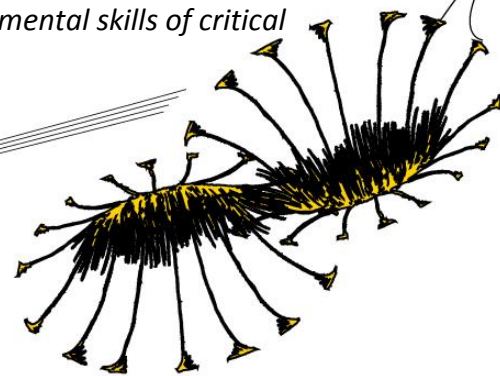# Master thesis

Critical thinking in the learning methods Geography in primary education.

"To what extent do current geography learning methods for primary education grade 7 utilise assignments that are likely to encourage learners to engage in the fundamental skills of critical thinking?"

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Ariëlle Huijgen,

May, 2018

Summary

Critical thinking is the skill to make a purposeful, regulatory judgement which is based upon high quality and standards (Facione, 1990; 2015; Paul & Elder, 2001, as cited in Petress, 2004). According to the Government, the learning of critical thinking starts at primary education (Rijksoverheid, 2015). One of the best ways to integrate critical thinking efficient in primary education is through the learning methods (Abrami et al., 2008; Hattie, Biggs & Purdie, 1996; Snyder & Snyder, 2008). Critical thinking can be deducted into the following essentials: the cognitive thinking skills (i.e. Interpretation, Analysis, Evaluation, Creation and Explanation) and dispositions (Metacognition) (Facione, 1990). These fundamental skills are needed to become a sufficient critical thinker (Facione, 1990; 2015). The practice of the fundamental skills in assignments of learning methods can possibly benefit the development of critical thinking. This research will answer the following question: "To what extent do current geography learning methods for primary education grade 7 utilise assignments that are likely to encourage learners to engage in the fundamental skills of critical thinking?" The assignments of the following three geography methods will be compared: Argus Clou, Grenzeloos and Meander. The developed coding scheme measures the verbs of each assignment that triggers a certain fundamental skill of critical thinking. The instrument has a Cohen's Kappa of .607. The results showed that all three learning methods stimulate all the essentials of critical thinking (i.e. Interpretation, Analysis, Evaluation, Creation, Explanation and Metacognition). In addition, all three learning methods stimulate the fundamental skill 'Interpretation' more in comparison to the other fundamental skills. Furthermore, the least stimulated skills were 'Explanation' and 'Metacognition'. The Logistic regression showed that Grenzeloos required the highest number of assignments that stimulate 'complex' fundamental skills of critical thinking (i.e. Analysis, Evaluation, Creation, Explanation and Metacognition), Argus Clou required the least of these skills. The methods Grenzeloos/Meander and Grenzeloos/Argus Clou are significantly different in terms of the verbs that are likely to trigger Analysis, Evaluation, Creation, Explanation and Metacognition. Argus Clou/Meander are not significantly different in terms of the verbs that are likely to trigger Analysis, Evaluation, Creation, Explanation and Metacognition.

Keywords:

Introduction

'Critical thinking is a way of thinking that contains a purposeful and self-regulatory judgement which is based upon intellectual standards and quality (Facione, 1990; 2015; Paul & Elder, 2001, as cited in Petress, 2004). This skill is more important than ever in this digital era. Sites such as Twitter, Instagram, News, YouTube and Facebook have grown in importance for people but also for companies. Worldwide, Facebook has 1.79 milliard active users and there are 315 million active users of Twitter (Oosterveer, 2017). One of the main reasons for participating in social networking sites is to keep up with news and views (Hermida, Fletcher, Korell & Logan, 2012). Imaginably, the information shared on these sites is immense. However, this shared information is possibly not reliable and biased (Viner, 2016). With the possibility of fake news, biased information and poor reliability, there is a greater appeal on the ability of humans to select and examine news and/or information critically (Flanagin & Metzger, 2008). With roughly 25 percent of the world's population on social networks, critical thinking is an important skill to develop for everyone. Therefore, critical thinking is one of the 21st century skills that have to be embedded in primary education (Rijksoverheid, 2015; Platform Onderwijs2032, 2016). One of the ways to embed critical thinking in primary education is through the learning methods. Integration of critical thinking in the learning methods will benefit teachers to stimulate critical thinking without the extra costs of time and loss of content (Snyder & Snyder, 2008). Therefore, this research will examine if the current learning methods stimulate the practice of critical thinking. In order to know how to embed critical thinking in the learning methods of primary education, critical thinking has to be defined first.

Critical thinking defined

The precursor of critical thinking is Dewey. He described it as 'reflective' thinking, which involves: "active, persistent and careful consideration of a belief or supposed form of knowledge in the light of the grounds which support it and the further conclusions to which it tends" (Dewey, 1909/1933, as cited in Fisher, 2001 p. 2; Fisher, 2013, p.39). Dewey shows that this reflective thinking is an attitude in which someone is consciously and voluntarily considering all the options. After Dewey, critical thinking is widely investigated and consequently has many definitions (See Table 1) (Beyer, 1995; Fisher, 2001; Paul & Elder, 2008; Pithers & Soden, 2000). From these definitions it can be deduced that critical thinking contains a judgement towards something; is purposeful, self-regulated, and has certain standards and quality. Furthermore, it can be deducted that critical thinking contains two aspects; a cognitive aspect and a dispositional aspect.

Table 1: Overview of critical thinking definitions.

Definition of critical thinking	Author
Critical thinking means reasonable and reflective thinking focused on deciding what to believe or do.	Ennis, 1991 (as cited in McGregor, 2007)
Critical thinking is skilled and active interpretation and evaluation of observations and communications, information and argument.	Fisher & Scriven, 1997 (as cited in De Glopper, 2002; McGregor, 2007)
Critical thinking is a purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation and inference, as well explanation of the evidential, conceptual, methodological, criteriological or contextual considerations upon which that judgement is based.	Facione, 1990;2015
That mode of thinking – about any subject, content, or problem – in which the thinker improves the quality of his or her thinking by skillfully taking charge of the structures inherent in thinking and imposing intellectual standards upon them.	Paul and Elder, 2001 (as cited in Petress, 2004)
Critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analysing, synthesizing, and/or evaluating information gathered from or generated by observation, experience, reflection, reasoning, or communication as a guide to belief and action.	Scriven and Paul, 2003 (as cited in Petress, 2004)

Cognitive aspect. The cognitive aspect of critical thinking encompasses a number of cognitive skills: Interpretation, Analysis, Evaluation, Creation, and Explanation (Anderson, Krathwohl & Bloom, 2001; Facione 1990; 2015). These skills seem to align with the cognitive skills mentioned in the Taxonomy of educational objectives by Bloom, Englehart, Furst, Hill and Krathwohl (1956). Bloom et al. (1956) classified these cognitive skills into lower and higher order thinking skills. The higher order thinking skills include Analysis, Evaluation and Creation (Bloom et al., 1956; King, Goodson & Rohani, 1998). Higher order thinking can be used for a variety of purposes, such as; deciding what to believe, deciding what to do, creating new ideas, making predictions and solving non-routine problems (Lewis & Smith, 1993; King et al., 1998). With critical thinking you are also deciding, what to do and/or believe, create new ideas, make predictions and solve non-routine problems. Therefore, the higher order thinking skills (i.e. analysis, evaluation and creation) specifically seem to be aligned with critical thinking. Furthermore these 'higher' fundamental skills seem to be most vital in the development of critical thinking (Facione, 1990; 2015; King et al., 1998).

Dispositions. The definitions in Table 1 all include some attitude towards thinking and/or judgement (Dewey, 1909/1933, as cited in Fisher, 2001; Fisher, 2013; Paul & Elder, 2001, as cited in Petress, 2004). The dispositions in critical thinking show attitudes such as curiosity, open-minded, fair-minded, having an investigative approach, respect towards evidence, reasoning and opinions, self-confidence in one's own abilities, flexibility and honesty (Beyer, 1995; Facione, 2015; SLO, 2017A). Thus, someone has to be reflective of their own thinking but also reflective towards information. Metacognition is likely one of the skills which requires the reflection needed in critical thinking, as it is the skill to control and reflect one's own thinking (Dwyer, Hogan & Stewart, 2014; Fisher, 1999; Grund, Brassler & Fries, 2014; Macklem, 2015; Zimmerman, 2000).

Thus, critical thinking is the skill to make a purposeful, regulatory judgement which is based upon high quality and standards (Facione, 1990; 2015; Paul & Elder, 2001, as cited in Petress, 2004). This skill contains a cognitive aspect which requires the cognitive thinking steps, Interpretation, Analysis, Evaluation, Creation and Explanation, and a dispositional aspect which requires reflective thinking, the skill Metacognition (Dewey, 1909/1933, as cited in Fisher, 2001; Fisher, 2013). It is possible to stimulate the development of these skills through the assignments in learning methods. Assignments in which these skills can be stimulated are assignments that require, for example one cognitive skill like analysing information from different sources. It is also possible to use projects and group assignments in which multiple skills and more dispositional aspects like metacognition are required. Lipman (2013) mentioned: 'critical thinking as a lifelong skill, which is improved during the whole career'. If adults are still improving and learning aspects of their critical thinking skills, than it is possible that critical thinking is a really difficult job for children. Since children have an extra disadvantage: their brain is still in development.

The readiness of children in primary education with regard to critical thinking

The capacity of the brain is fully developed around the age of 25 (Gray, 2011). Before the age of 25, the development of the fundamental skills can be affected by the development of the brain. Therefore, it is assumable that children of primary education are not directly capable of thinking critically. Looking at skills such as Analysis, Evaluation and Creation elements like seeing relationships and drawing conclusions are needed (Anderson et al., 2001; Bloom et al., 1956; Facione, 1990; 2015). Around the age of 12 and older children are able to see relationships and draw conclusions from information (Piaget as cited in Gray, 2011). Thus, from this age children are able to use these 'higher' fundamental skills of critical thinking. In addition, Vygotsky's zone of proximal development emphasized that children must be measured on what they could learn instead of what they already learned (Breeuwsma, 1999; Gray, 2011). This suggests that before age of 12 the different higher order thinking skills can already be stimulated. Therefore, the cognitive fundamental skills of critical thinking can be stimulated before age 12.

Looking at the dispositions of critical thinking, some children of primary education can ask quite a lot questions, are fair-minded, curious and critical. This suggests the readiness of the dispositions of critical thinking in children. Children naturally have a strong desire to understand the world around them and have a desire to discover the truth (Gopnik, 1998; Mills, 2013). Therefore, it is possible that children of primary education can develop their critical thinking skills. Moreover, it seems likely to primarily focus on the development of the cognitive side of critical thinking in primary education and not yet on the dispositional aspect. Nonetheless, there is a possibility that children in primary education only use aspects of their critical thinking skills when they already have the acquired

knowledge of something. Assumable the use of critical thinking is not yet self-evident. They need practice with the different fundamental skills and the awareness of critical thinking.

The stimulation of critical thinking in primary education

There are multiple programmes and interventions that aim to train critical thinking in primary education. However, the current learning methods are not yet studied with regard of critical thinking. The most common interventions focus on stimulation and development of reasoning, dialogue, asking questions, performance tasks and teacher interactions (Chun, 2010; Cojocariu & Butnaru, 2014; Elder & Paul, 1998; Fisher, 2013; Hemming, 2000; Massa, 2014; Snyder & Snyder, 2008). According to different studies, lessons that promote critical thinking must include ill-structured problems, criteria for assessing thinking, student assessment of thinking, improvement of thinking, performance tasks, interactive, discussions, asking questions, reasoning, hypothesis testing etc. (Broadbear, 2012; Chun, 2010; Fisher, 1999; Halpern, 1998; Mandernach, 2006). Especially asking questions is a returning and crucial aspect in the encouragement of critical thinking (Fisher, 1999; Ikuenobe, 2001; King, 1995; Paul & Elder, 2008; Snyder & Snyder, 2008). One technique that can be used during all these programmes and in learning methods is cognitive apprenticeship. With cognitive apprenticeship, the expert (teacher) guides students with the cognitive processes that are used when tackling complex tasks (Mayer, 2008). This guidance can be done through 1) modelling, 2) coaching and 3) scaffolding (Mayer, 2008). Modelling is the guidance in which teachers show their own cognitive processes throughout the task. Coaching is the offering of tips, tricks and comments. Scaffolding is the distribution of guidance when doing a task. First, the tasks that a child cannot perform will be done with him and this guidance will lessen until a child can do the whole task by himself. In the encouragement of questions, the modelling technique is very important.

There is a common conception that general abilities, such as critical thinking can be learned in isolation (Hemming, 2000). However, research shows that critical thinking is learned better when contextualized (Abrami et al., 2008; Hattie et al., 1996; Thompson, 2011). In this sense, critical thinking should not be learned in individual programmes but integrated into the curriculum. The most effective way to embed critical thinking is to make critical thinking objectives explicit into different courses in the current curricula (Abrami et al., 2008). Embedding critical thinking into the current learning methods of primary education is not only likely to benefit learning transfer, but it would also benefit teachers and schools who do not have to add additional time in their curricula for critical thinking (Snyder & Snyder, 2008). Furthermore, when critical thinking is not implemented into the learning methods, it has to be implemented into the regular lessons. With this implementation there are a couple of barriers mentioned 1) lack of training, 2) lack of information, 3) preconceptions and 4) time constraints (Snyder & Snyder, 2008). In order to stimulate critical thinking efficiently and without barriers the most effective way is to implement critical thinking in the learning methods of primary education. Therefore in this research current learning methods will be analysed on the stimulation of critical thinking. This will provide insights into what extent the current learning methods are already stimulating critical thinking.

Current Study

From the different interventions, it can be deduced that the essence of critical thinking lies in the stimulation of cognitive thinking skills and dispositions. This stimulation is most efficient when implemented into the current curriculum of primary education. One of the curricula subjects that is a good fit for the stimulation of critical thinking is geography (Korkmaz & Karakuş, 2009). As Korkmaz and Karakuş (2009) mentioned it: 'as a discipline analysing and synthesizing the information collected in the context of human-natural environment interaction, geography requires students to structure the acquired information by questioning it using these criteria at all stages' (p.53). Thus, geography requires the different fundamental skills of critical thinking (i.e. interpretation, analysis, evaluation, creation, explanation and metacognition).

Therefore, geography methods (i.e. Argus Clou, Grenzeloos and Meander) will be analysed on the practice of the different fundamental skills of critical thinking in their assignments. These fundamental skills will be recognized through the verbs that are used in the assignments. The verbs in the assignments will indicate the trigger of each cognitive thinking step (Anderson et al., 2001). The following fundamental skills will be measured: Interpretation, Analysis, Evaluation, Creation, Explanation and Metacognition. Figure 1 shows the research model in which the fundamental skills that are measured in the learning methods of geography will provide an answer on the question to what extent current instructional methods provide a foundation to stimulate critical thinking.
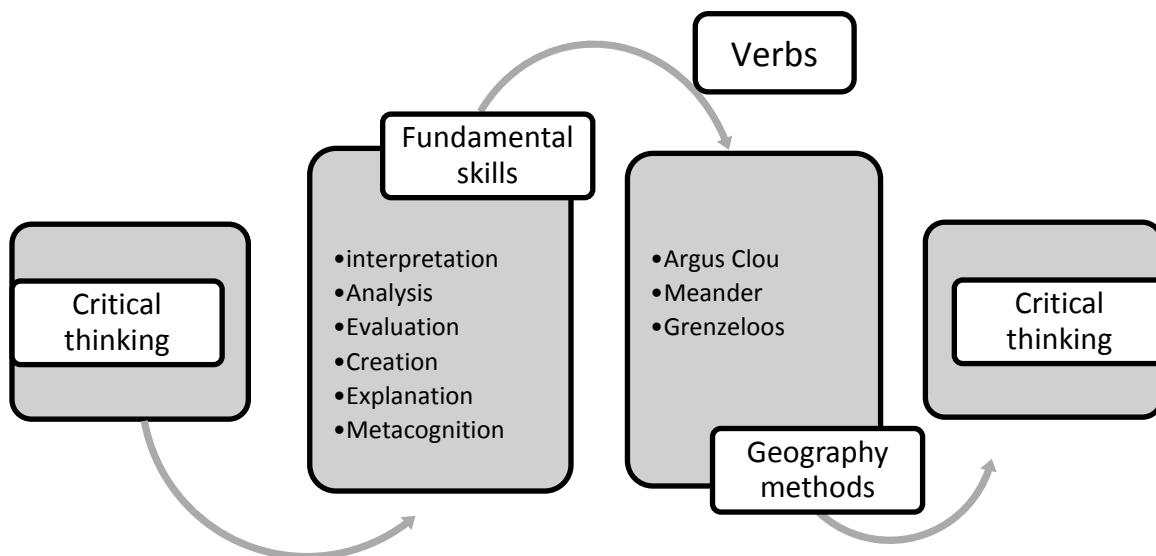

Figure 1: Research Model.

