesis H6a-4 that scores from the creativity measure proud of work increases between T1 and T2 for students in the experimental group is rejected. However, results support hypothesis H6b-4 that scores from the creativity measure proud of work stay the same between T1 and T2 for students in the control group.

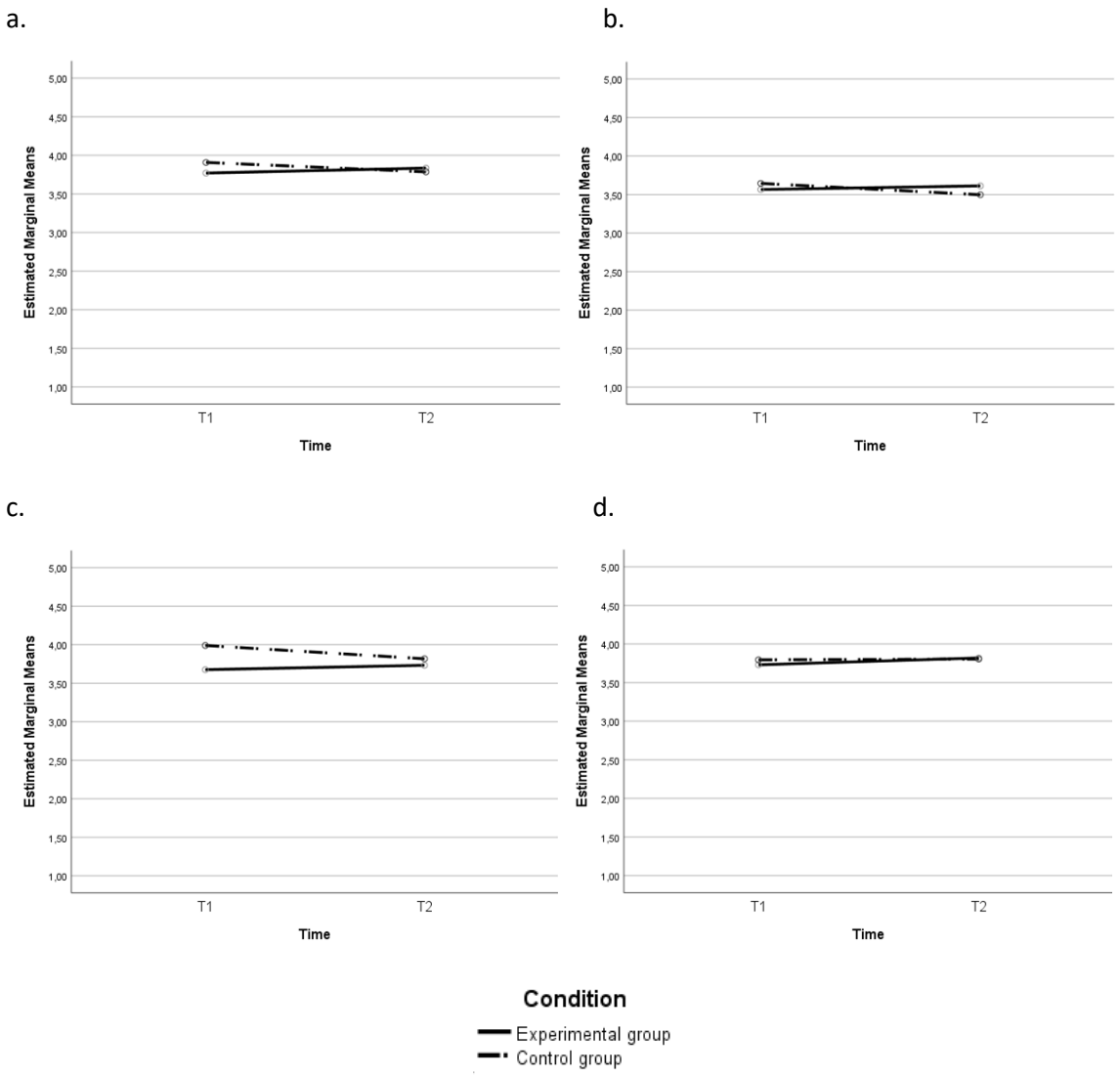

Figure 7. Profile plots of mean scores on curiosity (a), resourcefulness (b), output-oriented (c), and proud of work (d) on timepoints T1 and T2 for both the experimental group and the control group.

Daring to be different. Since there is no non-parametric alternative, a mixed ANOVA was conducted to test the hypotheses for daring to be different (H6a-b-5), even though data for daring to be different are not normally distributed. Results show there is no significant main effect of time on daring to be different, $F(1, 127) = 1.13$, $p = .291$. However, there is a significant main effect of condition on daring to be different, $F(1, 127) = 13.10$, $p < .001$, $\eta^2 = .09$, with a higher score on daring to be different for the experimental condition. There is no significant interaction effect between time and condition on daring to be different, $F(1, 127) = 1.90$, $p = .171$ (Figure 8a).

To conclude, hypothesis H6a-5 that scores from the creativity measure daring to be different increases between T1 and T2 for students in the experimental group is rejected. However, results

support hypothesis H6b-5 that scores from the creativity measure daring to be different stay the same between T1 and T2 for students in the control group.

Perseverance. Results of the mixed ANOVA show no significant main effect of time on perseverance, $F(1, 127) = 1.64$, $p = .203$. Also, there is no significant main effect of condition on perseverance, $F(1, 127) = 0.11$, $p = .743$. Furthermore, results show no significant interaction effect between time and condition on perseverance, $F(1, 127) = 3.88$, $p = .051$ (Figure 8b).

To conclude, hypothesis H6a-6 that scores from the creativity measure perseverance increases between T1 and T2 for students in the experimental group is rejected. However, results support hypothesis H6b-6 that scores from the creativity measure perseverance stay the same between T1 and T2 for students in the control group.

Interaction with others. Results of the mixed ANOVA show there is no significant main effect of time on interaction with others, $F(1, 127) = 0.38$, $p = .540$. However, there is a significant main effect of condition on interaction with others, $F(1, 127) = 5.13$, $p = .025$, $\eta^2 = .04$, with a lower score on interaction with others for the experimental condition.

Results show a significant interaction effect between time and condition, $F(1, 127) = 5.09$, $p = .026$, $\eta^2 = .04$, which means that the effect of time on condition is different for participants in the experimental group compared to the control group (Figure 8c). As a follow-up analysis, a Wilcoxon Signed-rank test was conducted, since the data for the experimental group on interaction with others are not normally distributed. The Wilcoxon Signed-rank test indicated that there is no significant difference between the score on interaction with others on T2 compared to T1 in the experimental group, $Z = 1.68$, $p = .093$. Since data on interaction with others for the control group are normally distributed, a *t*-test was conducted as a follow-up analysis. The *t*-test indicated that participants in the control group scored significantly lower on interaction with others at T2 than at T1, $t(85) = 2.29$, $p = .024$, $d = 0.25$.

To conclude, hypotheses H6a-7 and H6b-7 that scores from the creativity measure interaction with others increases between T1 and T2 for students in the experimental group and stay the same for students in the control group are both rejected.