In order to find the extent of critical thinking in the current geography methods the following research question will be answered:

"To what extent do current geography learning methods for primary education grade 7 utilise assignments that are likely to encourage learners to engage in the fundamental skills of critical thinking?"

<div align="center">**Method**</div>

Research design

The aim of this study is to evaluate to what extent current geography methods stimulate children to practice the cognitive skills that are fundamental to critical thinking. The fundamental cognitive skills are: Interpretation, Analysis, Evaluation, Creation, Explanation and Metacognition. These cognitive skills will be measured in the assignments of three Geography methods. This evaluative research embodies two research phases; a developmental and an evaluative phase.

The developmental phase followed the ADDIE model: Analysis, Design, Development, Implementation and Evaluation (Morrison, Ross, Kalman & Kemp, 2013). This resulted in an instrument that measures what cognitive thinking skills are required in the assignments of a learning method. The instrument is a coding scheme which focused on the verbs that are used in an assignment and their indication towards the different fundamental skills of critical thinking. The second research phase entails the evaluation of three geography methods. The aim of this phase is to use the instrument to detect the fundamental skills of critical thinking in the assignments of learning methods.

The geography methods

This study evaluates three geography methods for primary education: Argus Clou, Grenzeloos and Meander. These methods are the three primarily used to teach geography in primary education. In addition, the geography method Wijzer! is used as a pilot study, to evaluate the quality of the instrument. The methods used in this research have a different approach towards the use of critical thinking. Where Argus Clou (2012) does not mention critical thinking at all, the method Meander (2016) is specifically developed to encourage critical thinking. Grenzeloos falls in between the previously mentioned methods; the stimulation of critical thinking is done through inquiry based learning (Grenzeloos, 2014). As pilot the study Wijzer! has been chosen, because they specifically mentioned stimulating critical thinking through their assignments (Wijzer!, 2015). Since the assignments are already stimulating critical thinking, it is possible to test the instrument on Wijzer!. Furthermore, the method is not widely used and therefore better to use as a pilot than in the research sample (Wijzer!, 2015). In Table 2 the main aspects of each geography method are explained.

Table 2: Characteristics of the different learning methods Geography.

Learning method	Publisher	Year of Publication	Use in Dutch Primary education	Use of the 21st century skills
Argus Clou	Malmberg	2012	Number 3 of most used Geography methods.	Not specifically mentioned in their didactics.
Grenzeloos	Blink Educatie	2014	Around 400 Schools (6%).	Based on the inquiry based learning method, this allows integration with 21st century skills.
Meander	Malmberg	2008, renewed in 2016	Not mentioned, but number 1 of most used Geography methods.	Specifically developed to stimulate the 21st century skills.
Wijzer!	Noordhoff	2015	3/4% of primary education.	Integrated into the assignments.

The four learning methods will be elaborated more, starting with the geography method *Wijzer!* (2015). The aim of this method is to help children discover, understand, and learn from themselves and the world around them. The method teaches children to discover the world through direct instruction and independency. The assignments are highly structured and built upon reproduction, application and understanding. The method contains the same themes every year which results in the activation of prior knowledge. This ensures that the children are increasing their depth of knowledge. The five themes included are: 1) Agriculture, 2) Landscapes, 3) Population, 4) Industry and 5) Services.

The second method is *Argus Clou* (2012). Together with Professor Argus Clou, children will be challenged to be in his position as a new professor of everything. The aim is to challenge children to

think different about the world. It uses didactics, such as variety, the dare to explore, and it ensures better learning results. The method is highly structured into themes. The method uses the same themes every year so that children activate their prior knowledge. Every year the themes are increasing in depth of knowledge. The themes that are included are 1) Earth, humans as users of the earth; 2) Living and working, humans as users of the earth; 3) Traffic and energy; 4) Differences between people and 5) You as world citizen.

The third method is *Grenzeloos* (2014). The aim of the method is to trigger children to learn, discover and investigate themselves. The method employs activating didactics, such as to motivate and stimulate children. With the use of inquiry based learning, children are investigating and exploring the world. Children are learned to use the eight-step research cycle in four themes. These themes are different each year. The themes of grade 7 are 1) Earth layers and landscape; 2) Climate and landscape; 3) Collaboration in Europe and 4) Globalisation and trade.

The fourth method is *Meander* (2016). Meander is showing children how beautiful the world is and the importance of sustainability. The method is stimulating children to look around them, to make them curious about culture, landscapes and nature. Through the connection with their own environment, children will be more aware and involved in the world which they are living in. The aim of the method is to apply knowledge and skills directly in the final assignments of each theme. Every theme is based on a different 21st century skill. These themes are different for each year. The different themes for grade 7 are 1) Mountains and valleys; 2) The Netherlands is everywhere; 3) The earth and the sun; 4) Climate in Europe and 5) To another country.

Design of the instrumentation

As already apparent from the introduction, critical thinking can be distinguished into cognitive thinking skills and dispositions. Critical thinking contains the cognitive skills: Interpretation, Analysis, Evaluation, Creation and Explanation (Facione, 1990). In addition, in this research the skill Metacognition is added to the cognitive skills, because critical thinking is self-regulatory and purposefully (Facione, 1990; 2015). The dispositions of critical thinking are very hard to distinguish in methods. Since the stimulation of dispositions is only evident in the behaviour of children and not directly measured in the assignments of learning methods. Therefore, in this research besides Metacognition the dispositions are not taken into account. The assignments of learning methods will be evaluated on the following fundamental skills of critical thinking: *Interpretation, Analysis, Evaluation, Creation, Explanation* and *Metacognition*. This will be done with the use of the verbs in each assignment. The verbs indicate actions, these actions request children to activate their cognitive thinking skills (Anderson et al., 2001). Therefore, verbs can indicate which fundamental skills are required to solve the task at hand. In order to deepen the understanding of each cognitive thinking skill, the skills will be operationalised below.

Interpretation. Interpretation is the skill to create an own understanding of what information means, implies and/or intends (Anderson et al., 2001; Bloom et al., 1956; Facione, 1990). The skill already suggests the lower order thinking step 'Understanding' of Bloom et al. (1956). Furthermore, the skill also involves the lower order thinking steps 'Knowledge' and 'Application' (Anderson et al., 2001; Bloom et al., 1956). Since interpreting information asks from someone to process information. The process of information implies the skill 'Knowledge', which is the recall of information from prior knowledge. It asks to form an idea of the information with the use of understanding (Bloom et al., 1956). In other words, the process of information asks to integrate the knowledge and understanding into information, Furthermore with the skill of Application the information is handled with the correct procedure (Anderson et al., 2001; Bloom et al., 1956). It is likely to assume that Interpretation (i.e. Knowledge, Understanding and Application) is a premise upon which the other fundamental skills are built (i.e. Analysis, Evaluation, Creation, Explanation and Metacognition).

Analysis. Analysis is the skill to dissect information into small pieces and to investigate the meaning, structure and relationships between those (parts of) information (Anderson et al., 2001; Bloom et al., 1956; Facione, 1990). Analysis is labelled as a higher order thinking skill (Anderson et al., 2001; Bloom et al., 1956; King et al., 1998, SLO, 2017A). Higher order thinking is all about interrelations, rearrangements and extensions of information to achieve a purpose or possible solutions (Anderson et al., 2001; Bloom et al., 1956; Facione, 1990). Analysis is a key part in finding the relations and structures in all sorts of information.

Evaluation. Evaluation is the skill to value the found and analysed information on certain criteria. It is about making judgments based on criteria and standards (Anderson et al., 2001). The criteria are made beforehand by the students or the criteria is given to them. With the criteria the information is judged for a certain purpose (Bloom et al., 1956). The analysis and evaluation phase are a little confusing. The distinction lies in the investigation and the judgment. In the analysis phase information is investigated on certain criteria. However, the outcome of that investigation is used in the evaluation phase. For example, a text has to be examined on its relevance. The investigation of the text is done in the analysis phase. The outcome of the investigation takes place in the evaluation phase. So in the evaluation phase, you conclude/judge if the information is indeed relevant or not.

Creation. Creation is the skill to combine all the information and link the relations between the information in order to make conclusions. This higher order thinking skill knows different names such as, inference and synthesis (Anderson et al., 2001; Bloom et al., 1956; Facione 1990). It is the skill to create something new from all the information you possess. For example, the skill inference is showed in an assignment that asks for a new solution for a certain problem. The skill inference has been changed over the years. Bloom et al. (1956) mentioned inference as synthesis which is 'the putting together or elements and parts to form a whole'. This involves: 'the process of working with pieces, parts, elements etc. and arranging and combining them in such a way as to constitute a pattern or structure not clearly there before'. Facione (1990) mentioned inference a little bit easier in which it is only the putting together and combining information that is needed for drawing conclusions. With the revision of Bloom by Anderson et al. (2001) inference is changed into creating. In which the skill is 'putting elements together to form a coherent or functional whole; recognize elements into a new pattern or structure' (Anderson et al., 2001). In this research, the term Creation will be used to show the skill which goes above and beyond the information that is already known. It makes conclusions though it is also making something new with it.

Explanation. Explanation is the skill to explain and argue why one came to its conclusions. This skill is only mentioned by Facione (1990). It is explaining the reasoning behind your reasoning, why someone came to these conclusions (SLO, 2017A). Looking closely at Bloom's taxonomy, we can recognize evaluation in the explanation phase of Facione. Explanation is evaluating your own reasoning process. Therefore in this research, there is a distinction in the evaluation phase. There will be content evaluation which indicates the evaluation phase of Bloom et al. (1956) and Facione (1990). The second phase is process evaluation, which indicates the explanation phase of Facione (1990). As a result of these different phases, the verbs that categorize Explanation will be the same verbs that categorize Evaluation. However, the context will show if the assignment is indicative for Evaluation or Explanation.

Metacognition. Critical thinking is not just making a judgment but making a purposeful, self-regulatory judgment. This means that self-regulation, is also an aspect of critical thinking. Critical thinking is a skill that makes one think about one's own thinking during reasoning. Without self-regulation there is no critical thinking. Self-regulation means that someone is deliberately planning, monitoring, controlling and evaluating towards a certain goal or their own learning (Grund et al., 2014; Macklem, 2015, Zimmerman, 2000). Self-regulated learning has four different aspects: planning; monitoring; controlling their learning; and reflection (Grund et al., 2014; Macklem, 2015; Zimmerman, 2000). Metacognition can be seen as self-regulation as it is also monitoring, controlling and reflecting your own thinking, so the well-known definition thinking about thinking (Martinez, 2006). Metacognition is a skill that is interwoven into the different aspects of critical thinking. A critical thinker has to ask himself every time if their reasoning and their thinking is correct.

Deepening the knowledge of each cognitive thinking step makes it easier to suggest which verbs are indicative for a cognitive thinking step. For example, looking at the operationalisation of metacognition, it is clear that planning is one of its indicative verbs. Just like the verb combining will be indicative for creation. Nevertheless, there are more verbs to be aligned with the cognitive skills, which are not yet as clear.

Categorization of the verbs

The cognitive thinking steps fundamental for critical thinking are assumed to be aligned with the cognitive thinking steps of Bloom's taxonomy of educational objectives (Bloom et al., 1956). Anderson et al. (2001) have revised Bloom's taxonomy of cognitive thinking steps in which they developed and added a list of verbs that indicate each cognitive thinking step. However, there are possibly more

verbs than listed by Anderson et al. (2001). By consulting search machines such as the Library of University of Twente, Google and Google Scholar the list became more elaborated. The following finding terms are used in the above mentioned search machines: "Cognitive thinking verbs", "Bloom's taxonomy verbs", "Anderson Taxonomy verbs", "Verbs Bloom and Anderson", "Verbs revised Blooms taxonomy", "Blooms Taxonomy werkwoorden", "Cognitieve denkvaardigheden werkwoorden". There were two exclusion criteria; 1) Lists must be based upon scientific references and 2) Only unique lists were added to the collection. With these terms, it was possible to find thirteen unique lists of cognitive verbs, six Dutch and seven English. These lists were included for further analysis. Appendix A is showing all the English verbs that are mentioned by the different lists of verbs. Appendix D is showing all the Dutch verbs that are mentioned by the different lists of verbs.

In the analysis phase, the verbs are further examined in order to find the right indicative cognitive thinking step. The English and Dutch lists of verbs were both analysed on: their indication level, on similarities between verbs, and similar indication of the cognitive thinking step. At last, the verbs are examined on abnormalities between verbs and cognitive thinking steps. Afterwards, the English and Dutch lists are combined and examined again on similarity and/or abnormalities.

Indication level of verbs. First, all the verbs from each list were alphabetically categorized into the mentioned cognitive thinking skills. This revealed verbs that were mentioned multiple times in different lists. It is assumable that the more a verb is mentioned by different lists, the more reliable it is as an indicative verb of a cognitive thinking category (fundamental skill). Therefore, each verb in Appendix A (English) and Appendix D (Dutch) is further examined on the number of times it is mentioned in the different lists. The boundary level of usability with the English verb lay by four or more times mentioned out of seven lists. Verbs that are very reliable for the cognitive category, because of their frequent use (Anderson et al., 2001), were for example: 'compare' for Analysis; 'construct' for Creating; 'Explain' for Understanding; and 'list' for knowledge (See Appendix B). The boundary level of usability of the Dutch verb is two times or more mentioned (See Appendix E). The boundary level is lower, since the number of lists is smaller and the assessed geography methods are Dutch. Examples of verbs that are very reliable as indicative of a category are: 'berekenen' for Application, 'ontwerpen' and 'samenstellen' for Creating.

Similarities and abnormalities. Some verbs were indicative for more than one cognitive thinking skill. Appendix C (English) and F (Dutch) show the list of verbs that are indicative for multiple cognitive thinking skills. Examples of verbs that have multiple cognitive thinking skills are: 'Samenvatten' (Understanding and Evaluation), 'Concluderen' (Evaluation and Creating) and 'Onderzoeken' (Application and Analysis). In this part of the investigation all verbs will be used as indicative for all cognitive thinking steps. Assumable the context of the assignment is very important to align the right cognitive thinking step to the assignment. At last, there was similarity in the meaning of verbs. For example, the verbs 'argue' and 'explain' in the English list of verbs. The words are both explaining something, however 'argue' is explaining with arguments and structure whereas 'explaining' doesn't really need arguments. Therefore, 'argue' can be categorized in the evaluation phase and 'explain' in the understanding phase. As well in the Dutch list of verbs, there was the problem of similarity with words such as: 'herkennen' and 'identificeren'; 'aanpassen' and 'veranderen'. These words show the importance of context. Moreover, with the combining of the translated English verbs with the Dutch verbs, the similarity of words will grow. Thus, there has to be an addition of context in the instrument. The addition of the context will be further discussed when the Dutch and English verbs are combined.

Combination of the Dutch and English lists of verbs. The English verbs had to be translated without a modification in the meaning of the word. Some English words have multiple translations such as 'explain', which could be translated as 'uitleggen', 'verklaren', 'uiteenzetten' and 'verduidelijken' or 'convert', which could be translated as 'bekeren', 'omzetten' or 'veranderen'. In order to make the transition as good as possible, all the translated words are used in the new combined list (Appendix G). The similarity is addressed by the addition of the related verb. Appendix G is further examined on the possibility of the use of the verbs in the current geography methods grade 7. This examination is done with the use of the method Wijzer! in combination with common sense. Verbs such as 'bekeren', 'omwerken', 'afzonderen' and 'vertolken' are not likely to be seen in a learning method of primary education. Moreover in the list there were no indicative verbs for the cognitive thinking step Metacognition, because Bloom et al. (1956) do not mention Metacognition as a cognitive thinking step in their Taxonomy. With the use of the operationalisation and the method Wijzer! the following verbs are added to the category 'Metacognition': 'organiseren', 'plannen', 'prioriteiten stellen' and 'terugkijken op'. With the deletion and addition of those words, the final lists of words are presented in Appendix H.

The situation that one verb can indicate multiple cognitive thinking steps is addressed to add the different cognitive thinking steps behind each verb. As already mentioned, the context is important in the final decision of which cognitive thinking step is stimulated. The context will be examined in two ways: 1) With the knowledge of the meaning of each cognitive thinking step and 2) With the use of the previous sections in the learning methods it is possible to understand the assignment better.

To conclude, the fundamental skills of critical thinking are explained and operationalised. This led to the categorization of the verbs into their indicative cognitive thinking step (fundamental skill). These verbs will be recognized in the different assignments of each learning method. Below is an illustration to understand the meaning of each fundamental skill and the indicative verbs that are recognized in the assignments (See Table 3, for the Dutch illustration see Appendix I). The examples show how the verbs indicate a certain fundamental skill of critical thinking. As visible in Table 3, not all assignments are using verbs that are indicative. However, it is still possible to operationalise these assignments in the correct stimulated fundamental skill. This can be done through the operationalisation and the context. However, in order to categorize each assignment in the same way, there is a standardization needed.

Table 3: Illustration of the fundamental skills with their indicative verbs and an example of an assignment.

(Example reference: Learning method, Chapter, Lesson, Assignment, Part of the assignment)

Fundamental skill	Definition	Operationalised	Indicative verbs	Examples
Interpretation	The skill to create an own understanding of what information means implies and/or intends (Anderson et al., 2001; Bloom et al., 1956; Facione, 1990).	Knowledge Understanding Application	Define (K)	Define the word 'expat'? (Argus Clou, 4.4.4a)
			Give an example (U)	How do you conquer the world? When is a company successful or not, and what are the risks of a company. Give an example of each characteristic. (Grenzeloos 4.3.3)
			Belong to (K)	What belongs to a culture of people? Cross the correct answers (Meander 5.1.4)
Analysis	The skill to dissect information into small pieces and to investigate the meaning, structure and relationships between those (parts of) information (Anderson et al., 2001; Bloom et al., 1956; Facione, 1990)	Analysis	Examine (An)	Examine the climate graphics on the viewing plate. Which two climates do not have a climate graph on the viewing plate? (Argus Clou 1.5.3a)
			Compare (An)	Through weathering, pieces of rock are released from the mountain and fall down. If they fall on the road, it is dangerous. Therefore there are various plans to prevent rocks from falling on the road. What would be the best plan? Compare the different plans with each other. (Meander, 1.2.7)
			No indicated verbs mentioned however it is the investigation of multiple sources in order to find information.	What weather can Laura expect? Fill in the table with weather expectations for the different cities on the following characteristics. Use the resources on page 20 till 25. (Grenzeloos, 2.2.3)
Evaluation	The skill to value the found and analysed information on certain criteria. It is about making judgments based on criteria and standards (Anderson et al., 2001)	Content evaluation	Argument (Argue) (E)	The European countries came up with collaboration as a way to prevent war. Do you think this solution will also help in a fight on your school? Circle your answer and give at least one argument for your opinion. (Argus Clou, 5.1.2b)
			Discuss (E)	Discuss your map and conclusions with the class. Look if the results are comparable. Of which countries do your parents know the least? (Meander, 2, Challenge, 6)
			Explain (E)	Give your border a grade. Judge the border of your country in

				the EU. Use the answers of assignment 3 and 4 and use the following criteria […]. Explain why you give this rating. (Grenzeloos, 3.2.5a)
Creation	The skill to combine all the information and link the relations in order to go above and beyond the known information, to conclude and to use this information to make something new (Anderson et al., 2001; Bloom et al., 1956; Facione, 1990;2015).	Creation	Write (C), Think about (C)	Write down in a script who will speak and what he will say in the podcast. Think of an introduction in what you will tell something about the topic of the podcast and your guest. Write down the questions for the tree poster man and his answers. (Argus Clou, 3, this also works, assignment: I do my work)
			Discuss (C), Make (C), Prepare (C)	Discuss in your group about the best holiday destination. Use the arguments from the information you collected. Pick your destination. Prepare a plea. In this plea, you try to convince others to choose your destination. (Meander, 4, challenge, 5)
Explanation	The skill to explain and argue why you came to your conclusions (Facione, 1990).	Process Evaluation	Explain (E)	Why can your plant or animal survive in the desert? Explain. {previous assignment they created a new species that had to be able to live in the desert) (Argus Clou, 1, 4, 6c)
				In the winter solar beams have another angle than in the summer. Explain this with an experiment. Read "how to do this". Find materials and make a plan how to perform this experiment. Execute the experiment and explain what and why you do the steps of the experiment. (Meander, 3,2,7)
Metacognition	The skill to deliberately monitor, control and reflect your own thinking (Martinez, 2006)	Metacognition	No indicative verbs mentioned, however, it is an assignment which evaluated the collaboration in the group assignments. (Reflection is needed)	How did it go? You have come up with a plan to decrease the erosion in the Alps. Cross the characteristics that fits your plan. (Meander, 1, challenge, how did it go)
				I check my work. Circle your answers, are the following aspects clearly mentioned in your work? Why Rashida fled, why she cannot go back, do you think when you examine your work that the readers will have enough information about the situation of Rashida? (Argus Clou, 4, this also works lesson 3, assignment I check my work).

The standardization of the use of the instrument

A flowchart is developed to optimize the reliability during the examination of each assignment. To find the correct indicative cognitive thinking step in an assignment the examiner has to answer three questions. These questions have to be answered for each assignment and are the same for each learning method. The following questions are formulated in the flowchart to answer the main question 'What cognitive thinking step is required in the assignment' (Table 4 and Appendix J).

Table 4: Questions asked in the flowchart (Appendix J).

1. What verbs are used in the assignment?
2. Looking at the verbs, can we place the task in a cognitive category?
Yes, is the context also suggesting the same category?
No, is there a context that can be helping categorize the task?
3. Answering the main question 'What cognitive thinking step is required for the assignment?'

The flowchart is tested with the use of the method Eigentijds (2014), History. Eigentijds has been chosen for the following reasons: 1) The method has the same publisher as Grenzeloos, consequently both methods have the same structure, assignments and level of questioning; 2) History is also a subject in which a child learns to explain, understand, argue and analyse phenomena of the world (Tule, 2009). In this sense History includes the use of the fundamental skills of critical thinking.

Table 5: Example of an assignment of Eigentijds.

"8.1.2.6. Imagine you are making a decor of a medieval town. What things would you certainly include in your town?
[Middeleeuws decor. Stel je voor dat je een decor maakt van een middeleeuwse stad. Welke dingen zou je daar zeker in opnemen?]
Eigentijds 8, Chapter 1, Lesson 2, Assignment 6"
1. Verbs: Imagine, make, include [Voorstellen, maken, opnemen]
2. Verb "maken" → Application
Context: think about their own medieval city, what you would include in your own medieval town before they even learned which shops and buildings are present in a medieval city.
3. Looking at the context, it would be creating. Creating their own city and bringing all the learned knowledge of that chapter together. However with the verbs only it would be the fundamental skill application.

During the first trial, it became clear that the flowchart was not accurate enough. According to the verbs list, another cognitive thinking step was measured than was expected when looking at the context (See Table 5). Therefore, the following amendments to the instrument were done: 1) change of the context question and 2) the addition of the learning goal of the assignment. All the amendments have been integrated in the slightly changed question: "What is the context?" In the previous flowchart the context was integrated into the second question, now it is an independent question which makes the context more dominant. With the amendment the context can be divided into three different subjects: 1) the influence of extra text, such as text blocks and sources, 2) previous assignments and 3) The learning goal (See Table 6). First mentioned is the addition of extra text or sources. A previous text block or extra sources can give information, this could mean that information has to be analysed. It could also mean that an assignment asks for a definition which is mentioned in the text. Therefore, a previous text block can change an assignment from the fundamental skill Understanding into Knowledge or change Understanding into the fundamental skill Explanation (See Table 6). Second, the previous assignment, sometimes an assignment is divided into an a, b and/ or c. Therefore, the different assignments are probably linked to each other. Assignment c can be built upon the answers of a and b, this can also change the cognitive thinking step that is required (See Table 6). At last the learning goal. All learning methods have certain goals to attain (Tule, 2009). In order to attain these learning goals, each assignment stimulates (parts of) the learning goals. These learning goals are not given for each assignment, however when the probable learning goal of an assignment is known, it is also easier to find the underlying cognitive thinking steps. For example, an assignment that is asking for facts and recall is most recognizable for the cognitive thinking step Knowledge. An assignment where someone has to investigate is more recognizable for the higher order thinking skill, such as

Analysis or Evaluation. With the amendments in the context section of the flowchart and the deeper knowledge of each cognitive thinking step in the operationalisation section, it is more effective to find the correct cognitive thinking step. The revised flowchart is shown in Table 7.

Table 6: Example of the importance of context in an assignment of Argus Clou.

"1.4.6c. Why is your animal or plant suitable to live in the desert? Explain. [Waarom kan jouw dier of plant goed in de woestijn leven? Leg uit.] ***Argus Clou Chapter 1, Lesson 4, Assignment 6c."***

1. Verbs: Explain [Leg uit]

   Verb: "Leg uit" → Understanding, Application, Explanation
2. Context:
   a. Are there any text blocks/sources that have an influence on the assignment?
      There are no additional text blocks
   b. Are there previous assignments that have an influence on the assignment?
      Previous assignment: 6b "In de woestijn kunnen niet alle dieren en planten leven. Verzin een nieuw woestijndier of een nieuwe woestijnplant. Het dier of de plant moet goed aangepast zijn aan het leven in de woestijn. Teken het dier of de plant hiernaast." Assignment 6b → Creation
      Assignment 6c is asking why your animal you created is suitable to live in the desert, so the child has to explain why he created the animal or plant of assignment 6b.
   c. What is the learning goal of the assignment?
      Understanding of the differences between climates, explaining why you chose to create this animal, looking at the characteristics of a dry climate.
3. The answer to the question 'What cognitive thinking step is required for the assignment?'
   The assignment asks to explain why he created the animal or plant in assignment 6b. So this assignment requires the skill explanation

Table 7: Revised flowchart (Appendix K).

1. What are the verbs used in the assignment?
2. What is the context of the assignment?
   a. Are there any text blocks/sources that have an influence on the assignment?
   b. Are there previous assignments that have an influence on the assignment?
   c. What is the learning goal of the assignment?
3. Answer to the question 'What cognitive thinking step is required in the assignment?'

Pilot of the instrument

Both the flowchart and the lists of verbs are tested in a pilot study. The learning method used in this pilot is Wijzer! for grade 6. The pilot consists of 84 assignments. During the pilot, it became clear that the revised flowchart (Appendix K) is effective in finding the correct cognitive thinking step and optimize the standardization of the assessment of each assignment. However, the list of verbs was not yet optimal in finding the correct cognitive thinking step. Therefore, the following amendments are done to the list of verbs.

First, it became clear that there were verbs mentioned in an assignment that did not occur in the list of verbs. These so called action verbs were used in the assignment but do not indicate a fundamental skill of critical thinking. Examples of these verbs are ´cross´, ´look´ and ´read´ (See Table 8: example 1). Those verbs are only indicating an action that children have to perform. Therefore, these verbs were not added to the list. When looking at one assignment there are still other verbs used. In order to answer the first question correctly, it is suggested to ignore the context sentences. These sentences contain a lot of verbs that are not relevant to the indicative cognitive thinking step. For example in Table 8: example 2, the first sentence includes verbs. However, only the second sentence asks for the action in which a cognitive thinking step is required. Second, the list is extended with the nouns of the verbs mentioned in the list. In some assignments, the used verbs were only action verbs, but the nouns were indicating the cognitive thinking step. For instance, an assignment asked for a definition; without using the verb "define", for example a question like "What is the definition of Climate?" Thus, the nouns of each verb are also used to categorize the cognitive thinking step, such as 'definition', 'argument' and 'illustration'. The third amendment is the addition of other

verbs and key terms. Some verbs were used frequently in the assignments which were not on the list, for example, 'Bijhoren' (Knowledge) and 'Kennen' (Knowledge). Furthermore, some key terms that are highly related to the before mentioned operationalisations of the fundamental skills (See page 8 till 10) are also added to the list. These key terms are mostly related to the cognitive thinking skills Analysis and Evaluation. The following key terms are added: 'Relevantie' (Analysis and Evaluation), 'Betrouwbaarheid' (Analysis and Evaluation), 'Bruikbaarheid' (Analysis and Evaluation), 'Consistentie' (Analysis and Evaluation), 'Structuur' (Analysis and Evaluation), 'Criteria' (Evaluation) and 'Logica' (Evaluation).

Table 8: Example of an assignment Argus Clou.

Example 1	**"2.2.2d. To which sector belongs the head office? Cross the correct answer.** [Bij welke sector hoort het hoofdkantoor? Kruis het goede antwoord aan.] *Argus Clou Chapter 2, Lesson 2, Assignment 2d."*
Example 2	**"3.1.3b. Petroleum and natural gas are used everywhere. Write down three examples"** [Aardolie en aardgas worden overal om je heen gebruikt. Schrijf drie voorbeelden op.] *Argus Clou Chapter 3, Lesson 1, Assignment 3b."*

At last, it became clear that some assignments required more than one cognitive thinking skill. (See Table 9). With multiple verbs in one assignment and different indicative cognitive thinking steps, it is difficult to address the final fundamental skill. Initially the assignment could only develop the highest cognitive thinking step measured. Nevertheless, this is not possible because the skills that are linked to lower order thinking steps or higher order thinking skills are equal to each other. So Understanding and Application are equal to each other and Analysis is equal to Creation. Therefore, multiple cognitive thinking steps can be assigned to an assignment.

Table 9: Example of an assignment Meander.

"**1.2.9. How is the Flexenpass protected against falling stones? Collect images and explain.** [Hoe wordt de Flexenpass beschermd tegen vallende stenen? Verzamel afbeeldingen en schrijf er uitleg bij.] *Meander Chapter 1, Lesson 2, Assignment 9"*.
1. Verbs: Collect, write, explain [Verzamel, schrijf, uitleg] Context sentence: how is the Flexenpass protected against falling, can be ignored. This sentence shows the topic in which they have to answer the question. This sentence does not use verbs that indicate a cognitive thinking step.

2. Context:
    a. Are there any text blocks/sources that have an influence on the assignment? There are no extra text blocks. However than can go online to a search machine to find different images that can complement their knowledge.
    b. Are there previous assignments that have an influence on the assignment?
    In the previous assignments, the different possibilities examined to protect mountains against falling rocks. They are working on the skill to learn how to compare different plans.
    Previous assignment: 8 → Creation
    c. What is the learning goal of the assignment?
    Deepen knowledge about falling rocks and exercise with the skill to learn how to compare different ideas. So learn to use the investigation skills.

3. Cognitive thinking step: Understanding, Application, Analysis and Creation

This leads us to the final Instrument of the flowchart (Appendix K) and the list of verbs (Appendix H). The instrument will be used to evaluate the three geography methods Argus Clou, Grenzeloos and Meander.

Reliability

The final instrument is examined on its reliability with Cohen's Kappa. Cohen's kappa is measuring the chance that both examiners give the same assignment the same fundamental skill of critical thinking.

In this research, the second examiner has studied educational sciences and works in primary education. Because of her expertise, she examined 20% of all assignments. This 20% has been selected blindly out of the three learning methods. During this blindly selection the distribution of each method with regard of the number of assignments has been taken into account. The Cohen's kappa has the value of 0.607, which means that the reliability is reasonable on the edge of sufficient. During the analysis, the level of agreement between the two examiners for the lower order thinking skills (i.e. Interpretation) was 86.3% and for the higher order thinking skills was 74% (i.e. Analysis, Evaluation, Creation, Explanation and Metacognition).