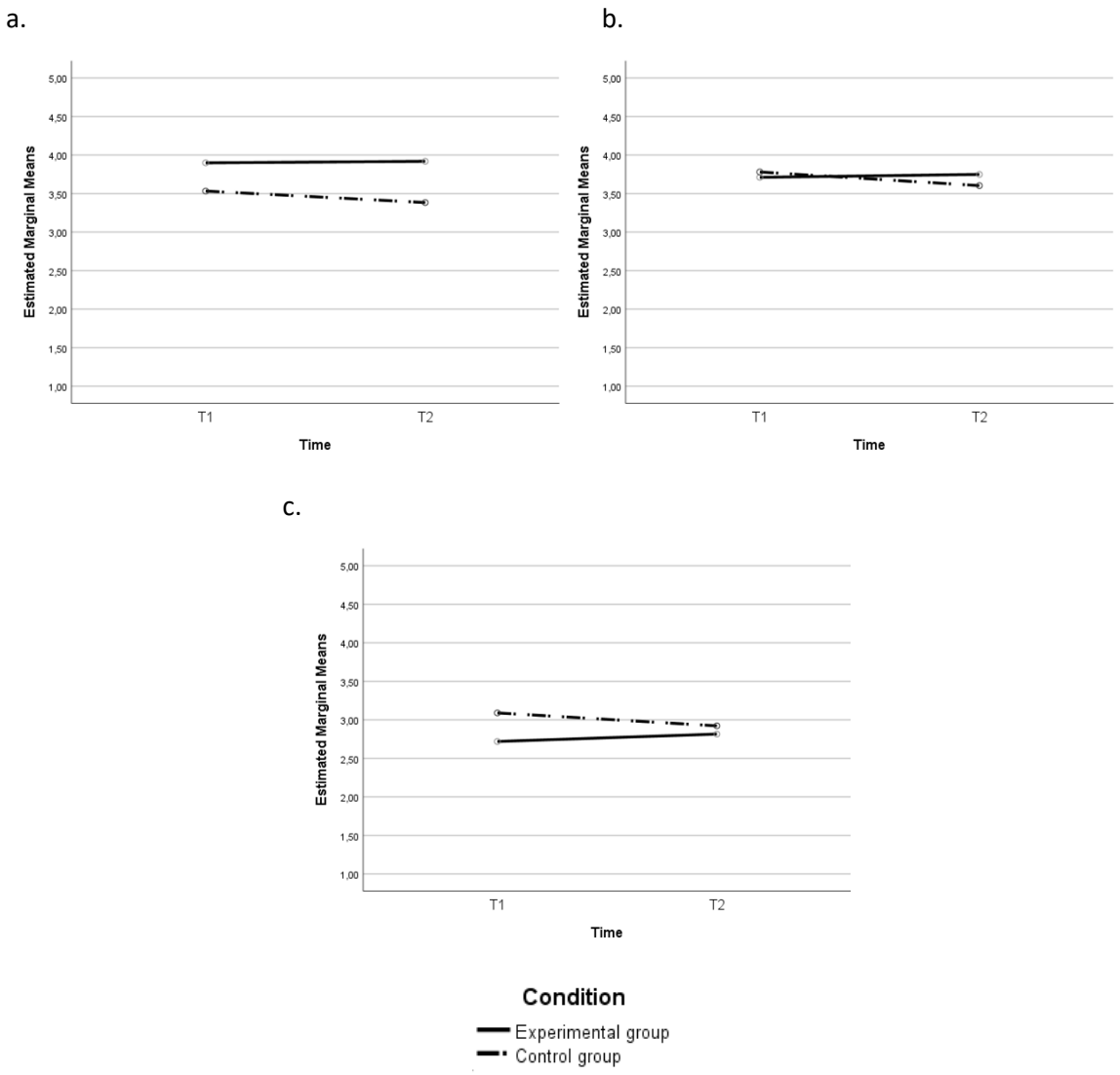

Figure 8. Profile plots of mean scores on daring to be different (a), perseverance (b), and interaction with others (c) on timepoints T1 and T2 for both the experimental group and the control group.

Qualitative Results

In the evaluation meeting several teachers indicated they were not able to perform as many lessons as intended due to lack of time. However, the group of student teachers were able to perform at least two lessons aimed at stimulating higher-order thinking. For these students, drawing up a lesson preparation was mandatory since it was part of a workpiece that would be graded by their teacher. One example of a prepared lesson aimed at stimulating higher-order thinking, was to start a debate on aerospace (Appendix F). Teachers who experienced lack of time were tempted to use ready-made lesson plans and assignments, for example lessons from ‘Outside the box’ series (Appendix G) and ‘denksleutels’. ‘Denksleutels’ is a teaching tool with questions or assignments to activate aspects of higher-order thinking.

We were curious to explore whether a group of students, who received more stimulation in using higher-order thinking skills, would score significantly higher on aspects of student creativity. From the teachers of whom the students were questioned on student creativity, one of the teachers indicated to have extensively used 'denksleutels' in the period of giving lessons and this could be considered as best practice compared to the other teachers. Therefore, paired *t*-tests were conducted to compare results on the seven constructs of creativity between T1 and T2 for this specific group of students. Just the paired *t*-test on 'proud of work' showed a significant result, which indicated that participants in this specific group scored significantly higher on proud of work on T2 than on T1, $t(22) = -2.27$, $p = .034$, $d = -0.47$.

Discussion

The goal of this research was twofold: first, to evaluate the effect of a TDP, that is focused on stimulating higher-order thinking, on the attitude and behaviour of primary school teachers towards stimulating higher-order thinking. Second, to evaluate the effect of teacher-designed lessons aimed at stimulating higher-order thinking on the creativity of students. Therefore, this study was guided by two research questions. The first was focused on the teacher: What is the effect of the TDP on the attitude and behaviour of teachers towards stimulating higher-order thinking? And the second question was focused on the students: What is the effect of the teacher-designed lessons aimed at higher-order thinking skills on the creativity of students?

Teacher Attitude

On the question of the effect of a TDP on teacher attitude, this study found that perceived relevance, self-efficacy, perceived student ability, and context-dependency significantly improved between before the training (T1) and giving lessons (T3) compared to the control group. Further analysis, by conducting paired *t*-tests, showed that the effect was mostly caused by the training, since there was a significant increase in all four constructs between before the training (T1) and directly after the training (T2). Notably, except for context dependency, all significant effects had large effect sizes. Self-efficacy increased even more after giving lessons (T3).

The fact that giving lessons had little effect on the three other constructs, could be caused by teachers failing to give as many lessons as instructed. During the evaluation meeting, teachers indicated they did not have enough time to give three lessons aimed at stimulating higher-order thinking. This could also be an explanation of why context-dependency did not increase between T2 and T3. Although perceived relevance, perceived student ability, and context-dependency did not improve between T2 and T3, the benefits of the training for teacher attitude towards higher-order

thinking were resistant of time since the scores on teacher attitude towards higher-order thinking stayed the same between T2 and T3.

Giving lessons did have an effect on self-efficacy, since self-efficacy logically increases as one does something more often. The effect of giving lessons on self-efficacy could also be explained by successful practices for teachers in giving lessons aimed at stimulating higher-order thinking, since teachers indicated in the evaluation meeting to have had positive experiences with stimulating higher-order thinking in the classroom. This is in line with a study of Xie et al. (2017) which showed a positive effect on teachers' self-efficacy after practical experience.

The positive results of this study support the hypothesis that this TDP improves teacher attitude, since all aspects of teacher attitude improved due to the teacher training. This comes as no surprise, given that, through specific topics and activities in the training, attention is devoted to the underlying constructs of attitude towards higher-order thinking (Table 26). The positive effect of the current TDP on attitude is important since it shows that teacher attitude towards higher-order thinking benefits from a TDP focused on attitude towards higher-order thinking. Although there are no other studies with TDP's specifically focused on attitude, the effect of a TDP on attitude has been shown in previous studies. For example, a study on teacher development in advanced educational technology found an improvement in attitude of science teachers towards educational computing (Ellis, 1992).

Table 26

The relation between activities in the teacher training and the constructs of teacher attitude towards higher-order thinking

Construct	Activity in teacher training
Perceived relevance	Discussing what the benefits of higher-order thinking skills are for students in class and in the future (Appendix D8)
Self-efficacy	Designing one lesson or more during the training in pairs or groups with guidance of the trainer (Appendix D13)
Perceived student ability	Discussing why higher-order thinking is beneficial and appropriate for all students (Appendix D3, D9)
Context-dependency	Providing examples of lesson ideas (Appendix D11)

Teacher Behaviour

On the question of the effect of a TDP on teacher behaviour, this study found that designing lessons, giving assignments, and questioning improved between before the training (T1) and giving lessons (T3) compared to the control group. Further analysis, by conducting paired *t*-tests, showed that the effect of designing lessons was mostly caused by giving lessons, since there was a significant increase of designing lessons between before the training (T1) and directly after the training (T2). The effect on giving assignments was mostly caused by the training, since there was a significant increase of giving assignments between directly after the training (T2) and after giving lessons (T3). Questioning was affected by both the training and increased even more after giving lessons. Furthermore, results of the paired *t*-tests to compare scores on the three timepoints for the experimental group indicated that stimulating problem solving, perspective taking, and creative thinking increased significantly due to giving lessons.

The increase of the scores on teacher behaviour due to giving lessons makes sense, because the questions on teacher behaviour teachers had to fill in the frequency of showing certain behaviour. The behaviour questioned in the questionnaire, was also the behaviour that was encouraged in the training by paying attention to the role of the teacher in stimulating higher-order thinking (Appendix D9) and how to design a good lesson aimed at higher-order thinking (Appendix D12). Furthermore, according to Ajzen (1991), attitude towards performing a certain behaviour influences the amount someone actually performing that certain behaviour and as mentioned before, teachers' attitude towards higher-order thinking did increase.