Procedure

All three learning methods have been examined in the same standardized manner. First the method Argus Clou has been analysed, second Grenzeloos and third Meander. In order to analyse the methods, in the same way, all the assignments of one learning method have been analysed in one time. In this way, consistency in the method has been noticed and the same sort of assignments are analysed the same way. The instrument is used according to the flowchart (Appendix K), so all questions had to be answered and the list of verbs (Appendix H) is used as a guideline in the flowchart. This will be illustrated with an example of an assignment of Argus Clou (Table 10). Looking at the example (Table 10) the first question is to recognize the indicative verbs. The verbs of the context sentences can be ignored because they only include action verbs such as 'read' and 'have'. Therefore, the only sentence that is important is: 'Explain the difference between climate and weather'. The indicative verb in this assignment is 'explain'. Next, the context is taken into account, with the different sub questions: text blocks, previous assignments and the learning goal. The assignment asks for the definition of multiple terms which can be linked to the knowledge. The learning goal is also reproducing knowledge which is mentioned in the text section before this assignment. However, the child has to explain the differences between the terms. Therefore looking at the operationalisation, this assignment stimulates understanding.

Table 10: Example of an assignment Argus Clou.

"1.5.3b. Read the weather broadcast. The Netherlands has a temperate maritime Climate. However, according to the broadcast it is about to freeze. Explain the difference between climate and weather. [Lees het weerbericht. Nederland heeft een gematigd zeeklimaat. Maar volgens het weerbericht gaat het flink vriezen. Leg het verschil uit tussen klimaat en weer.] *Argus Clou, Chapter 1, Lesson 5, Assignment 3B"*
1. Verbs: Explain [Uitleggen], Context sentences can be ignored. This means that the verbs, 'Read', 'go' and 'have' can be ignored.

2. Context:
    a. Are there any text blocks/sources that have an influence on the assignment?
       A text block is added in the assignment in which the broadcast is written. Children have to know the different terms Climate and weather, this knowledge have to be applied to the text block.
    b. Are there previous assignments that have an influence on the assignment?
       The previous assignment is recognizing different climates in different graphs (Assignment 3A → understanding)
    c. What is the learning goal of the assignment?
       Reproducing knowledge

3. The assignment asked for the explanation of different knowledge, so the child has to understand the differences between both terms. → Understanding

Data analysis

With the previously developed instrument, the assignments of three learning methods will be evaluated on the stimulation of the fundamental skills of critical thinking. The assignments of learning methods are categorized in the following operationalisations: Interpretation (i.e. Knowledge, Understanding and Application) Analysis, Evaluation (i.e. Evaluation content), Explanation (i.e. Evaluation process), Creation and Metacognition. In which Interpretation (i.e. Knowledge, Understanding and Application) is marked as lower order thinking skills and Analysis, Evaluation (i.e.

Evaluation content), Explanation (i.e. Evaluation process), Creating and Metacognition are marked as higher order thinking skills. Each assignment can stimulate one or more cognitive thinking skills. The collected data is quantitative of nature. The data will be analysed with SPSS.

Each assignment is categorized into their stimulated fundamental skill. Critical thinking occurs mostly with the use of higher order thinking skills (Bloom et al., 1956, Facione, 1990; 2015, King et al., 1998). Therefore, assignments are further divided into lower order thinking skills (i.e. Interpretation) or higher order thinking skills (i.e. Analysis, Evaluation, Creation, Explanation and Metacognition). The learning methods will be analysed on the number of skills that is stimulated more, the lower order or the higher order thinking skills. Furthermore, in order to show the variation in which the fundamental skills of critical thinking have stimulated the combination of lower or higher order thinking skills is added as a variable. The last variable added is the combination of different higher order thinking skills. Since critical thinking requires most of all higher order thinking skills (i.e. Analysis, Evaluation, Creation, Explanation and Metacognition), it is expected that the assignments that require multiple higher order thinking skills ("higher" fundamental skills) are most likely to stimulate the development of critical thinking more (King et al., 1998).

These variables will be analysed with the following SPSS tests: Chi-Square and Logistic regression. First, the Chi-square will test if there is a dependency between the cognitive thinking steps and the use of learning methods. All three assumptions are in this sample: 1) All variables are categorical; 2) there are no expected counts of 0 measured; 3) the expected count have to be higher than 5. The Chi-square will be done multiple times, for each cognitive thinking step separately, for the lower or higher order thinking steps, the combination of lower and higher order thinking steps and the combination of multiple higher order thinking steps in one assignment. During these Chi-square tests the following hypotheses are used with a significance level of .05 (α=.05).

H_0 = There is no dependency between the cognitive thinking step within the methods.

H_1 = There is dependency between the cognitive thinking step within the methods.

Because a Chi-square only tests dependency, it is unknown how this dependency works. Therefore, a logistic regression will be done. Here the hypotheses are:

H_0 = There is no dependency between the stimulation of the "higher" fundamental skills (i.e. Analysis, Evaluation, Explanation, Creation and Metacognition) and the learning method that is used.

H_1 = There is dependency between the stimulation of the "higher" fundamental skills (i.e. Analysis, Evaluation, Explanation, Creation and Metacognition) and the learning method that is used.

In this test the independent variable will be 'method' and the dependent variable will be 'higher or lower order thinking skills'. As reference method Grenzeloos has been chosen, because this method had the highest amount of stimulated higher order thinking skills. This will show the differences between Grenzeloos → Argus Clou and Grenzeloos → Meander. Nonetheless, the differences between Argus Clou and Meander are still unknown. Therefore a second logistic regression is done to test the differences between Argus Clou and Meander. Herewith Meander is the reference method because they show more higher order thinking skills than Argus Clou. The logistic regression will use a significance level of .05 (α=.05).

Results

The current study aimed to answer the question: *"To what extent do current geography learning methods for primary education grade 7 utilise assignments that are likely to encourage learners to engage in the fundamental skills of critical thinking?"* Three geography methods (i.e. Grenzeloos, Argus Clou and Meander) were analysed. Overall findings are reported after which findings on individual methods are reported and compared.

Descriptive statistics. In total 706 assignments were included in analysis; 282 assignments of Argus Clou, 174 assignments of Grenzeloos and 250 assignments of Meander. Figure 2 shows the percentages of the assignments that require each cognitive thinking step in the different learning methods.
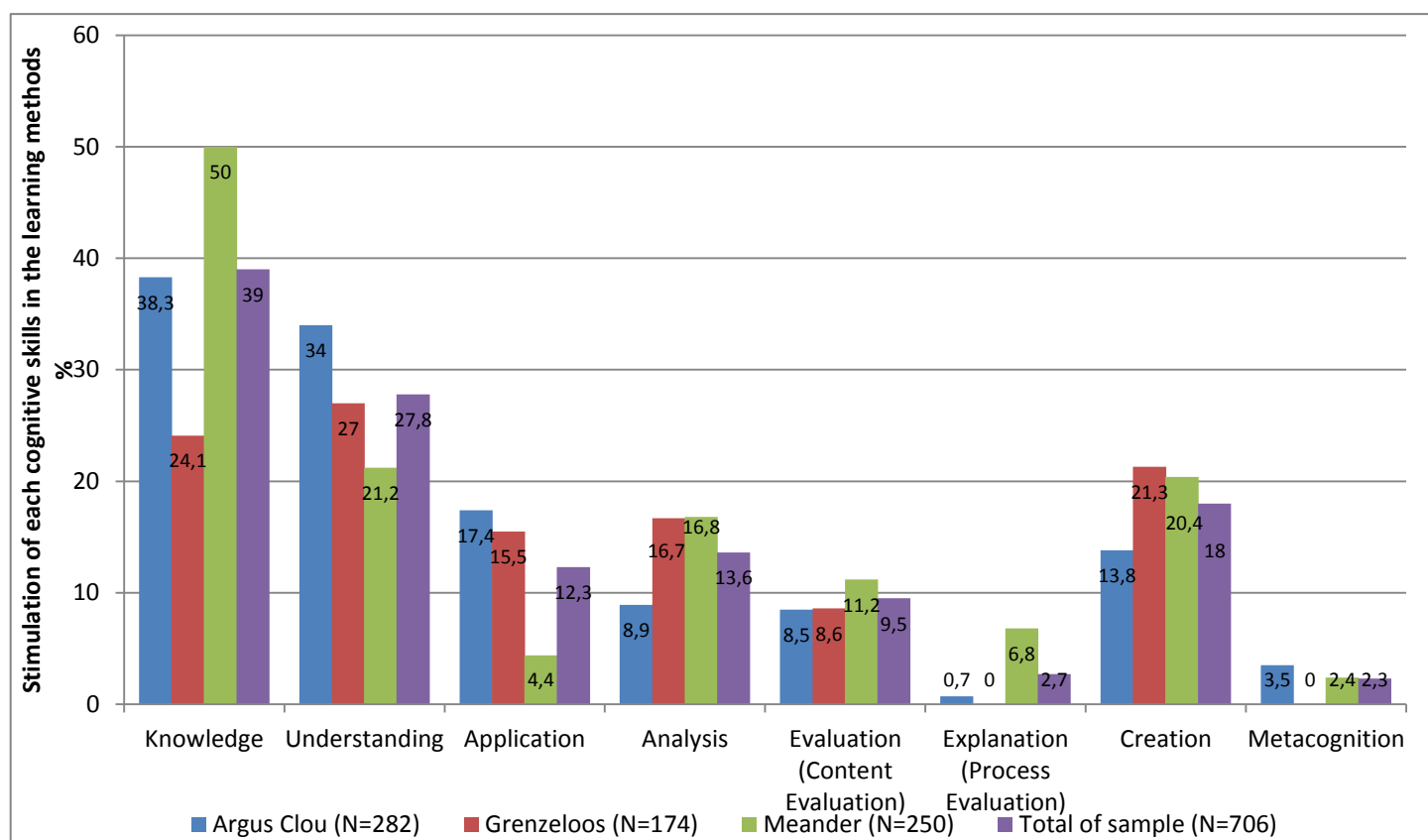
Figure 2: The percentages of the cognitive thinking skills required in the different learning methods.

The most required skills. In the overall sample, the most required cognitive thinking steps are Knowledge, Understanding and Creation. In the different methods, this top three is quite similar. In Grenzeloos and Meander, the most required cognitive thinking steps are Knowledge, Understanding and Creation. Argus Clou is slightly different with Knowledge, Understanding and Application instead of Creation (See Figure 2).

The least required skills. The least required skills in the overall sample are Explanation and Metacognition with less than 3%. In the separate learning methods, these two are also least required. Argus Clou showed a little of Explanation and Metacognition, respectively, 0.7% and 3.5%. Grenzeloos does not show any Explanation or Metacognition in their assignments. Meander shows more Explanation than Metacognition, respectively 6.8% and 2.4%. However, the assignments of Meander require more Explanation than Application, which is required in 4.4% of all assignments (See Figure 2).

Stimulation of the lower and/or higher order thinking skills. It is assumed that the more assignments require higher order thinking skills, the more critical thinking is stimulated (King et al., 1998). Therefore, the data is analysed on the stimulation of lower and/or higher order thinking skills (See Figure 3). In the overall sample more assignments require lower order thinking skills than higher order thinking skills. This is the same for the separate learning methods. The combination of lower and higher order thinking skills in an assignment are all around the 5% of all assignments. The combination of higher order thinking skills is more divided. In the overall sample 9.2% of the assignments show combinations of higher order thinking skills. However, in the separate learning methods the percentages are different. 4.6% of Argus Clou assignments required multiple higher order thinking skills in one assignment. The percentage for Grenzeloos is 2.3%. Meander has the most percentages of assignments that required multiple higher order thinking skills in one assignment, respectively 19.2% (See Figure 3).
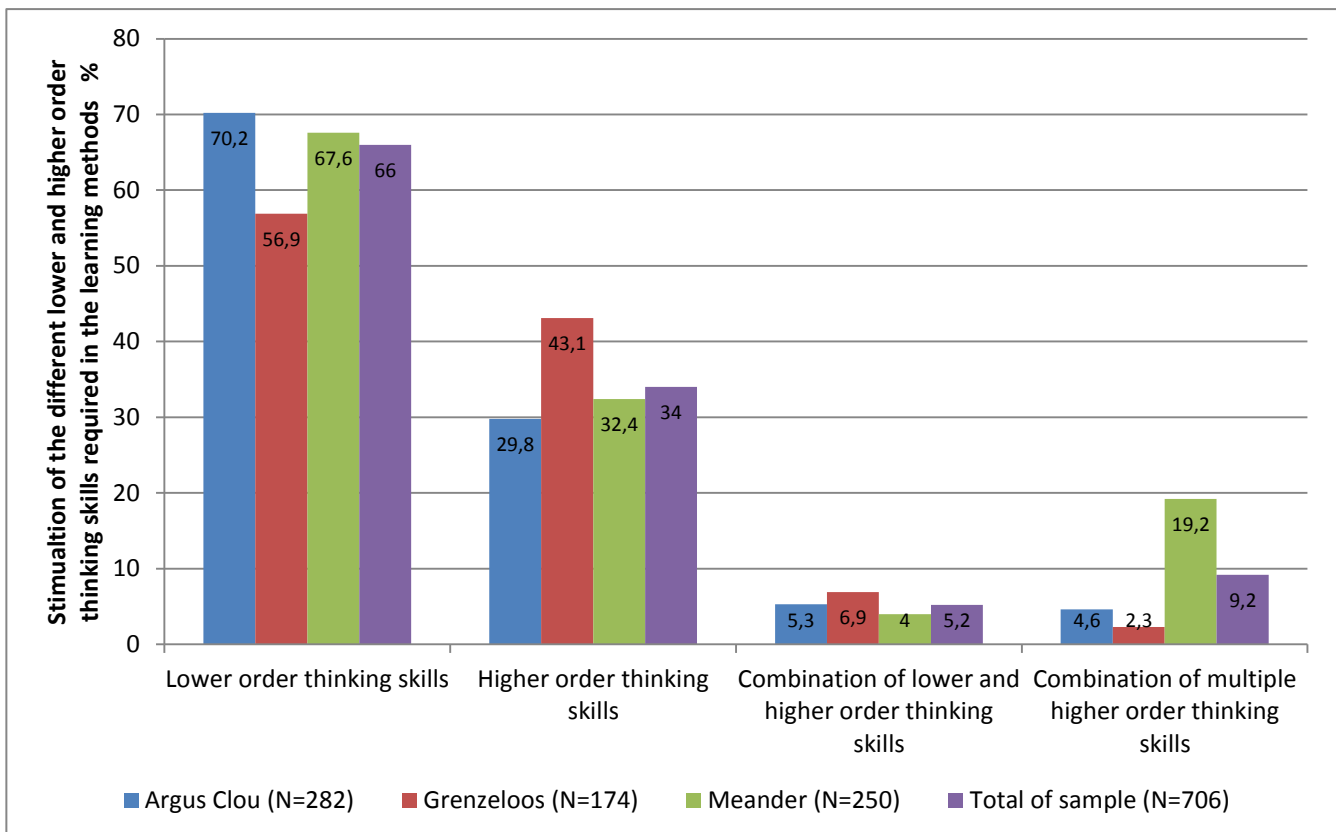
Figure 3: The percentages of the lower and higher order thinking skills required in the different learning methods.

Differences between methods. The Chi-square test of independence between cognitive thinking steps and learning methods is calculated and showed a significant effect (α=.05) on knowledge ($\mathcal{X}^2$ (2) = 28.94, p = .000), understanding ($\mathcal{X}^2$ (2) = 10.96, p =.004), application ($\mathcal{X}^2$ (2) = 22.83, p = .000), analysis ($\mathcal{X}^2$ (2) = 8.95, p = .011), explanation ($\mathcal{X}^2$ (2) = 25.16, p = .000), and metacognition ($\mathcal{X}^2$ (2) = 6.14, p = .046). Therefore it is assumable that the assignments that require these cognitive thinking skills are dependent from the method that is used. The cognitive thinking skills evaluation ($\mathcal{X}^2$ (2) = 1.32, p = .517) and Creation ($\mathcal{X}^2$ (2) = 5.56, p =.062) are not significant. With these results, it is not possible to say if there is dependency or independency between these cognitive thinking skills and the methods.

Furthermore, the Chi-square test of independence is calculated for the lower and higher order thinking skills. This test demonstrated that the stimulation of lower or higher order thinking skills is assumable dependent of the learning method used ($\mathcal{X}^2$ (2) = 8.94, p = .011). Moreover, it is not possible to tell if the combinations between lower and higher order thinking skills are dependent or independent of the different learning methods ($\mathcal{X}^2$ (2) = 5.93, p = .204). On the other hand, the combination of different higher order thinking skills is assumable dependent of the different learning methods ($\mathcal{X}^2$ (2) = 77.22, p = .000).

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Thus, it is clear that there is a dependency between methods looking at the stimulation of higher and lower order thinking skills. However, it is unclear how this dependency works. According to the logistic regression the odds of use of the higher order thinking is .560 times higher when decided to use method Argus Clou instead of Grenzeloos. This difference is significant. In addition, the odds of use of the higher order thinking are .633 times higher when decided to use method Meander instead of Grenzeloos (Table 11). Moreover, the odds of use of the higher order thinking skills are .885 times higher when decided to use method Argus Clou instead of Meander (Table 12). This difference is also significant. The success ratio of the method with the classification of different methods is 66%.

Table 11: Statistics of the Logistic Regression (reference method Grenzeloos).

	Standard Error	Significance level	Exp (B)	95% Confidence Interval for Exp (B)	
				Lower	Upper
Grenzeloos		.012			
Argus Clou	.201	.004	.560	.378	.830
Meander	.204	.025	.633	.424	.944
Constant	.153	.070	.758		

Table 12: Statistics of the Logistic regression (Reference method Meander).

	Standard Error	Significance level	Exp (B)	95% Confidence Interval for Exp (B)	
				Lower	Upper
Meander		.012			
Argus Clou	.188	.516	.885	.613	1.279
Constant	.135	.000	.479		

Conclusion

In this research, three geography methods for primary education have been examined on the stimulation of the practice of fundamental skills for critical thinking. Critical thinking can be divided into the following fundamental skills: Interpretation (i.e. the lower order thinking skills with Knowledge, Understanding and Application), Analysis, Evaluation, Creation, Explanation and Metacognition (i.e. the higher order thinking skills). The question answered in this study is: "To what extent do current geography learning methods for primary education grade 7 utilise assignments that are likely to encourage learners to engage in the fundamental skills of critical thinking?"

The results show that all three learning methods stimulate all fundamental skills of critical thinking. In addition, all three learning methods stimulate more Interpretation than Analysis, Evaluation, Explanation, Creation and Metacognition. The least stimulated fundamental skills were Explanation and Metacognition. Furthermore, looking at the amount of assignments that stimulate the practice of the higher order thinking skills (i.e., Analysis, Evaluation, Creation, Explanation and Metacognition), the most stimulating was Grenzeloos and the least stimulating was Argus Clou. Looking at the stimulation of both 'lower' fundamental skill Interpretation and the 'higher' fundamental skills Analysis, Evaluation, Explanation, Creation and Metacognition in one assignment the most stimulating was Grenzeloos, the least stimulating was Meander. The methods Grenzeloos/Meander and Grenzeloos/Argus Clou were significantly different on the stimulation of the higher order thinking skills. Argus Clou/Meander were not significantly different on the stimulation of the higher order thinking skills (i.e., Analysis, Evaluation, Creation, Explanation and Metacognition). Critical thinking is characterized by multiple higher order thinking skills (Bloom et al. 1956; King et al., 1998). Looking at the difference between the learning methods on the characteristic: "if one assignment includes multiple skills" such as, Analysis, Evaluation, Creation, Explanation and Metacognition. Meander is the most striking. 19.2% of all assignments require multiple higher order thinking skills in one assignment, whereas the percentages of Argus Clou and Grenzeloos are a lot lower with respectively, 4.6% and 2.3%.

Discussion

Looking at the three learning methods, the upcoming importance of critical thinking is noticed. The oldest method, Argus Clou does not mention the use of the 21st century skills including critical thinking. Meander, the newest method, is specifically focused on the 21st century skills and uses learning goals that stimulate critical thinking. This could be an indication that critical thinking is a skill that becomes more important to develop in daily life. Moreover, it shows that publishers of learning methods are already working on critical thinking. This research looked closely at the differences between geography learning methods in the stimulation of the fundamental skills of critical thinking. All three learning methods stimulate the fundamental skills of critical thinking. The different learning methods all have some of the same characteristics such as: the high stimulation of Interpretation; and the low stimulation of Explanation and Metacognition. These will be discussed below.

First of all, it is not remarkable that in all three learning methods, the fundamental skill 'Interpretation' is stimulated most (See Figure 3). The goal of primary education is to make sure that children have a solid understanding of essential concepts and dynamics (Onderwijsraad, 2017). Therefore, the focus in primary education is predominantly on acquiring knowledge and less on the development of skills, such as critical thinking. With knowledge building as one of the primary goals, the focus is on the lower order thinking skills. In this research, the methods were indeed focused more on the lower order thinking skills, Interpretation (i.e. Knowledge, Understanding and Application), than on the higher order thinking skills (i.e. Analysis, Evaluation, Explanation, Creation and Metacognition). It is assumed that Interpretation (i.e. Lower order thinking skills) is a premise upon which the other fundamental skills were built. In this context, automaticity is very important when developing cognitive thinking skills. Automaticity means that someone can execute a cognitive skill without paying attention (Mayer, 2008). In order to work on complex tasks that need higher order thinking skills (i.e. Analysis, Evaluation, Explanation, Creation and Metacognition), the lower order thinking skills (i.e. Interpretation) have to be automated. Poor transfer is a result of too much cognitive load, this happens when the lower order thinking skills are not automated enough (Mayer, 2008). Therefore, primary education is more focused on automating lower order thinking skills (i.e. interpretation), since they are essential to perform more complex tasks in which the "higher" fundamental skills of critical thinking are needed (i.e. Analysis, Evaluation, Explanation, Creation and Metacognition).

Second, all learning methods also stimulate the other skills that underlie critical thinking such as: Analysis, Evaluation, Creation, Explanation and Metacognition. Approximately 34% of the assignments stimulate these 'higher' fundamental skills of critical thinking (See Figure 3). However, the fundamental skills Explanation and Metacognition were least stimulated by all three learning methods (See Figure 2). The skills Explanation and Metacognition are not mentioned in the Taxonomy of Bloom (Bloom et al., 1956). This resulted in fewer indicative verbs of these cognitive thinking skills. There is a possibility that due to the fewer indicative verbs mentioned in the instrument, the fundamental skills were also harder to distinguish in the assignments. This could be the case for the fundamental skill Metacognition. On the other hand, the fundamental skill Explanation had more indicative verbs, because it is linked to the evaluation step of Bloom (Bloom et al., 1956). However, it was not mentioned more often than Metacognition (See Figure 2). The skill Explanation required someone to explain and argue why he came to its conclusions (Facione, 1990). Explanation is simply stating the process of evaluation, so explaining the reasoning behind the evaluation phase. Metacognition is the skill to deliberately monitor, control and reflect your own thinking. Here the indicative verbs were: 'control', 'plan', 'monitor' and 'reflect'. Assignments that stimulated metacognition were assignments in which someone had to evaluate his thought process. Questions that someone has to ask himself are: 'am I on the right track?', 'do I have a bias?' and 'is my thinking correct?'. During Metacognition the explanation phase is also used, since there is a reflection on your own thinking and an explanation why these options were chosen. Adding metacognitive and explanative assignments can be implemented in different ways, such as addition of these aspects at the end of each chapter; the end of a lesson; or during an assignment. An example is shown in Table 13. In the methods Meander and Argus Clou there were reflective assignments at the end of a lesson or chapter and at the end of a project assignment. However, Grenzeloos did not use reflective assignments in their method.

Table 13: Example in which a metacognitive aspect is added.

Grenzeloos *Chapter 3, lesson 5, Assignment E*	
Original.	**With metacognitive aspects.**
United States of Europe?	United States of Europe?
How does the future look like? How convenient would it be to make Europe one united country? What would be better, the opponents of Europe that want to split Europe in individual countries or the supporters of Europe?	How does the future look like? How convenient would it be to make Europe one united country? What would be better, the opponents of Europe that want to split Europe in individual countries or the supporters of Europe?
Suppose you are the boss of Europe and you have to decide what the future of Europe will be. What would you decide: A United States of Europe or a split of Europe? Or something else? How do you ensure the happiness of the Europeans regarding this decision? Write an article for the newspaper Eurotopia.	Suppose you are the boss of Europe and you have to decide what the future of Europe will be. What would you decide: A United States of Europe or a split of Europe? Or something else? How do you ensure the happiness of the Europeans regarding this decision? Write an article for the newspaper Eurotopia.
	First make a plan how to tackle this assignment. List the ideas of the supporters and the opponents of Europe. Consider if these ideas are good enough to write in a newspaper.
Tip!	Finished your article?
Read in your textbook what opponents think of the unity of Europe.	Check if the newspaper is accurate enough. Is it clear what the ideas are from the opponents and the supporters of Europe? Yes/No Is it clear what the decision has become? Yes/no Are the arguments of the decision clear? Yes/No Would the Europeans be happy with your decision? Yes/No.
	Tip! Read in your textbook what opponents think of the unity of Europe.

So there are some similarities between the methods, even though all three learning methods stimulate the fundamental skills of critical thinking in different ways (See Chi-square test, page 20). Grenzeloos showed that they stimulate the most 'higher' fundamental skills such as: Analysis, Evaluation, Explanation, Creation and Metacognition (See Figure 3). Their approach is making assignments which each focus on one "higher" fundamental skill. All the fundamental skills are mostly learnt separately resulting in less cognitive load. On the other hand, Meander showed that they stimulate multiple fundamental skills in one assignment and only give these assignments in the end of each chapter. For example in three assignments, the first required Interpretation, the second required Analysis and the last assignment required both Evaluation and Creation. However, as they only give these assignments at the end of each chapter; the stimulation of multiple cognitive thinking steps could stimulate children in more learning transfer and possibly less cognitive load.

The second difference is in line with the previous difference, namely the distribution of how the fundamental skills are provided in the assignments. Grenzeloos stimulates the most fundamental skills in all assignments (See Figure 3), Meander stimulates the most fundamental skills in one assignment (See Figure 3) and Argus Clou doesn't mention any stimulation of critical thinking in their vision (Table 2). Looking at the relative number of assignments that stimulate the "higher" fundamental skills (i.e. Analysis, Evaluation, Explanation, Creation, Metacognition) there is no significant difference between Argus Clou and Meander (See Table 12), possibly because they have the same publisher (See Table 2). It is possible that the number of assignments that stimulate the "higher" fundamental skills does not necessarily mean that it results in a better development of critical thinking. It is recommended to investigate if a relative higher amount of assignments that require the "higher" fundamental skills also improve the critical thinking of children. A research with two similar groups in a pre-post-test experiment can investigate this hypothesis. The base group should be doing assignments that require only lower order thinking skills (i.e. Interpretation) and the experimental group should be doing assignments that require only the "higher" fundamental skills (i.e. Analysis, Evaluation, Creation, Explanation and Metacognition). Afterwards, the critical thinking skills of the pre-test and the critical thinking skills of the post-test can be compared.

The third difference between the methods is the use of learning objectives and contextualized assignments. The most effective way to stimulate critical thinking is to make sure that content is contextualized and learning objectives of critical thinking are explicit (Abrami, et al., 2008; Hattie et al., 2008). Meander addresses both aspects in which the learning objectives are mentioned in the beginning of each chapter. Grenzeloos and Argus Clou do not address critical thinking objectives though it addresses contextualized assignments. Note that Argus Clou does not mention any stimulation of critical thinking in their method (See Table 2). Table 14 shows some examples of contextualized assignments. Contextualized assignments that have clear learning objectives are beneficial for the learning transfer (Mayer, 2008). Furthermore, with these aspects, it is easier for teachers and schools to implement critical thinking in their lessons (Snyder & Snyder, 2008). A recommendation for learning methods of Grenzeloos and Argus Clou is the addition of learning objectives. However, not every method has a revision each year and schools might not buy new learning methods regularly. Therefore, teachers can give additional information, such as suitable learning objectives of critical thinking, when explaining the instruction during a lesson. It is important to bring some behavioural and some cognitive skills under attention (Duron et al., 2006).

Table 14: Different examples of contextualized assignments.

Meander *Chapter 4, Lesson 2, assignment 7*	Grenzeloos *Chapter 2, lesson 2, assignment 3 and 4*	Argus Clou *Chapter 5, Lesson Zo kan het ook, lesson 3*
Learning goal chapter 4: You practice how to make a choice. You will choose a winner by putting arguments together. **Assignment:** Landscapes look differently in each climate zone. Even the houses are different in each climate zone. Suppose:	**Assignment:** What kind of weather can Laura expect? Write down the weather forecast in the table on page 2. This is how you do it: Write down in which month Laura is there.	**Assignment:** It's your choice. You can co-decide on the money of the EU by voting for the European Parliament. However, you want more influence than you already have. That is why you decide to set up your own political party. To make sure people will choose you, you create a pamphlet: a piece of paper that you

In the summer you are going to Spain. You can help to choose a holiday home. It is easier to choose when you know what you should pay attention to.
Put your requirements for a holiday home in a list. Read: 'That's how you do it!'

That's how you do it!
View the requirements
Are there requirements missing, please add.
Put the requirements in a list.
Put the most important requirement on the top and the least requirement at the bottom. Give all the other requirements a choice in the middle.
Make a choice.
Compare your list with the information of each holiday home. Choose the house that is most suitable with your requirements.

Fill in the temperature, the amount of sun and the amount of rain.

Tips
Use the textbook pages 20 till 25. In the southern hemisphere, the seasons are exactly opposite of ours. If it is winter here, it is summer in South Africa and vice versa.

Assignment:
What clothes do you advise Laura to take with her on her world trip?

Look at the table of assignment 3. What should Laura take with her in her suitcase?

can hand out on the street.

Step 1: What am I going to do
On your pamphlet you want to explain clearly how the voting works for the European Union. You explain why it is important to vote and why they should choose your party. Therefore you need to explain how you want to spend the money of the European Union.

Step 2: How do I do it?
Read source B and D. Look at Source E. How does the governance of the EU look like? What is everyone doing? Why do people have to vote?
Then read source G and I. What do you think is so good about the EU? What has to change? How do you want to spend the money, To what will you spend money and what not?

Step 3: I do my work.
Make your pamphlet on a separate piece of paper.
First create a name for your party
Does your party name get an abbreviation? Which one?
Why does someone have to vote for your party?
Do you have a good slogan?
Put the name of your party and your slogan on top of the pamphlet. Write the text in short and powerful sentences. Use striking letters and colours.

Step 4: I Check my work.
Circle your answer.
Are the following characteristics mentioned on your pamphlet?
A clear explanation about the EU? Yes/No
Why it is so important to vote? Yes/No
What things do you want to spend EU money on? Yes/No
Do you think many people will vote for your party? Yes/No

These differences in approaching the fundamental skills of critical thinking in the learning methods made it difficult to say what the best practice is to stimulate the fundamental skills of critical thinking. Though these results give insights in how the current methods are built in regard of the stimulation of the fundamental skills of critical thinking, since they all stimulate the fundamental skills of critical thinking. Even though Meander has a vision that is specifically focused on the stimulation of these skills and Argus Clou has no vision of stimulating critical thinking.

This research used a limited view of critical thinking, since critical thinking includes a cognitive and a dispositional aspect. The focus lay on the cognitive side; the dispositional aspect is only taken into account with the use of Metacognition. Looking at Metacognition, there are just a couple of

assignments that require this fundamental skill in the learning methods. Even though, it seems that children naturally develop some dispositions of critical thinking (Gopnik, 1998; Mills, 2013), it is not guaranteed that this natural attitude is enough to develop a sufficient level of critical thinking. For example, when a child is curious but he does not know how to use his cognitive levels to examine information, than he will not develop a sufficient level of critical thinking, as will a child who knows how to analyse information but does not have the incentive to reflect the information, their own thinking and to say it aloud. So, both cognitive skills and dispositions must be stimulated in order to become a sufficient critical thinker (Facione, 2015; Paul and Elder, 2008; SLO, 2017A). In this research, the importance of the dispositions has not been taken fully into account. This led to the exclusion of other learning methods, such as Ik creëer mijn wereld (2017). The vision of this method is to develop world citizens that are in harmony with each other. Through self-reliance, children develop a sense of the world around them. Moreover, they learn their own selves and develop confidence which can be helpful during the development of critical thinking. All assignments are focused on the dispositional side in which the 21st century skills are stimulated. It is highly recommended to investigate critical thinking in its whole definition. Currently, the analysed learning methods are focused on the cognitive side and do not require a lot of the dispositional aspect: Metacognition. The stimulation of dispositions could be done by the teacher. This integration of dispositions can be done through teacher guidance and through assignments that require specific skills such as collaboration. It is recommended to investigate if the role of the teacher to stimulate critical thinking is already integrated in the current learning methods. The instrument can be used in combination with the study of teacher interactions and observations in the classroom. This can give a broader insight into all the dimensions of critical thinking during the lesson.