However, it is important to keep in mind that participating teachers admitted in the evaluation meeting to have given fewer lessons than instructed. This could be because the lessons teachers did perform already caused a higher frequency, perhaps due to the fact the amount of performed lessons being a lot higher than usual. Furthermore, we cannot rule out that teachers filled in socially desirable answers based on the expectation of the trainer towards the teachers to have given the instructed amount of lessons.

Strangely enough, the increase of frequency of giving assignments is caused by the training. This could be explained by teachers becoming more aware of what assignments belong to stimulating higher-order thinking. It could be that during the training teachers found out that more assignments belong to stimulating higher-order thinking than teachers imagined and that teachers already gave those type of assignments before they received the training. This could also be true for questioning. For example, introducing examples of questions challenging student to engage in higher-order thinking, could have made teachers realise they ask those type of questions already,

resulting in a higher frequency of questioning between before the training (T1) and directly after the training (T2).

The results show no significant increase on frequency of conducting lessons and stimulating inquiry learning. This is in contrast with the other results of the current study on teacher behaviour, but could be explained by the fact that, in most cases, teachers integrated higher-order thinking in existing lessons instead of conducting lessons solely to stimulate higher-order thinking. Furthermore, inquiry learning is only one of many ways to stimulate higher-order thinking and perhaps harder to integrate in existing lessons.

On most questions on teacher behaviour, either the training or giving lessons had a positive effect on the frequency of teacher behaviour. Logically, giving lessons most likely affected teacher behaviour. However, with the theory of planned behaviour of Ajzen (1991) in mind, one might consider the training having more effect than the current research design is able to show, since attitude visibly increased between before the training (T1) and after the training (T2) and affected teacher behaviour, which teachers were not able to show until after giving lessons (T3). Furthermore, findings of Porter et al. (2000) who showed that teachers' use of higher-order teaching strategies increased due to professional development focused on these specific strategies.

It is clear that there are important benefits to be seen in a TDP focused on stimulating higher-order thinking for the attitude and teaching behaviour of teachers. The positive effect of the current TDP could be explained by the fact several key elements of a successful TDP out of literature are included in the current TDP. For example, content focus, active learning, coherence, classroom implementation, and collective participation. Only the key element of duration was beyond the scope of the current research, since it indicates a minimum amount of 20 contact hours. Besides, when the TDP would have asked for more time of teachers, it would have been even harder to find respondents, since lack of time was the most important reason schools did not participate in the current study. Despite the limited duration, the TDP designed for this study proved to be beneficial for teachers' attitude and behaviour towards higher-order thinking.

Student Creativity

On the question of the effect of stimulating higher-order thinking in the classroom on student creativity, this study did not show any significant increase in student creativity. The results do indicate, however, a significant decrease in curiosity, resourcefulness, output-oriented, and interaction with others for the control group. What actually led to the rejection of the four hypotheses (H6a-1, 2, 3, 7) was that the scores on creativity stayed the same. Furthermore, on the

construct interaction with others the experimental group scored overall significantly lower than the control group. Notably, all the significant results on creativity had small effect sizes.

The results were not in line with the hypotheses that stimulating higher-order thinking would increase student creativity. This could be explained by the fact teachers did not give as many lessons as instructed. Furthermore, the specific constructs might not be addressed in the teacher designed lessons or assignments aimed at stimulating higher-order thinking. Moreover, when we look at the best practice, there was a significant increase of the construct proud of work. This could mean that constructs of creativity might increase, if teachers would stimulate higher-order thinking more.

The decrease of creativity among the participants in the control group, might be caused by students being more aware of some aspects of creativity and noticing they are not as curious, resourceful, output-oriented or interacting with others as much as they thought. The higher scores on interacting with others for the control group could be caused by the fact the control group originates from one specific school. In the meetings with this school (upon completion of the two measurement moments, the teachers of the control group took part in the development programme as well) it seemed that interaction with others is a priority area for that school and therefore teachers explicitly stimulate students to interact with each other. Several cooperative working methods came up during the meetings and almost every designed lessons consisted of collaboration exercises.

Limitations and Further Research

Due to practical constraints, this paper cannot provide a comprehensive review of the feasibility of the TDP in primary education as a whole. All participating teachers took part in the study voluntarily, which could cause teachers to be intrinsically motivated and easier to convince of the importance of higher-order thinking. On the other hand, most students and the teachers returning to the teacher profession did not participate voluntarily since the training was part of one of their course days.

Another limitation is the fact there were fewer responses than desired for the third measurement moment. Several teachers failed to give as many lessons as intended and sometimes failed to give any lessons at all. Also, the group of teachers returning to the teacher profession appeared to be only suitable for testing the effect of the training on teacher attitude and not teacher behaviour, since most of them did not do internships yet. Therefore, insight in the effect of giving lessons on teacher attitude and behaviour was limited.

Furthermore, this study has been unable to demonstrate that stimulating higher-order thinking increases student creativity. This could be caused by the way teachers stimulated higher-

order thinking in class. Since there were no observations in class, this study does not provide insights in actual teacher practice. Therefore, it is unclear whether teacher practice was effective. Also, during the evaluation meetings, several teachers pointed out they had not been able to stimulate higher-order thinking as much as planned.

Despite the limitations, the current TDP proved to have a positive effect on teacher attitude and for a large part on teacher behaviour. Now the practical challenge is to implement this on a large scale. Further research is required to determine whether the TDP is effective for primary schools in general by including more and various types of schools. Further research could also be conducted to determine the effectiveness of the TDP in the long term. According to Timperley (2008), sustainability is not only determined by the content of the TDP, but also by the amount of support afterwards. In order to sustain stimulating higher-order thinking in schools, for example, it is important to plan follow-up meetings for a longer period of time. This is among others suggested by Tennill and Cohen (2013). Furthermore, further research should be carried out to establish whether greater effort from teachers to stimulate higher-order thinking over a longer period of time would cause an increase in student creativity. In light of this, it could be interesting to observe how teachers stimulate higher-order thinking in the classroom in further studies. Since, besides effort, the way teachers stimulate higher-order thinking could influence student creativity as well.

Practical Implications

The success of the TDP designed for this study proved to be beneficial for teachers' attitude and behaviour towards higher-order thinking. This highlights the potential usefulness of TDP's in sustaining 21st century skills in primary education. Furthermore, the current study showed that when a TDP is focused on a specific construct of attitude, this construct is tended to improve.

Lack of time was the reason most schools did not participate in the study and during evaluation meetings, participating teachers mentioned lack of time as the only reason why they were not able to perform lessons aimed at stimulating higher-order thinking. Therefore, it is necessary for schools to clear time in the teaching schedule for higher-order thinking. An even better option would be to incorporate higher-order thinking in the regular curriculum.

In turn, integration of higher-order thinking in the curriculum means that teacher education will provide more attention towards it. More attention in schools and teacher education programs will help integrating higher-order thinking in daily education and as part of every school subject. When higher-order thinking is integrated in standard school subjects, or perhaps in teaching methods for those subjects, it will not take up any time of other subjects, it will only ask for a new format.

In any case, I will transfer my enthusiasm towards stimulating higher-order thinking in the classroom in my new job as a student career counsellor in teacher education. I hope my next career step will be to give educational science and research topics on higher-order thinking and make a start with the integration of higher-order thinking in daily school practice.

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Appendix A

Teacher Attitude Questionnaire

TOOLS VRAGENLIJST – Het stimuleren van hogere orde denken
Deze vragenlijst gaat over de houding van leerkrachten ten aanzien van het stimuleren van hogere-orde denken bij leerlingen.

Lees eerst onderstaande informatie goed door, voordat je aan de vragen begint.

Eerlijke mening: Het is belangrijk dat je de vragen eerlijk beantwoordt zodat het onderzoek een objectief en betrouwbaar beeld oplevert. Er zijn geen goede of foute antwoorden, het gaat echt om jouw persoonlijke mening. We willen je vragen om de vragenlijst volledig in te vullen, omdat onvolledige vragenlijsten niet gebruikt kunnen worden voor het onderzoek.