Hence, it is assumable that the stimulation of critical thinking is dependent of more than just the assignments in learning methods, such as the educational context and teachers. These factors are not taken into account in this research. A further study with more focus on these factors is therefore suggested. Considering that research showed that preconceptions of teachers can hinder the ability of teachers and students to use their critical thinking skill (Snyder & Snyder, 2008). Furthermore, Massa (2014) reports that teacher's beliefs can influence the practices in the classroom and the achievements of students. In addition, schools have not only the goal to train and stimulate teachers but also to provide a good learning climate and school ethos (Boyd, 1997 as cited in Fisher, 1999). Training can help teachers to address the fundamental skills in their lessons, help them use effective dialogue techniques and enhance the awareness of critical thinking in children (Fisher, 1999). So these aspects all influence the stimulation of critical thinking. Currently, one way to stimulate critical thinking is through the learning methods. It is recommended to investigate the other aspects that influence the development of critical thinking in combination with the learning methods.

At last, it has to be noted that each method in this research contained regular assignments and enriched assignments. This enriched material deepened the knowledge and uses integrative projects of multiple subjects like history. There is a possibility that the enriched assignments require more fundamental skills of critical thinking than the regular assignments. However, the enriched material is different for each learning method and classified as optional. Therefore, only the regular assignments have been evaluated on the fundamental skills of critical thinking. For further research, it is possible to look at the enriched materials. This will give insights in the differences between the regular assignments and the enriched assignments. When the differences between both types of assignments on the stimulation of critical thinking is studied, it is also possible to look at the development of critical thinking between the "advanced" and the "less advanced" children.

Design of this research

The instrument used in this research, was designed to measure the fundamental skills of critical thinking in the learning methods. In the following section, some recommendations will be made regarding: 1) The view of the fundamental skill Metacognition; 2) The alignment with Bloom et al. (1956); 3) Validity of the instrument; and 4) The context aspect of the instrument.

The instrument is focused on the cognitive fundamental skills of critical thinking, which seem to be aligned with the Taxonomy of Bloom et al. (1956). This alignment has a couple of implications. First, Metacognition is not mentioned by Bloom et al. (1956) in their Taxonomy of educational objectives. In the view of this research, Metacognition implements the fundamental skills Analysis, Evaluation, Explanation and Creation on their own thinking. As consequence, Metacognition is equal to the skills Analysis, Evaluation, Explanation and Creation. However, this equality is debatable since it

is the implementation of those skills. Therefore, it can be argued that Metacognition cannot be categorized into the lower or higher order thinking skills of Bloom's Taxonomy (Bloom et al., 1956 However, even though it is not categorized by Bloom et al. (1956) as a higher order thinking skill, it does not mean that it is not a higher order thinking skill. It is a skill that requires advanced thinking, just as the other higher order thinking skills (i.e. Analysis, Evaluation, Creation and Explanation). According to SLO (2017A) Metacognition or self-regulation can be seen as an independent skill. This skill is needed in multiple 21st century skills such as: critical thinking, problem solving and computational thinking. Although the skill be seen as an independent and can be learned in multiple subjects, the skill is also crucial for critical thinking. When someone is not looking critically towards their own thinking, this person will have a bias in their thinking which results in poor decision making. Therefore in this research, Metacognition is seen as one of the higher order thinking skills that is fundamental for the development of critical thinking.

Second, it can be argued that Bloom only shows the use of a cognitive level but not the extent of this level. Consequently, the method is only showing the use of a fundamental skill of critical thinking and not the extent in which this fundamental skill is used. It is possible that the measure of the practice of the fundamental skills of critical thinking does not necessarily mean that it results in a better development of critical thinking. Because, it is unknown to what extent someone has to use their fundamental skills to develop a sufficient critical thinking skill. It is possible that children use their cognitive thinking skills in an assignment but that they are not yet thinking critically with these fundamental skills and vice versa. Thus, the instrument only measures a cognitive level and not to what extent these levels are used. (Page 8 till 11). It is recommended to investigate to what degree someone has to master the fundamental skills to develop a sufficient critical thinking skill. Further research can be done on the alignment of Bloom's cognitive levels and the degree of the cognitive levels in regard of critical thinking. The alignment with Bloom's taxonomy is assumable, because children need the cognitive skills to develop a sufficient critical thinking skill. Nonetheless, awareness for the stimulation of critical thinking is important. It is not self-evident that children know that they have to use their critical thinking skills and why. Maybe children only use their critical thinking skills when they already have the knowledge, but when they do not have the knowledge; they refrain from using their critical thinking skills. They assume that the information is correct and valid, even though it is not. It is essential that children are learned how to develop their cognitive skills so that they can use them in the development of critical thinking.

It has been established that children need to develop the cognitive skills (i.e. Interpretation, Analysis, Evaluation, Creation, Explanation and Metacognition) that are fundamental for critical thinking (Facione, 1990; 2015; King et al., 1998). These cognitive skills can be recognized in the assignments with the use of verbs (Anderson et al., 2001; Bloom et al., 1956). Part of the study was the collection of verbs that are likely to trigger the fundamental skills of critical thinking. Because of the highly related foundation upon the Bloom's Taxonomy (Anderson et al., 2001; Bloom et al., 1956), it is assumed that the instrument is measuring the correct cognitive thinking steps. In this way the content validity, which is the coverage of the fundamental skills of critical thinking, has been taken into account. To ensure the reliability and the systematic process, the verbs were further selected with boundary levels. As a result of these boundary levels, it is possible that some indicative verbs are missed because some verbs were sparsely mentioned. The accuracy of the instrument could be improved by adding more verbs that are indicative for a certain cognitive thinking step. Secondly, some verbs and key terms were added because some verbs were frequently used in the assignments. This benefits the alignment with the practical field. The construct validity of the instrument can be increased by investigating if the verbs are really requiring the categorized fundamental skill. This can be studied through the answer models of each learning method. With the analysis of the answer models, it is possible to see if the assignments really request the use of the fundamental skills required for critical thinking. With the evaluation of the answer models it is not possible to see if the children use their fundamental skills, but it can be confirmed that the assignment really request the fundamental skills. Another way in which it is possible to investigate if children really use the fundamental skills that are essential for critical thinking is through an interview method with a thinking aloud protocol. This requires children to say aloud what their brain is processing while making assignments that require the fundamental skills. Afterwards the interview will be analysed if the children also use their own fundamental skills during these assignments.

At last, the context was added to the instrument in order to improve the alignment with the indicative cognitive thinking step. With the addition of the context, there is a possibility of bias. Every examiner could see the context in another manner. This is minimized by the use of a flowchart.

Nonetheless, it is highly recommended to train the examiners before the use of the instrument. With training, examiners not only have the knowledge of each cognitive thinking step required for critical thinking but they also know how to interpret the context objectively. This will minimalize the bias and will improve the reliability. The reliability of the instrument was investigated using the Cohen method. Currently, the Cohen's kappa of the instrument was 0.607. This is on the edge of reasonable and sufficient.

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Appendices

Appendix A: All English verbs mentioned in the different lists

Anderson (Anderson et al., 2001)
Revised blooms taxonomy action verbs (Azusa Pacific University, 2017)
Max Vibrant (Kumar, 2016)
Questions provoking critical thinking (Brown Education, 2017).
Bloom's taxonomy - action verbs requiring cognitive outcomes (Reagan, 2008)
Bloom's taxonomy verb list (Madison Area Technical College, 2017)
Action Words for Bloom's taxonomy (Center for University Teaching, Learning and Assessment, 2017)
Bloom's taxonomy action verbs (Huitt, 2011)

	Knowledge	Understanding	Application	Analysis	Evaluation	Creation	Metacognition
Verbs	(avoid the	abstracting	acquire	advertise	agree	abstract	
	word	add	act	analyse	appraise	adapt	
	understand)	approximate	adapt	analyse	appraise	adapt	
	arrange	articulate	administer	analyse	appraise	animate	
	arranges	ask	allocate	analyse	appraise	anticipate	
	choose	associate	alphabetize	analyse	appraise	arrange	
	cite	associate	applies	analyses,	appraises	arrange	
	copy	categorizing	apply	apply	argue	arrange	
	define	characterize	apply	appraise	argue	arrange	
	define	cite	apply	appraise	assess	assemble	
	define	clarify	apply	appraise	assess	assemble	
	define	clarifying	apply	assume	assess	assemble	
	define	classify	apply	audit	assess	assemble	
	defines	classify	apply change	blueprint	assess	budget	
	delineate	classify	articulate	breadboard	assess	build	
	describe	classify	ascertain	break down	award	categorize	
	describe	compare	assign	break down	attach	categorize	
	describe	compare	attain	break down	check	categorizes	
	describe	compare	avoid	calculate	choose	change	
	describes	comprehends	back up	calculate	choose	choose	
	discover	compute	build	categorize	choose	choose	
	draw	concluding	calculate	categorize	choose	choose	
	duplicate	constructing	calculate	categorize	compare	code	
	duplicate	models	capture	categorize	compare	collaborate	
	enumerate	contrast	carry out	change	compare	collect	
	enumerate	contrast	carrying out	characterize	compare	collect	
	examine	contrast	change	choose	compare	collect	
	find	contrasting	change	classify	compares	combine	
	how	convert	changes	classify	conclude	combine	
	identifies	convert	chart	classify	conclude	combine	
	identify	convert	choose	classify	conclude	combine	
	identify	converts	choose	coherence	conclude	combines	
	identify	defend	choose	compare	conclude	compile	
	identify	defend	classify	compare	concludes	compile	
	identifying	defends	collect	compare	consider	compile	
	index	demonstrate	complete	compare	contrast	compiles	
	indicate	demonstrate	complete	compare	contrast	comply	
	knows	describe	compute	compares	contrasts	compose	
	label	describe	compute	compute	convince	compose	
	label	describe	compute	conclude	coordinating	compose	
	label	describe	computes	conclusion	counsel	compose	
	label	describe	construct	confirm	criteria	compose	
					criticize	composes	

label	describe	construct	connect	criticize	construct
labels	detail	construct	contrast	criticize	construct
list	differentiate	construct	contrast	criticizes	construct
list	differentiate	constructs	contrast	critique	construct
list	discover	customize	contrast	critique	construct
list	discuss	demonstrate	contrast	critique	construct
list	discuss	demonstrate	contrasts	critique	constructing
list	discuss	demonstrate	correlate	critique	cope
listen	discuss	demonstrate	correlate	critiques	correspond
lists	distinguish	demonstrate	critique	debate	create
locate	distinguish	demonstrates	criticize	decide	create
match	distinguish	depreciate	criticize	decide	create
match	distinguishes	derive	debate	deduct	create
match	elaborate	determine	deconstruct	defend	create
match	estimate	determine	deconstructing	defend	create
match	estimate	develop	deconstructs	defend	create
matches	estimate	develop	deduce	defend	creates
meet	estimate	diminish	demonstrate	defends	cultivate
memorize	estimates	discover	detect	describe	debug
memorize	example	discover	devise	describes	delete
name	explain	discover	diagnose	detecting	depict
name	explain	discovers	diagram	determine	design
name	explain	diagram	diagram	determine	design
name	explain	dramatize	diagram	discriminate	design
name	explain	dramatize	diagrams	discriminate	design
name	explain	dramatize	draw	discriminate	design
names	explain	draw	differentiate	discriminates	design
observe	explains	employ	differentiate	disprove	design
omit	express	employ	differentiate	distinguish	designing
omit	express	employ	differentiates	editorialize	designs
order	express	establish	discriminates	estimate	develop
outline	express	examine	discover	estimate	develop
outline	extend	examine	discover	estimate	develop
outline	extend	exercise	discriminate	estimate	develop
outlines	extend	experiment	discriminate	evaluate	develop
point	extend	experiment	discriminating	evaluate	devise
quote	extends	with	dissect	evaluate	devise
quote	extrapolate	explain	dissect	evaluate	devise
read	extrapolating	explore	dissect	evaluate	devises
read	factor	expose	distinguish	evaluates	dictate
recall	generalize	express	distinguish	explain	discuss
recall	generalize	factor	distinguish	explain	elaborate
recall	generalize	figure	distinguish	explain	enhance
recall	generalized	graph	distinguishes	explain	estimate
recall	generalizes	handle	distinguishing	explains	explain
recalls	generalizing	hypothesize	divide	estimate	explain
recite	give	identify	divide	find errors	explains
recite	give example(s)	illustrate	document	grade	express
recognize	give examples	illustrate	dramatize	grade	facilitate
recognize	gives an	illustrate	employ	hire	facilitate
recognize	example	implement	ensure	importance	format
recognize	group	interconvert	estimate	influence	formulate
recognizes	identify	interpret	evaluate	interpret	formulate
record	identify	interpret	examine	interpret	formulate
record	identify	interpret	examine	interpret	formulate
record	illustrate	interpret	examine	interprets	formulate
relate	illustrate	interview	experiment	judge	generalize
relate	illustrate	interview	experiment	judge	generalize
relate	illustrating	investigate	explain	judge	generate
repeat	indicate	judge	explore	judge	generates

repeat	indicate	list	figure out	judge	handle
repeat	infer	make use of	file	judge	happen
repeat	infer	manipulate	finding	judging	hypothesize
reproduce	infer	manipulate	focus	justify	hypothesize
reproduce	infer locate	manipulate	focusing	justifies	hypothesizing
reproduce	infers	manipulates	function	justify	imagine
reproduces	instantiating	model	group	justify	imagine
retell	interact	modify	identifies	justify	import
retrieve	interpolate	modify	identify	justify	improve
retrieving	interpolating	modifies	illustrate	justify	improve
review	interpret	modify	illustrate	mark	incorporate
select	interpret	operate	illustrate	measure	infer
select	interpret	operate	illustrate	measure	integrate
select	interprets	operate	illustrates	measure	integrate
select	judge	operate	infer	measure	interface
selects	locate	operates	infer	monitoring	intervene
show	mapping	organize	inference	opinion	invent
specify	matching	paint	infers	order	invent
spell	observe	personalize	inspect	perceive	invent
state	observe	plan	inspect	persuade	join
state	order	plot	integrating	predict	justify
state	outline	practice	interpret	predict	lecture
state	paraphrases	practice	interrupt	predict	make
states	paraphrasing	practice	inventory	prescribe	make up
study	paraphrase	practice	inventory	prioritize	manage
tabulate	paraphrase	predict	investigate	prove	manage
tabulate	paraphrase	predict	lay out	rank	maximize
tell	paraphrase	predict	list	rank	minimize
tell	picture	predicts	manage	rate	model
trace	graphically	prepare	manipulate	rate	modifies
underline	predict	prepare	maximize	rate	modify
visualize	predict	prepare	minimize	rate	modify
what	predict	prepares	modify	rate	modify
when	predict	price	motive	recommend	negotiate
where	predicting	process	operate	recommend	network
which	predicts	produce	optimize	recommend	organize
who	recognize	produce	order	recommend	organize
why	recognize	produce	order	reframe	organize
write	relate	produces	organize	relate	organizes
	relate	project	organize	relates	original
	rephrase	protect	outline	release	originate
	report	provide	outline	revise	originate
	report	record	outlines	rule on	outline
	represent	relate	outlining	score	overhaul
	representing	relate	parsing	score	plan
	research	relates	plan	select	plan
	restate	report	point out	select	plan
	restate	round off	point out	select	plan
	review	schedule	practice	select	plan
	review	schedule	predict	summarize	plan
	review	schedule	prepare	summarize	plans
	review	select	prioritize	summarize	predict
	rewrite	sequence	prioritize	summarizes	predict
	rewrite	show	produce	support	prepare
	rewrite	show	proofread	support	prepare
	rewrites	show	query	support	prepare
	select	show	question	supports	prepare
	select	show	question	support	prescribe
	show	show	relate	test	produce
	show	shows	relate	test	produce
				testing	

subsuming	simulate	relate	validate	produce
subtract	sketch	relates	value	program
summarize	sketch	relationships	value	propose
summarize	sketch	schedule	value	propose
summarize	sketch	select	verify	propose
summarize	sketch	select	weigh	portray
summarize	solve	selecting		rearrange
summarize	solve	selects		rearrange
summarizes	solve	separate		rearrange
tell	solve	separate		rearranges
trace	solve	separate		reconstruct
transform	solve	separates		reconstruct
translate	solve	show		reconstructs
translate	solves	simplify		refer
translate	stimulate	size up		relate
translate	subscribe	sketch		relate
translates	tabulate	solve		relates
translating	teach	solve		reorganize
visualize	transcribe	structuring		reorganize
	transfer	subdivide		reorganize
	translate	subdivide		reorganizes
	translate	survey		report
	use	survey		revise
	use	take part in		revise
	use	test		revise
	use	test		revises
	use	test for		rewrite
	use compute	theme		rewrite
	uses	train transform		rewrite set up
	using	use		rewrites
	utilize	write		role-play
	write			schematize
	write			setup
				simulate
				solution
				solve
				solve
				specify
				speculate
				structure
				substitute
				summarize
				summarize
				summarizes
				support
				suppose
				synthesize
				tell
				tells
				test
				test
				theory
				validate
				write
				write
				write
				writes

Appendix B: The amount of times that the English verbs are mentioned in the different lists

Knowledge   Application   Evaluation
Understanding   Analysis   Creation

7x genoemd	6x genoemd	5x genoemd	4x genoemd
Compare *	Analyse	Assess	Arrange
Construct *	Apply	Combine	assemble
Design	Appraise	Construct *	Categorize
Explain *	Compare *	Critique *	Choose
Judge	Compose	Defend	Classify *
List	Conclude	Describe *	Classify *
Name	Contrast *	Estimate *	compile
Plan	Create	Explain *	Compute
Solve	Define	Extend	Contrast *
Use	Demonstrate	Formulate	Convert
	Describe *	Infer *	Criticize *
	Distinguish *	Justify	develop
	Evaluate	Operate	devise
	Generalize	Rate	Diagram
	Identify	Recognize	Differentiate
	Label	Select *	Discover
	Match	State	Discriminate *
	Paraphrase	Support	Discriminate *
	Predict *		Discuss
	Recall		Distinguish *
	Shows		Employ
	Summarize *		Estimate *
	Translate		Express
			Give example
			Illustrate *
			Illustrate *
			Infer *
			Interpret *
			Interpret *
			Interpret*
			Manipulate
			Measure
			Modify *
			Modify *
			organize
			Outline *
			Outline *
			Practice
			Predict *
			Prepare *
			Prepare *
			Produce
			Rearrange
			Recommend
			Relate *
			Relate *
			Reorganize
			Repeat
			Reproduce
			Review
			revise
			Rewrite *

Rewrite *
Select *
Select *
Separate
Sketch
Summarize *
write

Appendix C: Similarity in English words and categories

Verb	Category
Classify	Understanding, Analysis
Compare	Analysis, Evaluation
Construct	Application, Creation
Contrast	Understanding, Analysis
Critique / Criticize	Evaluation (taken together)
Describe	Knowledge, Understanding
Discriminate	Analysis, Evaluation
Distinguish	Understanding, Analysis
Estimate	Understanding, Evaluation
Explain	Understanding, Evaluation
Illustrate	Understanding, Analysis
Infer	Understanding, Analysis
Interpret	Understanding, Application
Modify	Application, Creation
Outline	Knowledge, Analysis
Predict	Understanding, Application
Prepare	Application, Creation
Relate	Application, Analysis
rewrite	Understanding, Creation
Select	Analysis, Evaluation
Summarize	Understanding, Evaluation

Appendix D: All Dutch verbs mentioned in the different lists

Hannekemli bloom gereviseerde taxonomie (Hannekemli, 2017)
Leerdoelen formuleren (BKO Reader Leerdoelen Formuleren, 2017)
Werkwoorden bij beheersingsniveau Bloom (Horst & Martens, 2017; Universiteit van Twente, 2017)
Eindtermen formuleren (Leermiddelen VO, 2017)
SLO talent stimuleren (SLO informatiepunt, 2017)

	Knowledge (Kennis)	Under-standing (Inzicht)	Application (Toepassen)	Analysis (Analyseren)	Evaluation (evalueren)	Creation (Creëren)	Meta-cognition (Meta-cognitie)
Verbs	aanwijzen	aanduiden	aandeel leveren	afkeuren	aanbevelen	aanpassen	
	benoemen	aanduiden	aangeven	afleiden	adviseren	aanpassen	
	benoemen	aangeven	van grenzen	afleiden	adviseren	afkeuren	
	benoemen	aantonen	aanpassen	afleiden	argumenteren	afleiden	
	beschrijven	aanvullen	aantonen		assessen	afleiden uit	
	beschrijven	aanwijzen	beheersen	afwegingen maken	associëren	afwegingen maken	
	beschrijven	beargumenteren	beoordelen	alternatieven voorleggen	beargumenteren	alternatieven voorleggen	
	bestempelen	begrip opbrengen	(door kennis en inzicht toe te passen)	analyseer	becommentariëren	argumenteren	
	classificeren	voor	bepalen	analyseren	bekritiseren	becommentariëren	
	classificeren	beredeneren	bereken	analyseren	beoordelen	bedenken	
	definiëren		berekenen	analyseren	beoordelen	belangen	
	herkennen	beschrijven	berekenen	argumenteren	beoordelen	afwegen	
	herkennen	beschrijven	berekenen	becommentariëren	beschouwen	bouwen	
	herkennen	bespreken	berekenen	belangen	beslissen	combineren	
	hoe	bewijzen	beschrijven	afwegen	commentaar geven	combineren	
	identificeren	categoriseren	beschrijven	beproeven	commentaar geven	concluderen	
	identificeren	conclusies trekken	bewaken	categoriseren	concluderen	concluderen	
	identificeren	contrasteren	bewaken	categoriseren	discussiëren	conclusies trekken	
	imiteren (?)		bijdragen	classificeren	doorlichten	construeren	
	in volgorde	demonstreren	classificeren	classificeren	evalueren	construeren	
	in volgorde plaatsen		construeren, maken	concluderen	evalueren	construeren	
	inventariseren	discussiëren	Contrasteren	conclusies trekken	evalueren	controleren	
	lokaliseren		definiëren	construeer	evalueren	creëren	
	lokaliseren,	duiden	demonstreer	construeren	evalueren	discussiëren	
	nadoen (?)	exploreren	demonstreren	controleren	geef een aanbeveling	formuleren	
	navertellen	formuleer	demonstreren	deconstrueer	geef een cijfer	formuleren	
	navertellen	conclusies, formuleren	demonstreren	destilleren	herkennen	formuleren	
	noemen	formuleren	een overzicht	differentiëren	inschatten	fouten	
	noemen	formuleren	geven	discrimineren	interpreteren	opsporen	
	noemen	herkennen	experimenteren	discussiëren	keuzes	generaliseren	
	omschrijven (schetsen)	herkennen	gebruiken	fouten	maken	herformuleren	
	onderkennen	herschrijven	gebruiken	opsporen	kritisch doorlichten	herschrijven	
	onderkennen	illustreren	gebruiken	herformuleren	meet	hypothetiseren	
	onderkennen	illustreren	generaliseren	hypothese formuleren	mening geven	initiëren	
	onderzoek	illustreren	hanteren	interpreteren	onderbouwd beoordelen	innoveren	
	opnoemen	in verband brengen met	hanteren	leiding geven	onderbouwde visie geven	leiding geven	
	opsommen		hanteren	modelleren		maken	
	opsommen	interpreteren		motiveren		maken	
	opsommen			onderhandelen		managen	
	plaatsen			onderscheiden		modelleren	
	registreren			onderzoeken		motiveren	
	reproduceren					onderhandelen	
	reproduceren						

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reproduceren	interpreteren	hiaten e.d. behandelen	onderzoeken /research	onderbouwen	onderzoek
rubriceren	interpreteren	illustreer	ontwerpen	onderscheid maken	ontwerpen
rubriceren	karakteriseren	kiezen	opbouwen	ondersteunen	ontwerpen
selecteren	kennen	kiezen	opsporen	ondersteunen	ontwerpen
selecteren	kenschetsen	kiezen	ordenen	oordelen	ontwerpen, opstellen
tekenen	leg verbanden	kunnen	ordenen	ordenen	ontwikkelen
tonen	maak een inschatting	raadplegen	organiseren	overtuigen	ontwikkelen
uit elkaar halen	met eigen woorden	onderzoeken	overleggen	overwegen	opbouwen
uit elkaar houden	vertellen	ontdekken	overzien	redeneren	oplossen
verzamelen	namaken (?)	ontwikkelen	patronen herkennen	samenvatten	opstellen
voordragen	nuanceren	oplossen	prioriteiten stellen	samenvatten	opzetten
waar	observeren	oplossen	prioriteren	selecteren	ordenen
wanneer	omschrijven (schetsen)	oplossen	problemen oplossen	taxeren	organiseren
wat	omzetten	opstellen	rangschikken	toets	organiseren
weergeven	onderscheiden	opstellen	relateren	toetsen	overleggen
weergeven	onderscheiden	organiseren	relatie / verbanden leggen	uitleggen	plan
weergeven	onderscheiden	plannen	samenstellen	verdedigen	plannen
weergeven	opdracht geven	praktiseren	samenvatten	verdedigen	prioriteiten stellen
welk	opdracht geven	presenteren	scheiden	vergelijken	problemen oplossen
wie	opzoeken	procedure kiezen en volgen	selecteren	vergelijken	produceren
	ordenen	rapporteren	signaleren	vergelijken	rangschikken
	parafraseren	rapporteren	sorteren	verifiëren	reconstrueren
	relateren	relateren	structureren	voorspel	relateren
	samenvatten	schatten	ter discussie stellen	waarderen	samenstellen
	samenvatten	schetsen	testen	wegen	samenstellen
	samenvatten	schiften	tot stand brengen	zelfstandig optreden.	samenstellen
	schema's maken, schematiseren	tegenover elkaar stellen	uitleggen		samenstellen
	schetsen	toepassen	uitvoeren		samenstellen
	selecteren	toepassen	verband/relatie leggen		samenvatten
	signaleren	toepassen	verbinden		tot stand brengen
	tekenen	tonen	vergelijken		uitstippelen
	toelichten	uitleggen	vergelijken		uitvinden
	toelichten	uitleggen	vergelijken		uitvoeren
	typeren	uitleggen	vergelijken		vernieuwen
	uitdrukken	uitvoeren	verklaren		verzamelen
	uitdrukken	uitzoeken	voorspelling doen (voorspellen)		voorspellen
	uitleggen	vaardig gebruiken			voorstellen
	uitleggen	vaststellen			voortvloeien
		veranderen			wat als?
		verduidelijken			
		vergelijken			
		verrichten			
		verslag doen			
		verslag maken			
		verwerken			
		voorspellen			
		voorstel doen			
		vormgeven			
		vormgeven			
		vragen formuleren			
		vul aan			

uitleggen (in eigen woorden)	weergeven
	weergeven
vaststellen	
verdedigen	
vergelijken	
verkennen	
verklaren	
vertalen	
vertalen	
vertegenwoordigen	
vervangen	
verwoorden / onder woorden brengen	
verzamelen	
voorbeelden	
voorbereiden	
voorspel	
voorspellen	
weergeven	
werk uit voor een andere context	
werk uit voor verschillende doelgroepen	

Appendix E: The amount of times that the Dutch verbs are mentioned in the different lists

Knowledge
Understanding

Application
Analyse

Evaluation
Creation

5x genoemd	4x genoemd	3x genoemd	2x genoemd
berekenen	Analyseren	Afleiden *	Aanduiden
ontwerpen	Beschrijven *	Beargumenteren/bekritiseren/	Aanpassen
samenstellen	Categoriseren/classificeren *	becommentariëren *	Adviseren
	Demonstreren	Benoemen	Afleiden (uit) *
	Evalueren	Beoordelen	Argumenteren/becommentariëren *
	Formuleren *	Concluderen *	
	Herkennen *	Construeren *	Beschrijven *
	Vergelijken	Formuleren *	Beschrijven *
	Weergeven	Gebruiken	Bewaken
		Hanteren	Classificeren *
		Identificeren	Combineren
		Illustreren	Commentaar geven
		Interpreteren	Concluderen *
		Kiezen	Construeren *
		Noemen	Herformuleren/herschrijven *
		onderbouwen	Herkennen *
		Onderkennen	In volgorde plaatsen
		Onderscheiden	Lokaliseren
		Oplossen	Maken
		Opsommen	Navertellen
		Reproduceren	Ondersteunen
		Samenvatten *	Onderzoeken *
		Uitleggen *	Onderzoeken *
		Uitleggen *	Ontwikkelen
			Opdracht geven
			Opstellen
			Ordenen
			Organiseren
			plannen
			Prioriteiten stellen/prioriteren
			Rapporteren
			Relaties/verbanden leggen / relateren
			Rubriceren
			Samenvatten *
			Selecteren
			Toelichten
			Toepassen
			Toetsen
			Uit elkaar halen
			Uitdrukken
			Verdedigen
			Vergelijken
			Verslag doen
			Vertalen
			Vormgeven
			Weergeven

***Appendix F**: Similarity in Dutch words and categories

Verb	Category
Afleiden	Analysis, Creation
Beargumenteren/bekritiseren/becommentariëren	Evaluation Creation
Beschrijven	Knowledge, Understanding
Categoriseren/ Classificeren	Knowledge, Analysis
Concluderen	Analysis, Creation
Construeren	Analysis, Creation
Formuleren	Understanding, Creation
Herkennen	Knowledge, Understanding
Onderzoeken	Application, Analysis
Samenvatten	Understanding, Evaluation
Uitleggen	Understanding, Application

Appendix G: All indicative verbs together (Dutch and translated English verbs)

Knowledge	Understanding	Application	Analysis	Evaluation	Creation
Bekeren/ omzetten/ veranderen beschrijven	Beschrijven	Aantonen/ bewijzen	Analyseren	Aanbevelen	bedenken/beramen
Bestempelen als/ beschrijven als	Bespreken/ discussiëren	Berekenen	Categoriseren	Achten/ schatten/ waarderen	bijeenbrengen
Contrasteren	Classificeren	Bewerken/ teweegbrengen	Classificeren	Beoordelen	combineren
Definiëren/ beschrijven	Generaliseren	Construeren	Contrasteren	Bespreken/ beoordelen	Construeren
Herhalen	Gevolg trekken, betekenen	Demonstreren	Diagram/ figuur	Concluderen/ besluiten	creëren
Herkennen	herschrijven	Gebruiken	Gevolg trekken/ betekenen	Evalueren	formuleren
Identificeren	Illustreren	Gebruiken/ aanvaarden	Illustreren	Interpreteren/ verklaren/ uitleggen/ vertolken	herschikken
Koppelen	Interpreteren/ verklaren/ uitleggen/ vertolken	Interpreteren/ verklaren/ uitleggen/ vertolken	Onderscheiden	Kiezen	herschrijven
Lijst opmaken van	Onderscheiden	Manipuleren/ behandelen/ hanteren	Onderscheiden/ herkennen	Kritiek	herzien/ nazien
Noemen (be) reproduceren	Opnieuw bekijken/ inspecteren	Oefenen	Schetsen/ in grote lijnen/ aangeven	Meten	ontwikkelen
Schetsen/ in grote lijnen/ aangeven	Parafraseren	Oplossen	Selecteren	Onderscheiden/ herkennen	ontwikkelen
Selecteren	Samenvatten	Produceren/ opleveren/ opbrengen	Sorteren/ afzonderen	Rechtvaardigen/ verdedigen samenvatten	organiseren
Verklaren/ beweren/ uiteenzetten	Schatten (in)	schetsen	Verbanden leggen	Schatten	plannen
Voor de geest halen	Uitbreiden	Toepassen	Vergelijken	Schatten (in)	reorganiseren
	Uitdrukken	Verbanden leggen		Selecteren	samenstellen
	Uitleggen	Voorbereiden		Steunen (onder)	schikken (rang)
	Vertalen	Voorspellen		Uitleggen	schrijven
	Voorbeeld geven	Wijzigen		Vaststellen/beoordelen	verzamelen/ monteren
	Voorspellen			Verdedigen	voorbereiden
				Vergelijken	wijzigen