Anonimiteit: De vragenlijsten worden anoniem verwerkt en niet gekoppeld aan personen. In verband met vervolgonderzoek zouden we wel graag de mogelijkheid hebben om de data van een afzonderlijke school te bekijken. Daarom vragen we je om de naam van de school in te vullen. Ook wordt er gevraagd om een code te maken. Deze wordt gebruikt om de eerste en de tweede meting aan elkaar te koppelen.

Over de vragenlijst: Het kan voorkomen dat sommige vragen erg op elkaar lijken. Dat voelt misschien overbodig, maar dat is statistisch gezien noodzakelijk om de vragenlijst betrouwbaar te maken. Daarom verzoeken we je om toch alle vragen in te vullen.

Als je een vraag verkeerd hebt ingevuld zet dan een kruis door het verkeerde antwoord en vul het juiste antwoord in. Tenzij anders vermeld, kun je maar één antwoord aankruisen per vraag.

☐ **Ik heb bovenstaande informatie gelezen en ga ermee akkoord dat mijn antwoorden op de vragen in deze vragenlijst worden gebruikt voor onderzoeksdoeleinden.**

Alvast hartelijk dank voor je medewerking!

Deel 1: Achtergrondkenmerken

1. Ik ben een … ☐ Man
☐ Vrouw

2. Wat is je leeftijd?

3. Ik ben een … ☐ Leerkracht op een basisschool

Aan welke groep(en) geef je dit jaar les? (meerdere antwoorden mogelijk)

☐ Groep 1 ☐ Groep 5 ☐ Plusgroep
☐ Groep 2 ☐ Groep 6 ☐ Anders
☐ Groep 3 ☐ Groep 7
☐ Groep 4 ☐ Groep 8

Wat is je hoogst genoten vooropleiding?
☐ PABO
☐ Academische PABO
☐ HBO Master
☐ Academische Master
☐ Verkorte lerarenopleiding/zij-instromer
☐ Anders

Naam van de school waar je werkzaam bent?

☐ PABO student

In welk leerjaar zit je nu?
☐ Jaar 1 ☐ Jaar 2 ☐ Jaar 3 ☐ Jaar 4

Wat is je hoogst genoten vooropleiding?
☐ HAVO ☐ HBO
☐ VWO ☐ Anders
☐ MBO

Waar volg je je opleiding? (bijv. Windesheim of Saxion)

CODE: Een deel van jullie zal deze vragenlijst een tweede keer gaan invullen. Om de gegevens van deze vragenlijst te koppelen aan de tweede vragenlijst (zonder dat we weten wie je bent) hebben we een unieke code nodig die gelijk is voor beide vragenlijsten. Deze code wordt alleen voor deze koppeling gebruikt.
Kun je daarom hieronder (aan elkaar, zonder spatie) jouw geboortedatum en het nummer van je eigen postcode invullen? Dus bijvoorbeeld: geboortedatum 01 januari 1990 en postcode 1234 AB wordt dan: 010119901234

Deel 2: Het stimuleren van hogere-orde denken

BELANGRIJK: De onderstaande vragen gaan over HET STIMULEREN VAN HOGERE-ORDE DENKEN

Met het stimuleren van hogere-orde denken bij leerlingen bedoelen we het aanbieden van opdrachten, vragen, problemen of dilemma's waarbij kinderen complexe cognitieve denkvaardigheden moeten gebruiken (zoals analyseren, evalueren en creatief denken) om te komen tot een oplossing, beslissing, voorspelling, oordeel of product. Voorbeelden hiervan zijn (1) leerlingen zoveel mogelijk oplossingen laten bedenken voor een gegeven probleem, (2) leerlingen een ontwerp laten maken voor een nieuw nog niet bestaand product (zoals een huis dat geen rechte lijnen heeft), (3) leerlingen voor- en tegenargumenten laten bedenken rondom een stelling om zo een eigen mening te vormen over een bepaald onderwerp.

Leerkracht

Heb je ooit meegedaan aan binnenschoolse of buitenschoolse nascholing waarin het stimuleren van hogere-orde denken bij jouw leerlingen aan bod kwam?

☐ Nee

☐ Ja, ik heb 1 keer aan zo'n nascholing meegedaan

Uit hoeveel bijeenkomsten bestond deze nascholing?

☐ Ja, ik heb meerdere keren aan zo'n nascholing meegedaan

Uit hoeveel bijeenkomsten bestonden deze nascholingsprogramma's in totaal?

	Helemaal mee oneens		…		Helemaal mee eens
	1	2	3	4	5
Bij ons op school krijg ik veel ruimte om deel te nemen aan nascholing rondom het stimuleren van hogere-orde denken bij mijn leerlingen	☐	☐	☐	☐	☐

PABO student

Is er in jouw opleiding aandacht besteed aan het stimuleren van hogere-orde denken bij jouw leerlingen?

☐ Nee

☐ Ja, maar alleen bij bepaalde vakken

☐ Ja, bij alle vakken

BELANGRIJK: De onderstaande vragen gaan over HET STIMULEREN VAN HOGERE-ORDE DENKEN

Met het stimuleren van hogere-orde denken bij leerlingen bedoelen we het aanbieden van opdrachten, vragen, problemen of dilemma's waarbij kinderen complexe cognitieve denkvaardigheden moeten gebruiken (zoals analyseren, evalueren en creatief denken) om te komen tot een oplossing, beslissing, voorspelling, oordeel of product. Voorbeelden hiervan zijn (1) leerlingen zoveel mogelijk oplossingen laten bedenken voor een gegeven probleem, (2) leerlingen een ontwerp laten maken voor een nieuw nog niet bestaand product (zoals een huis dat geen rechte lijnen heeft), (3) leerlingen voor- en tegenargumenten laten bedenken rondom een stelling om zo een eigen mening te vormen over een bepaald onderwerp.

In dit deel van de vragenlijst vragen we weer naar *jouw* mening. De antwoordschaal loopt steeds in vijf stappen op van (1) helemaal mee oneens tot (5) helemaal mee eens.

	Helemaal mee oneens		…		Helemaal mee eens
	1	2	3	4	5
Ik denk dat het cruciaal is voor het leren van leerlingen dat zij worden aangezet tot hogere-orde denken	☐	☐	☐	☐	☐
Ik ben goed in staat om vragen te stellen aan mijn leerlingen waarmee hogere-orde denken wordt gestimuleerd	☐	☐	☐	☐	☐
Ik denk dat 'slimme' leerlingen veel beter zijn in hogere-orde denken dan 'zwakke' leerlingen	☐	☐	☐	☐	☐
Voor mij is extra tijd doorslaggevend of ik wel of geen hogere-orde denken stimuleer bij mijn leerlingen	☐	☐	☐	☐	☐
Ik beschik over genoeg vaardigheden om mijn lessen te verrijken met hogere-orde denkopdrachten	☐	☐	☐	☐	☐
Om de ontwikkeling van leerlingen te stimuleren, vind ik dat je niet vroeg genoeg kunt beginnen met het aanbieden van opdrachten waarin hogere-orde denken aan bod komt	☐	☐	☐	☐	☐
Voor mij is het maken van hogere-orde denkopdrachten voor mijn lessen alleen mogelijk als ik een methode heb waarin beschreven staat wat ik moet doen	☐	☐	☐	☐	☐
Ik denk dat 'zwakke' leerlingen opdrachten die hogere-orde denken vereisen niet aan kunnen	☐	☐	☐	☐	☐
Ik ben goed in staat om leerlingen te begeleiden bij het maken van opdrachten waarbij zij aangezet worden tot hogere-orde denken	☐	☐	☐	☐	☐
Voor mij is de beschikbaarheid van een scholingsprogramma een voorwaarde om hogere-orde denken te stimuleren bij mijn leerlingen	☐	☐	☐	☐	☐

BELANGRIJK: De onderstaande vragen gaan over HET STIMULEREN VAN HOGERE-ORDE DENKEN

Met het stimuleren van hogere-orde denken bij leerlingen bedoelen we het aanbieden van opdrachten, vragen, problemen of dilemma's waarbij kinderen complexe cognitieve denkvaardigheden moeten gebruiken (zoals analyseren, evalueren en creatief denken) om te komen tot een oplossing, beslissing, voorspelling, oordeel of product. Voorbeelden hiervan zijn (1) leerlingen zoveel mogelijk oplossingen laten bedenken voor een gegeven probleem, (2) leerlingen een ontwerp laten maken voor een nieuw nog niet bestaand product (zoals een huis dat geen rechte lijnen heeft), (3) leerlingen voor- en tegenargumenten laten bedenken rondom een stelling om zo een eigen mening te vormen over een bepaald onderwerp.