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Appendix H: Final list of verbs

K = Knowledge = Remembering
U = Understanding
Ap = Application
An = Analysis
E = Evaluation
C = Creating / Inference / Synthesis
M = Metacognition

Aanbevelen (E)
Aanduiden (U)
Aanpassen (C)
Aanvaarden (Ap)
Achten (E)
Afleiden (uit) (An) (C)
Afzonderen (An)
Analyseren (An)
(be)Argumenteren (E) (C) → Uitleggen (Verschil in criteria, argumenten geven.
                                                Uitleggen hoeft niet per se met argumenten te zijn.)
Becommentariëren (E) (C)
Bedenken (C)
Behandelen (Ap)
Bekeren (U)
Bekijken (An) →in de vorm van kijken (enkel kijken is wegvallen actie verb), in de vorm van
                        onderzoeken, analyseren
Bekritiseren (E)
Benoemen (K) noemen (be) (K)
Beoordelen (E)
Beramen (C)
Berekenen (Ap) rekenen (be) (Ap)
Beschrijven (als) (K) (U) (Ap)
Besluiten (E)
Bespreken (U) (E)
Bestempelen als (K)
Betekenen (U) (An)
Betrouwbaarheid (E)
Bewaken (Ap)
Beweren (K)
Bewerken (Ap)
Bewijzen (Ap)
Bijeenbrengen (C)
Bijhoren (K)
Bruikbaarheid (An) (E)
Categoriseren (K) (U) (An)
Classificeren (K) (U) (An)
Combineren (C)
Commentaar geven (E)
Concluderen (An) (E) (C)
Consistentie (An) (E)
Construeren (Ap) (An) (C)
Contrasteren (U) (An)
Controleren (M)   → zie ook nakijken en monitoren.
Creëren (C)
Definiëren (K)
Demonstreren (Ap)
Discussiëren (K) (U) (E) (C)

Doen (Ap)
Evalueren (E)
Figuur/ diagram (An)
Formuleren (U) (C)
Gebruiken (Ap)
Generaliseren (U)
Gevolg trekken (U) (An) (C)
Hanteren (Ap)
Herformuleren (C)
Herhalen (K)
Herkennen (K) (U) (An) (E) → Enkel herkennen van kennis is (U)
Herschikken (C)
Herschrijven (U) (C)
Herzien (C)
Hoe (K) (U) → zie ook verklaren
Identificeren (K) → Zie herkennen
Illustreren (U) (An)
In grote lijnen aangeven (K) (E)
In volgorde plaatsen (K)
Inschatten (U)
Inspecteren (U)
Interpreteren (U) (Ap) (E)
Kennen (K)
Kiezen (Ap) (E)
Koppelen (K)
Kritiek (E)
Lijst opmaken van (K)
Lokaliseren (K)
Logica (An) (E)
Maken (C)
Manipuleren (Ap)
Mening van de auteur (An) (E)
Meten (E)
Monitoren (M)   → zie ook controleren
Monteren (C)
Nakijken (E) (M)   → zie ook controleren
Navertellen (K)
Nazien (C)
Oefenen (Ap)
Omwerken (U) (C)
Omzetten (U)
Onderbouwen (U) (E)
Onderkennen (K)
Onderscheiden (U) (An) (E)
Ondersteunen, steunen (E)
Onderzoeken (Ap) (An)
Ontdekken (Ap)
Ontwerpen (C)
Ontwikkelen (C)
Opbrengen (Ap)
Opdracht geven (U)
Opleggen op (Ap)
Opleveren (Ap) (C)
Oplossen (Ap) (C)
Opnieuw bekijken (U) (C)
Opsommen (K)
Opstellen (Ap)
Ordenen (An)
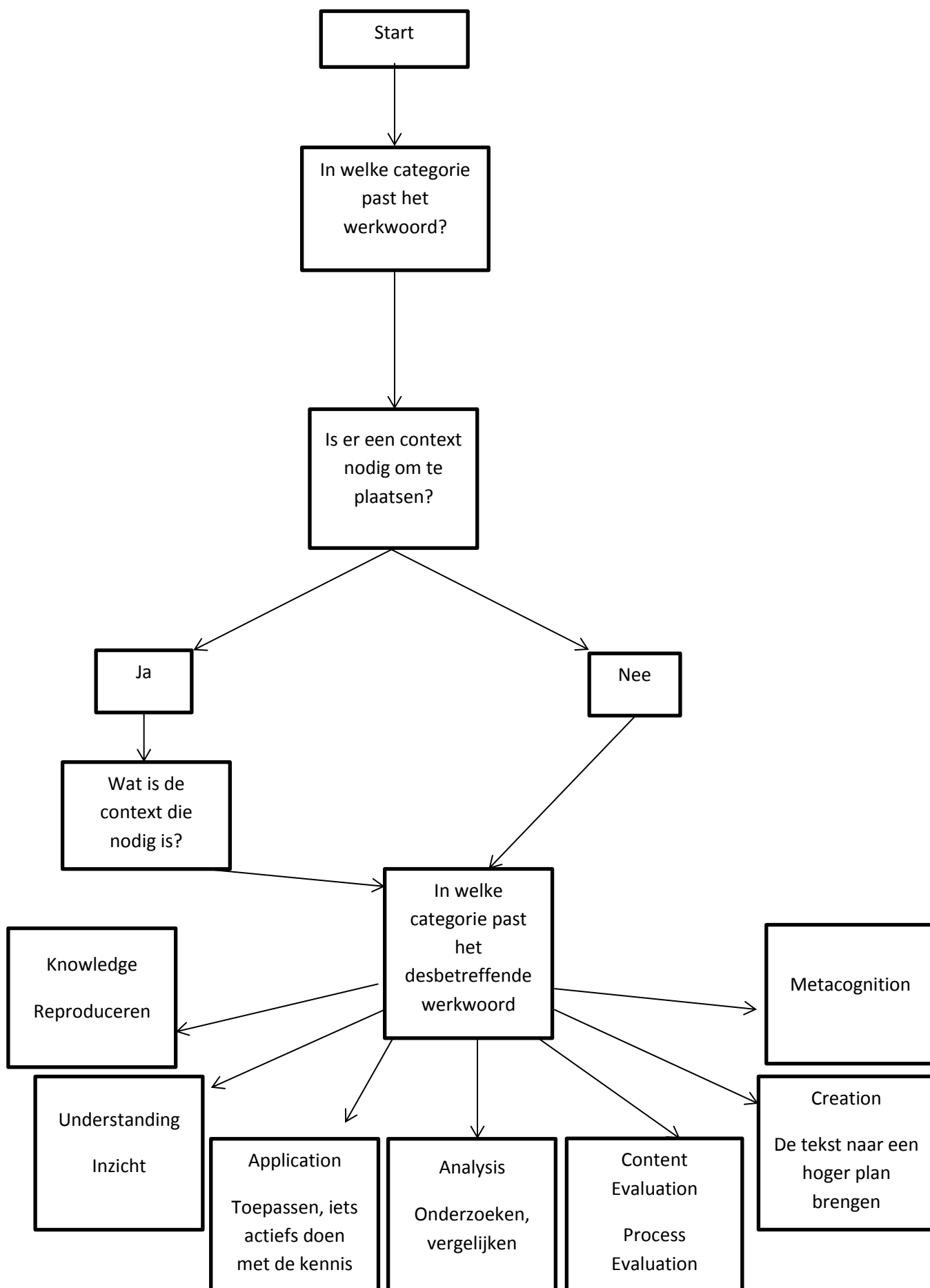Organiseren (C) (M)
Parafraseren (U)

Plannen (C) (M)
Prioriteiten stellen (An) (M)
Produceren (Ap)
Rapporteren (Ap)
Rechtvaardigen (E)
Reflecteren (M)   → wat denk jij? Waardeoordeel, (E), reflectie op eigen denkproces (M)
Relateren (An)
Relaties tonen (An)
Relevantie (An) (E)
Reorganiseren (C)
Reproduceren (K)
Rubriceren (K)
Samenstellen
Samenvatten (U) (E)
Schatten (in) (An) (E)
Schetsen (K) (Ap) (E)
Schikken (rang) (C)
Schrijven (C)
Selecteren (K) (An) (E)
Sorteren (An)
Structuur (An) (E)
Terugkijken op (M)
Terugroepen (K)
Teweegbrengen (Ap)
Toelichten (U)
Toepassen (Ap)
Toetsen (E)
Tonen (aan) (Ap)
Uit elkaar halen (K)
Uitbreiden (U)
Uitdrukken (U)
Uiteenzetten (K)
Uitleggen (U) (Ap) (E) → Zie ook beargumenteren
Vaststellen (E)
Veranderen (U) (C) → Zie ook Aanpassen
Verband leggen (Ap) (An)
Verdedigen (E)
Vergelijken (An) (E)
Verklaren (K) (U) → Zie ook uitleggen
Verslag doen (Ap)
Vertalen (U)
Vertellen (Ap) (An)
Verzamelen (An) (C)
Voor de geest halen (K)
Voorbeeld geven (U)
Voorbereiden (Ap) (C)
Voorspellen (U) (Ap) (C)
Vormgeven (Ap)
Waarderen (E)
Waarom (U) → Uitleggen, verklaren
Wat (K) (U)
Wat vind jij (U) (E) → Is er sprake van criteria of niet (U = zonder of E = met)
Weergeven (K) (Ap)
Welke (K) (U)
Weten (K)
Wijzigen (Ap) (C)

Appendix I: Illustration of the fundamental skills with their indicative verbs and an example of an assignment.

Fundamental skill	Definition	Operationalised	Indicatieve werkwoorden	Voorbeelden
Interpretation	De vaardigheid om een eigen begrip te vormen van wat er met de gegeven informatie wordt bedoeld en betekend (Anderson et al., 2001; Bloom et al., 1956; Facione, 1990).	Knowledge Understanding Application	Betekenen / Definiëren(K)	Wat betekent het woord 'expat'? (Argus Clou, 4.4.4a)
			Voorbeeld geven (U)	Hoe verover je de wereld met jouw product, denk je? Denk terug aan de ontwikkelingskansen in het spe Markt veroveren. Wanneer is een bedrijf succesvol in de wereld? En welke risico's loopt een bedrijf? Geef bij elke 'bouwsteen' een voorbeeld. (Grenzeloos 4.3.3)
			Bijhoren (K)	Wat hoort bij de cultuur van een volk? Kruis de goede antwoorden aan. (Meander 5.1.4)
Analysis	De vaardigheid om informatie te ontleden in kleine stukjes om deze te onderzoeken op betekenis, structuur, relaties in deze informatie en tussen de kleine stukjes van informatie. (Anderson et al., 2001; Bloom et al., 1956; Facione, 1990)	Analysis	Bekijken (An)	Bekijk de klimaatgrafieken op de kijkplaat. Van welke klimaten staat er geen klimaatgrafiek op de kijkplaat? (Argus Clou 1.5.3a)
			Vergelijk (An)	Door verwering raken stukken rots van de berg los en rollen naar beneden. Als ze op de weg vallen is dat levensgevaarlijk. Er zijn verschillende plannen om te voorkomen dat rotsblokken niet op de weg terechtkomen. Wat zou het beste plan zijn? Vergelijk de plannen met elkaar. (Meander, 1.2.7)
			Het werkwoord wat wordt gebruikt is schrijf. Echter gaat het dan enkel om het antwoord op te schrijven. De opdracht vraagt om het analyseren van meerdere bronnen om tot de informatie te komen.	Wat voor weer kan Laura verwachten? Schrijf de weersverwachting in de tabel op pagina 2. Schijf op in welke maand Laura er is. Vul dan de temperatuur, hoeveelheid zon en hoeveelheid regen in. Gebruik hiervoor de bronnenboekpagina's 20 tot en met 25. (Grenzeloos, 2.2.3)
Evaluation	De vaardigheid om informatie te waarderen op de gevonden en geanalyseerde criteria. Het gaat om het beoordelen van informatie gebaseerd op criteria en bepaalde standaarden. (Anderson et al., 2001)	Content evaluation	Argument → Beargumenteer (E)	De Europese landen bedachten dat samenwerking een manier was om oorlog te voorkomen. Werkt die oplossing ook bij ruzie op school, denk je? Omcirkel je antwoord en geef ten minste één argument voor je mening. (Argus Clou, 5.1.2b)
			Bespreken (E)	Bespreek jullie kaart en de conclusies met de klas. Kijk of de resultaten vergelijkbaar zijn. Van welke landen weten jullie ouders het minste. (Meander, 2, Uitdaging, 6)
			Uitleggen(E)	Geef de grens een cijfer. Beoordeel de grens van jouw EU land. Gebruik de antwoorden die je bij vraag 3 en 4 hebt gegeven en het bronnenboek […]. Leg ook uit waarom je het cijfer geeft. (Grenzeloos, 3.2.5a)

Creation	De vaardigheid om informatie te combineren, de relaties aan elkaar te verbinden. Op deze manier wordt de informatie naar een hoger niveau gebracht zodat er conclusies kunnen worden gemaakt en de informatie wordt gebruikt om iets nieuws te creëren. (Anderson et al., 2001; Bloom et al., 1956; Facione, 1990; 2015).	Creation	Schrijf (C), Bedenk (C)	Schrijf in het script precies op wat door wie wordt gezegd. Bedenk eerst een inleiding waarin je verteld waar de uitzending over gaat, en wie er te gast is. [..] Bedenk daarna de vragen die je wilt stellen aan de bomenplakker. Schrijf alles uit en ook de antwoorden van de bomenplakker. Gebruik hierbij je aantekeningen. (Argus Clou, 3, zo kan het ook! les 3, opdracht: Ik doe mijn werk)
			Discussiëren (C), Voorbereiden (C)	Discussieer in je groep over de beste vakantiebestemming. Gebruik argumenten uit de informatie die je verzameld hebt. Kies jullie bestemming. Bereid dan jullie betoog voor. In het betoog proberen jullie anderen te overtuigen om ook te kiezen voor die bestemming. (Meander, 4, uitdaging, 5)
Explanation	De vaardigheid om uit te leggen en te beargumenteren waarom iemand komt tot die specifieke conclusies. (Facione, 1990).	Process Evaluation	Leg uit (E)	Waarom kan jouw dier of plant goed in de woestijn leven? Leg uit. (In de vorige opdracht moest er een dier of plant worden verzonnen dat zou kunnen leven in de woestijn). (Argus Clou, 1, 4, 6c)
			Leg uit (E)	In de winter vallen de zonnestralen veel schuiner op de aarde dan in de zomer. In de zomer schijnen de stralen bijna recht op de aarde. Leg dit uit met behulp van een proefje. Lees 'Zo doe je dat' Zoek de materialen, bedenk hoe je jouw proefje wilt uitvoeren, voer je proefje uit. Leg uit wat je doet en waarom je dat doet. (Meander, 3,2,7)
Metacognition	De vaardigheid om weloverwogen zijn eigen denken te monitoren, te controleren en te reflecteren. (Martinez, 2006)	Metacognition	Geen werkwoorden, echter is het een evaluatie over hoe het verloop van de opdracht ging. Hier is reflectie naar het eigen gemaakte werk.	Hoe ging het? Jullie hebben een plan bedacht om erosie door skiën in de Alpen te verminderen. Kruis aan wat er bij jullie werk past. Tel daarna de punten bij elkaar op. (Meander, 1, uitdaging, opdracht hoe ging het.)
			Nakijken (M)	Ik kijk mijn werk na. Omcirkel je antwoord. Staat er duidelijk in jouw stukjes: Waarom Rashida is gevlucht? Waarom zij niet meer terug kan? Denk je dat mensen die de stukjes lezen voldoende informatie krijgen over de situatie van Rashida? (Argus Clou, 4, zo kan het ook! les 3, opdracht ik doe mijn werk.).

Start

In welke categorie past het werkwoord?

Is er een context nodig om te plaatsen?

Ja

Nee

Wat is de context die nodig is?

In welke categorie past het desbetreffende werkwoord

Knowledge

Reproduceren

Understanding

Inzicht

Application

Toepassen, iets actiefs doen met de kennis

Analysis

Onderzoeken, vergelijken

Content Evaluation

Process Evaluation

Metacognition

Creation

De tekst naar een hoger plan brengen

Appendix K: Revised Flowchart (Final)