	Helemaal mee oneens		…		Helemaal mee eens
	1	2	3	4	5
Ik denk dat de meeste opdrachten die hogere-orde denken vereisen te moeilijk zijn voor 'zwakke' leerlingen	☐	☐	☐	☐	☐
Ik denk dat het voor de ontwikkeling van het denken van leerlingen essentieel is om hogere-orde denken te stimuleren	☐	☐	☐	☐	☐
Voor mij is een pasklaar pakket met voorbeeldmaterialen (bijv. Denksleutels) een voorwaarde om hogere-orde denken aan te moedigen bij mijn leerlingen	☐	☐	☐	☐	☐
Voor mij is de grootte van de groep bepalend of ik wel of geen hogere-orde denken stimuleer bij mijn leerlingen	☐	☐	☐	☐	☐
Ik denk dat de meeste opdrachten die hogere-orde denken vereisen frustrerend zijn voor 'zwakke' leerlingen	☐	☐	☐	☐	☐
Ik ben goed in staat om zelf opdrachten te maken die mijn leerlingen aanzetten tot hogere-orde denken	☐	☐	☐	☐	☐
Ik denk dat opdrachten die hogere-orde denken vereisen geschikter zijn voor 'slimme' leerlingen dan voor 'zwakke' leerlingen	☐	☐	☐	☐	☐
Ik denk dat het stimuleren van hogere-orde denken zo belangrijk is, dat alle leerkrachten dit regelmatig moeten doen in hun lessen	☐	☐	☐	☐	☐
Voor mij is de samenwerking met collega's een voorwaarde om hogere-orde denken te stimuleren bij mijn leerlingen	☐	☐	☐	☐	☐
Ik denk dat we van 'zwakke' leerlingen weinig hogere-orde denken moeten verwachten	☐	☐	☐	☐	☐

BELANGRIJK: De onderstaande vragen gaan over HET STIMULEREN VAN HOGERE-ORDE DENKEN

Met het stimuleren van hogere-orde denken bij leerlingen bedoelen we het aanbieden van opdrachten, vragen, problemen of dilemma's waarbij kinderen complexe cognitieve denkvaardigheden moeten gebruiken (zoals analyseren, evalueren en creatief denken) om te komen tot een oplossing, beslissing, voorspelling, oordeel of product. Voorbeelden hiervan zijn (1) leerlingen zoveel mogelijk oplossingen laten bedenken voor een gegeven probleem, (2) leerlingen een ontwerp laten maken voor een nieuw nog niet bestaand product (zoals een huis dat geen rechte lijnen heeft), (3) leerlingen voor- en tegenargumenten laten bedenken rondom een stelling om zo een eigen mening te vormen over een bepaald onderwerp.

	Nooit	een paar keer per jaar	één keer per maand	een paar keer per maand	één keer per week	Een paar keer per week	Dagelijks
	1	2	3	4	5	6	7
Hoe vaak ontwerp je zelf een les waarin het hogere-orde denken van leerlingen expliciet wordt gestimuleerd?	☐	☐	☐	☐	☐	☐	☐
Hoe vaak geef je een les (zelf ontworpen of uit een lesmethode) waarin het hogere-orde denken van leerlingen expliciet wordt gestimuleerd?	☐	☐	☐	☐	☐	☐	☐
Hoe vaak geef je jouw leerlingen opdrachten waarbij hogere-orde denken nodig is?	☐	☐	☐	☐	☐	☐	☐
Hoe vaak stel je vragen aan jouw leerlingen om hogere-orde denken te stimuleren?	☐	☐	☐	☐	☐	☐	☐
Hoe vaak moedig je jouw leerlingen aan in de les om meer dan één oplossing te vinden voor een probleem?	☐	☐	☐	☐	☐	☐	☐
Hoe vaak spoor je jouw leerlingen aan om een onderwerp vanuit verschillende perspectieven te benaderen (zoals voor- én tegenargumenten laten bedenken)?	☐	☐	☐	☐	☐	☐	☐
Hoe vaak stimuleer je jouw leerlingen om creatief te denken (zoals het ontwerpen van een nog niet bestaand product)?	☐	☐	☐	☐	☐	☐	☐
Hoe vaak motiveer je jouw leerlingen om een fenomeen (zoals hoe kan een vliegtuig vliegen) te onderzoeken?	☐	☐	☐	☐	☐	☐	☐

Appendix B

Student Creativity Questionnaire

Vragenlijst creativiteit

Met de vragenlijst die nu voor je ligt, willen wij nagaan hoe de creativiteit van kinderen in de bovenbouw is. Creativiteit heeft bijvoorbeeld te maken met nieuwsgierig zijn, ideeën bedenken, vragen stellen, samen overleggen, maar ook doorzetten en je concentreren.

De antwoorden in de vragenlijst worden anoniem verwerkt, dat betekent dat niemand weet wat jij hebt geantwoord. Omdat we willen weten of de creativiteit toeneemt de komende tijd, vragen we je de vragenlijst later nog een keer in te vullen. We vragen alleen om je naam en twee letters van je achternaam zodat we de eerste vragenlijst kunnen vergelijken met de tweede vragenlijst. Als je niet mee wil doen met het onderzoek geef dit dan aan bij je leerkracht.

Mijn voornaam is _____ en ik zit in groep _____

Eerste twee letters van mijn achternaam (als je achternaam bijv. Jansen is, schrijf je JA op en als je achternaam 'van Breukelen' is, schijf je 'BR' op): _____

☐ **Ik heb alles gelezen wat hierboven staat en vind het goed dat mijn antwoorden op de vragen in deze vragenlijst worden gebruikt voor het onderzoek.**

Voordat je begint, is het belangrijk dat je let op het volgende:

- De vragenlijst is geen test, er zijn geen goede of foute antwoorden, want het gaat alleen om jouw mening.
- Het is belangrijk dat je elke vraag beantwoordt, ook al lijkt deze op een vraag die je al hebt gehad.
- Als je bij een vraag toch een ander antwoord wilt invullen zet dan een kruis door je vorige antwoord en omcirkel het nieuwe antwoord.

		Hele-maal niet mee eens	Niet mee eens	Niet mee eens en niet mee oneens	Mee eens	Hele-maal mee eens
1.	Ik merk dingen op die anderen vanzelfsprekend vinden.	1	2	3	4	5
2.	Ik start pas met mijn opdracht als ik er over nagedacht heb.	1	2	3	4	5
3.	Ik ga door op mijn manier, ook als anderen vinden dat het anders moet.	1	2	3	4	5
4.	Ik vraag anderen naar mijn werk te kijken.	1	2	3	4	5
5.	Ik werk verder, ook als het moeilijk is.	1	2	3	4	5
6.	Ik stel vragen om dingen beter te begrijpen.	1	2	3	4	5
7.	Ik kom zomaar op ideeën.	1	2	3	4	5
8.	Ik vind het leuk na te denken over dingen om mij heen.	1	2	3	4	5
9.	Ik bedenk nieuwe dingen.	1	2	3	4	5
10.	Ik denk na hoe ik mijn werk zo goed mogelijk kan doen.	1	2	3	4	5
11.	Ik vind dat mijn ideeën er mogen zijn.	1	2	3	4	5
12.	Ik geef anderen feedback op hun werk, ook als ze daar niet om vragen.	1	2	3	4	5
13.	Ik denk mee met anderen over hun ideeën.	1	2	3	4	5
14.	Als ik een vraag niet meteen kan beantwoorden, werk ik toch verder.	1	2	3	4	5
15.	Ik werk verder, ook als het even tegen zit.	1	2	3	4	5
16.	Ik kan uitleggen welke keuzes ik gemaakt heb.	1	2	3	4	5
17.	Ik wil meer weten van mijn opdracht voordat ik eraan begin.	1	2	3	4	5
18.	Ik bedenk verschillende manieren om de opdracht uit te werken.	1	2	3	4	5
19.	Ik wil weten hoe iets echt werkt.	1	2	3	4	5

		Hele-maal niet mee eens	Niet mee eens	Niet mee eens en niet mee oneens	Mee eens	Hele-maal mee eens
20.	Ik vind het leuk om nieuwe dingen te ontdekken.	1	2	3	4	5
21.	Ik probeer meer manieren uit.	1	2	3	4	5
22.	Ik wil mijn werk graag goed doen.	1	2	3	4	5
23.	Ik vertel anderen over mijn ideeën.	1	2	3	4	5
24.	Ik geef niet op als ik het even niet meer weet.	1	2	3	4	5
25.	Ik vraag anderen naar mijn werk te kijken, ook als het nog niet af is.	1	2	3	4	5
26.	Ik geef anderen feedback op hun aanpak, ook als ze daar niet om vragen.	1	2	3	4	5
27.	Ik volg mijn idee, ook als anderen dat een minder goed idee vinden.	1	2	3	4	5
28.	Ik weet hoe ik mijn idee moet uitleggen, zodat anderen begrijpen wat ik bedoel.	1	2	3	4	5
29.	Ik zorg dat ik mijn opdracht begrijp, voordat ik eraan begin.	1	2	3	4	5
30.	Ik wil graag begrijpen hoe anderen dingen bedoelen.	1	2	3	4	5
31.	Ik verwonder me over dingen om me heen.	1	2	3	4	5
32.	Ik heb altijd veel ideeën als ik een opdracht krijg.	1	2	3	4	5
33.	Ik kijk hoe ik mijn werk beter kan doen.	1	2	3	4	5
34.	Ik vertrouw op mijn ideeën.	1	2	3	4	5
35.	Ik durf aan de slag te gaan, ook als het mis kan gaan.	1	2	3	4	5
36.	Ik vraag anderen mee te denken over mijn ideeën.	1	2	3	4	5
37.	Ik ga door op mijn manier, ook als anderen op een andere manier werken.	1	2	3	4	5
38.	Ik onderzoek wat ik allemaal moet doen.	1	2	3	4	5
39.	Ik maak dingen die voor mij nieuw zijn.	1	2	3	4	5

		Hele-maal niet mee eens	Niet mee eens	Niet mee eens en niet mee oneens	Mee eens	Hele-maal mee eens
40.	Ik vraag mij af hoe iets zit.	1	2	3	4	5
41.	Ik maak nieuwe dingen.	1	2	3	4	5
42.	Ik kan uitleggen wat ik met mijn werk bedoel.	1	2	3	4	5
43.	Ik geef anderen feedback op hun werk, als ze daar om vragen.	1	2	3	4	5
44.	Ik vraag mij af hoe iets ontdekt is.	1	2	3	4	5

Dit is het einde van de vragenlijst. Kijk nog even of je alle vragen hebt beantwoord en of je een kruisje hebt gezet op de eerste pagina. Bedankt voor het invullen!

Appendix C

Teacher Instruction on Administering Student Questionnaire

Zet een bak klaar waar de leerlingen op een geschikt moment zelf hun vragenlijst in mogen doen. Dit kan bijvoorbeeld een kartonnendoos van het printpapier zijn, deze heeft ook een deksel dus dat geeft de kinderen hopelijk het gevoel dat hun vragenlijst niet bekeken wordt.

Stap 1: laat de leerlingen bovenaan de eerste bladzijde de datum van vandaag en een 1 opschrijven.

"Voor je ligt een vragenlijst over creativiteit. Schrijf links bovenaan de datum van vandaag: ….."

"Schrijf rechts bovenaan het cijfer 1"

Stap 2: lees samen met de leerlingen de eerste bladzijde.

Stap 3: benadruk dat jij (de leerkracht) de antwoorden op de vragenlijsten niet bekijkt en dat de antwoorden in het onderzoek anoniem worden gebruikt.

"Ik ga jullie vragenlijsten niet bekijken, die mogen jullie …….. (kies zelf een geschikt moment) inleveren in 'deze' bak en die komt de onderzoeker binnenkort ophalen. Jullie antwoorden worden door de onderzoeker anoniem gebruikt."

Stap 4: vraag de leerlingen een kruisje te zetten als ze het goed vinden dat de antwoorden van de vragenlijst worden gebruikt voor het onderzoek.

"Als je het goed vindt dat de onderzoeker jouw antwoorden in het onderzoek gebruikt, dan zet je een kruisje in het vakje."

Stap 5: vertel dat er twee woorden in de vragenlijst voorkomen die ze misschien lastig vinden en dat je ze daarom even met de leerlingen bespreekt. Vraag of ze weten wat wordt bedoeld met "vanzelfsprekend" en "feedback". Leg zo nodig de woorden uit.

"In de vragenlijst staan twee lastige woorden. De eerste is: vanzelfsprekend. Als iets vanzelfsprekend is dan is iets begrijpelijk of logisch. Het tweede woord is feedback. Als je feedback aan iemand geeft, dan geef je tips en tops aan iemand. Je kan zelf ook feedback krijgen, dan vertelt iemand aan jou wat je goed hebt gedaan en wat nog beter kan."

Stap 6: vertel de leerlingen dat ze de vragenlijst op de hoek van hun tafel moeten leggen als ze klaar zijn.

"Als je klaar bent met de vragenlijst dan leg je deze op de hoek van je tafel".

Stap 8: vertel wat de leerlingen in stilte kunnen gaan doen als de vragenlijst klaar is, zodat ze de leerlingen die nog bezig zijn niet storen.

Stap 9: Leerlingen vullen de vragenlijst in (+/- 10 minuten)

Stap 10: als iedereen klaar is met het invullen van de vragenlijst vraag je de leerlingen nog een keer te checken of de datum, het cijfer 1 en het kruisje op het eerste blad staan. Ook checken de leerlingen of ze overal wat hebben ingevuld.

"Ik zie dat iedereen klaar is met het invullen van de vragenlijst. Kijk nog even op het voorblad of daar de datum van vandaag staat, of er een 1 op staat en of je het vakje hebt aangekruist. Kijk ook even op alle bladzijdes of je echt overal iets hebt ingevuld".

Stap 11: laat de leerlingen op een geschikt moment de vragenlijsten zelf inleveren in een bak/doos.

Appendix D

Accompanying Presentation of Teacher Training

1.

HOGERE-ORDE DENKEN

HET STIMULEREN VAN CREATIEF, KRITISCH EN PROBLEEMOPLOSSEND DENKEN IN DE KLAS

2.

INHOUD TRAINING

- Vragenlijst invullen
- Voorkennis ophalen
- Informatie hogere orde denken
- Actief aan de slag met hogere-orde denken

Pauze

- Voorbeelden van hogere-orde denken
- Lesontwerpen
- Planning
- Vragenlijst

3.

VOORKENNIS OPHALEN

- Wat weten jullie al over hogere-orde denken?
- Wanneer kan je hogere-orde denken inzetten?
- Voor wie is hogere-orde denken geschikt?
- Waarom zou je hogere-orde denken in willen zetten?

4.

WAT IS HOGERE-ORDE DENKEN?

- "Higher order thinking occurs when a person takes new information and information stored in memory and interrelates and/or rearranges and extends this information to achieve a purpose or find possible answers in perplexing situations" (Lewis & Smith, 1993).
- Complex: verschillende denk-processen en situaties, overlap

5.

CREATIEF DENKEN

- Het bedenken van nieuwe ideeën en deze kunnen uitwerken en analyseren
- Een onderzoekende en ondernemende houding, vragen stellen
- Het kunnen denken buiten de gebaande paden en nieuwe samenhangen kunnen zien
- Risico's durven nemen en fouten kunnen zien als leermogelijkheden.
- Divergent en convergent denken om op nieuwe ideeën te komen
- Basis principes en regels toepassen in nieuwe situaties
- Relevante aspecten van een probleem zien en nieuwe informatie verbinden met wat je al weet.

6.

KRITISCH DENKEN

- Formuleren van een eigen, onderbouwde visie of mening
- Het effectief kunnen redeneren en formuleren
- Informatie kunnen interpreteren, analyseren en synthetiseren
- Hiaten in kennis kunnen signaleren
- Het kunnen stellen van betekenisvolle vragen
- Het kritisch reflecteren op het eigen leerproces
- Het open staan voor alternatieve standpunten

7.

PROBLEEMOPLOSSEND DENKEN

- Problemen kunnen signaleren, analyseren en definiëren
- Kennen van strategieën om met onbekende problemen om te gaan
- Oplossingsstrategieën kunnen genereren, analyseren en selecteren
- Het creëren van patronen en modellen
- Het kunnen nemen van beargumenteerde beslissingen
- Data interpreteren, variabelen controleren, hypotheses formuleren
- Een onderzoekscyclus plannen en uitvoeren om tot een passend antwoord te komen of tot de beste oplossing van een probleem

8.

WAAROM IS HOGERE-ORDE DENKEN BELANGRIJK?

- Kennis
- Denkprocessen
- Zelfvertrouwen en doorzettingsvermogen
- Weloverwogen beslissingen nemen
- Actief denken en bewust denkvaardigheden in zetten.
- Onderbouwen van antwoorden, het behalen van waardevolle resultaten en het ontwikkelen van andere intellectuele vaardigheden.
- Zelf-evaluatie, open-minded zijn en het hebben van een flexibele houding.

9.

10.

11.

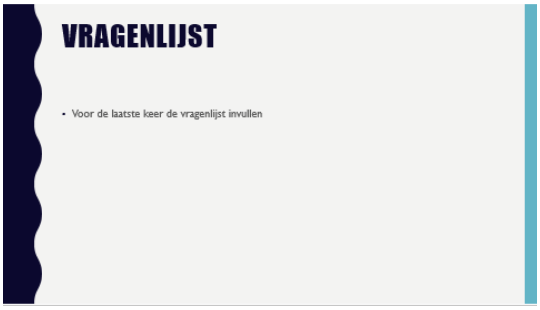
12.

13.

14.

Appendix E

Accompanying Presentation of Evaluation Meeting



Appendix F

Lesson Preparation Form of Student Teacher

ONDERWERP VAN DE LES		DENKVAARDIGHEDEN
Vragen over de ruimtevaart	Welke denkvaardigheden spreek je aan in deze les?	**Critical thinking**

HULPVRAGEN	DOELSTELLING(EN)
Wat moeten de leerlingen kennen en kunnen aan het einde van de les met betrekking tot de leerstof?	Aan het eind van de les weten de leerlingen hoe er geplast en gedoucht wordt in het ISS. Aan het eind van de les weten de leerlingen waarom ruimtevaart veel geld kost. Aan het eind van de les weten de leerlingen wat voor een verband de signaalwoorden maar, ook, zodat, daarna, en weergeven. Aan het eind van de les weten de leerlingen dat begrijpend lezen niet alleen bij nieuwsbegrip voorkomt, maar eigenlijk overal tijdens het lezen.
Welke denkvaardigheden moeten de leerlingen ingezet hebben om zich de leerstof eigen te maken?	De leerlingen gaan bezig met critical thinking. Aan het eind van de les kunnen de leerlingen een debat houden, met opgezochte informatie, waarbij ze vervolgens een ander standpunt moeten aannemen

HULPVRAGEN	BEGINSITUATIE
Wat is het vertrekpunt van de leerlingen met betrekking tot de leerstof?	De leerlingen zijn sinds de Kinderboekenweek bezig geweest met het thema ruimtevaart. Ze behandelen in de laatste twee weken voor de herfstvakantie een aantal vragen die geïnventariseerd zijn aan het begin van het thema ruimtevaart. Dit zijn vragen waarmee de leerlingen zijn gekomen, en waarbij de leerkracht en leerlingen samen op zoek gaan naar het antwoord.
Wat is het vertrekpunt van de leerlingen met betrekking tot de denkvaardigheden van de leerlingen?	De leerlingen zijn nog niet eerder bezig geweest met deze vorm van debatteren. Wel moeten ze soms bij nieuwsbegrip argumenten opzoeken. Echter is deze vorm nieuw.

HULPVRAGEN	MODEL VOOR LEREN
Op welke manieren kun je als leraar in deze les een model voor het leren van leerlingen zijn? Wat kun je zelf als leraar aan de leerlingen laten zien ten aanzien van het gebruik van denkvaardigheden. Beschrijf dit zo concreet mogelijk.	Om het kritisch denken uit te leggen neem ik een voorbeeld. Ik geef aan dat één van de leerlingen voetbal ziet als een sport voor alleen maar jongens. Ik geef als leerkracht aan dat ik het hier niet mee eens ben, maar ik probeer mij wel in te leven in deze leerling. Hiermee neem ik dus een ander standpunt aan en ben ik bezig met kritisch denken.

INLEIDING			
ONTWERPTIPS EN VRAGEN	**LESBESCHRIJVING**	**DENKVAARDIGHEDEN**	
Wat is er nodig om creatief, kritisch, probleemoplossend te denken? Hoe zorg je dat leerlingen vragen durven te stellen, risico's durven te nemen, fouten durven te maken en op te durven komen voor hun eigen mening?	Ik geef aan dat we vandaag bezig gaan met een nieuwe vraag. De vraag luidt als volgt: Hoe plas je in de ruimte? Daarnaast valt hiermee de vraag hoe douche je in de ruimte samen. Ik vraag vervolgens wie deze vraag heeft bedacht. Ik geef aan dat vandaag een aantal kinderen bezig gaan met kritisch denken. Vervolgens leg ik uit wat dit is. Voor het kritisch denken geef ik het voorbeeld dat hiernaast beschreven staat. Daarnaast staat dit voorbeeld ook beschreven bij het model voor leren hierboven. De leerlingen begrijpen vervolgens allen wat kritisch denken inhoudt. Vervolgens geef ik aan dat een aantal leerlingen bezig gaan met kritisch denken met een van de vragen die zijn opgesteld.	Om het kritisch denken uit te leggen neem ik een voorbeeld. Ik geef aan dat één van de leerlingen voetbal ziet als een sport voor alleen maar jongens. Ik geef als leerkracht aan dat ik het hier niet mee eens ben, maar ik probeer mij wel in te leven in deze leerling. Hiermee neem ik dus een ander standpunt aan en ben ik bezig met kritisch denken. De leerlingen gaan vervolgens binnen hun groepjes bezig om een standpunt te nemen waarbij ze het allemaal eens zijn. Dit standpunt schrijven ze op hun wisbordje op. Vervolgens worden de standpunten uitgewisseld. Hierbij nemen de andere leerlingen de andere kant van het standpunt in.	15 min

KERN

ONTWERPTIPS EN VRAGEN	LESBESCHRIJVING	DENKVAARDIGHEDEN	
Creatief denken Kun je activiteiten bedenken waardoor de leerlingen de leerstof gebruiken en toepassen op nieuwe manieren? **Kritisch denken** Kun je activiteiten bedenken waardoor de leerlingen kritisch denken over de leerstof? **Probleemoplossend denken** Kun je activiteiten bedenken waardoor de leerlingen de leerstof toepassen om een doel te bereiken of een plan te maken en uit te voeren? Kunnen de leerlingen een probleem oplossen gekoppeld aan de leerstof?	Ik zet in een PowerPoint op het bord het schema van alle signaalwoorden. Hierbij heb ik de woorden gearceerd die te in de tekst terug te vinden zijn. De leerlingen lezen vervolgens in tweetallen de tekst, de tweetallen zijn gemaakt door middel van het kiezen van stokjes. De leerlingen gaan op zoek naar de signaalwoorden en de antwoorden op de vragen hoe douche- en plas je in de ruimte. Ze zijn hierbij ondertussen bezig met begrijpend lezen.	Als verdiepende opdracht neem ik zes leerlingen apart aan de instructietafel. Deze leerlingen heb ik gekozen om basis van niveau van begrijpend lezen. Deze leerlingen vinden dit eenvoudig en hebben hier geen moeite mee. Daarnaast weet ik van deze leerlingen dat ze vaker uitdaging nodig hebben. Hierbij geef ik de leerlingen de volgende stelling: Ruimtevaart kost veel te veel geld. De leerlingen laten merken of ze dit wel of niet vinden. Vervolgens geef ik aan dat de leerlingen nu een ander standpunt in gaan nemen (dus niet wat ze zelf hadden). Ze gaan op zoek naar informatie over deze stelling, dit doen ze in drietalen. Van tevoren heb ik al een aantal sites met informatie opgezocht die de leerlingen kunnen gebruiken. Daarnaast zijn ze zelf vrij om nog meer informatie op te zoeken.	**25 min**

AFSLUITING

ONTWERPTIPS EN VRAGEN	LESBESCHRIJVING	DENKVAARDIGHEDEN	
Creatief denken: kunnen de leerlingen benoemen tot welke nieuwe inzichten/ ideeën ze zijn gekomen? **Kritisch denken:** kunnen de leerlingen hun eigen mening geven over de les of wat ze hebben geleerd en kunnen ze dat beargumenteren? **Probleemoplossend denken:** kunnen de leerlingen aangeven wat voor 'probleem' er aan het begin was en hoe ze dat hebben opgelost? Kunnen de leerlingen aangeven hoe ze de manieren van denken in de les kunnen toepassen in andere situaties?	We bespreken klassikaal waar de signaalwoorden aan bod kwamen en wat voor een verband ze weergeven. Tevens bespreken we klassikaal wat het antwoord is op de vraag. Als aanvulling hierop kijken we twee filmpje waarin Andre Kuipers uitlegt hoe er geplast en gedoucht wordt in de ruimte. Ten slotte bespreken we gezamenlijk hoe we de manier van kritisch denken in de klas kunnen toepassen. (denk hierbij aan: iedereen mag een mening hebben, niets is fout etc.)	De leerlingen die bezig zijn geweest met de opdracht waarbij het kritisch denken aan bod kwam presenteren hun mening (die ze moesten aannemen) aan de klas. Ze leggen uit welke opdracht ze van mij hebben gekregen en wat ze moesten doen.	**15 min**

Appendix G

Lesson Plan and Assignment to Stimulate Higher-Order Thinking in Students

DOEPELVAL

GESCHATTE TIJD: 1 UUR
GROEPERING: PER TWEE

DE OPDRACHT

Bedenk een val voor 'doepels', die pijnloos is voor deze wezentjes.

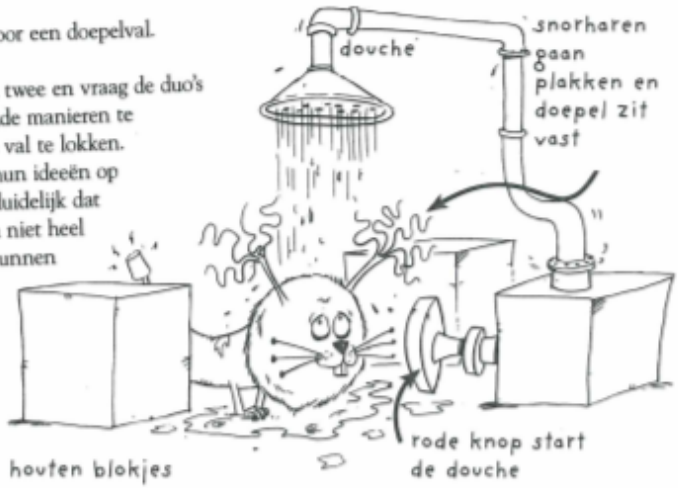
DE ACTIVITEIT INLEIDEN

Neem het leerlingenblad door met de hele klas en zorg ervoor dat iedereen alles begrijpt. Leg de leerlingen uit dat de doepels op vele verschillende manieren gevangen kunnen worden, maar dat zij een ideale val moeten bedenken, waarbij de doepel ongedeerd blijft.

Leg uit dat:
wanneer de oren van de doepel ergens in vastraken, hij ze zelf niet kan losmaken;

- de doepel zichzelf niet kan bevrijden wanneer zijn staart plat op een stuk staal of ijzer vastraakt;
- de doepel zichzelf niet kan losmaken wanneer zijn snorharen ergens aan vastraken;
- de doepel niet zou kunnen ontsnappen als hij in een houten of glazen doos zou zitten.

Hier is één mogelijk ontwerp voor een doepelval.



Verdeel de klas in groepjes van twee en vraag de duo's om zo veel mogelijk verschillende manieren te bedenken om een doepel in de val te lokken. Moedig de leerlingen aan om hun ideeën op papier te schetsen. Maak hen duidelijk dat het niet erg is als hun schetsen niet heel duidelijk zijn, zolang ze maar kunnen omschrijven hoe hun val werkt. Laat de leerlingen na enkele minuten stoppen en vraag hen om enkele van hun ideeën met de rest van de klas te delen. Vraag dan aan elk duo om zo veel mogelijk ideeën te blijven bedenken.

Laat elk duo hun favoriete ontwerp voorstellen aan de rest van de klas. De leerlingen kunnen dat doen door eenvoudigweg op deze vragen te antwoorden.

1. Wat zorgt ervoor dat de doepel naar de val komt?
2. Waardoor kan de doepel niet ontsnappen?
3. Waarom was dit idee het beste van al je ideeën?

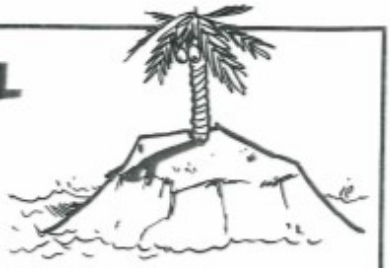
UITBREIDING

DE LEERLINGEN KUNNEN:

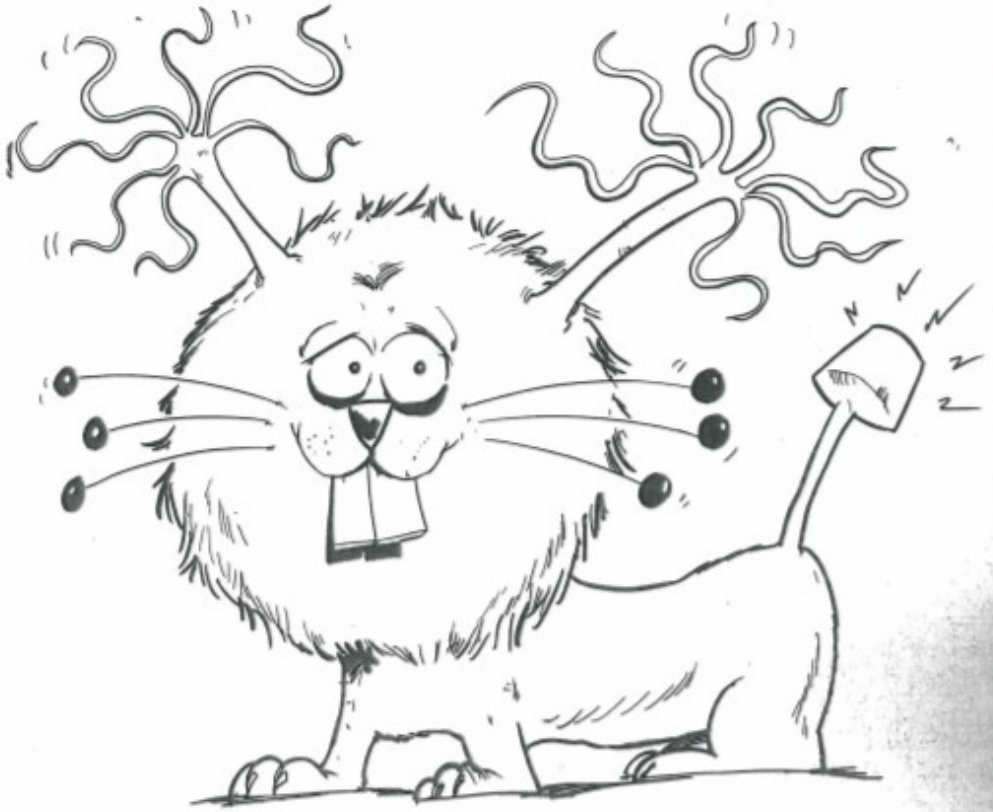
een plan van hun val uittekenen (in vogelperspectief) en er dingen op aanduiden;

- een reclamespot voor hun val bedenken;
- de doepel op de bladzijde hiernaast inkleuren en de omgeving natekenen, waarin het wezentje goed gecamoufleerd is. Ze kunnen de doepel uitknippen en zelf nagaan hoe doeltreffend hun camouflage is!
- de problemen bespreken die iemand zou kunnen ervaren als hij of zij een doepel als huisdier had.

DOEPELVAL



De doepels werden hierheen gebracht van op het eiland Flippo en dan vrijgelaten. Het probleem is dat doepels bakstenen eten en dat ze onze huizen proberen op te eten. Daarom moeten we ze vangen en terugbrengen naar het eiland Flippo.
Dit is een doepel.



Je opdracht

Kun je een val ontwerpen waarmee je doepels kunt vangen zonder dat ze pijn hebben?

Enkele weetjes die je kunnen helpen ...
Doepels eten graag worstjes.
Doepels drukken graag op rode knopjes.
Doepels volgen altijd groene pijlen.
Doepels eten bakstenen, maar ze eten nooit hout of glas.
De oren van doepels raken heel snel in alles verstrikt.
Doepels hebben een heel sterke magneet aan het uiteinde van hun staart.
Als een doepel nat wordt, plakken de uiteinden van zijn snorharen vast.