THE INFLUENCE OF AGE AND IMPLICIT THEORIES OF ABILITY ON CHILDREN'S ATTITUDES TOWARDS CURIOSITY: A SURVEY STUDY

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Abstract

This paper presents an empirical research of the possible decrease of attitudes towards curiosity of children and whether implicit beliefs could possibly influence these attitudes as well. Multiple researchers have mentioned that curiosity, though a vital skill for education, seemingly decreases when children enter primary education. However, barely any empirical research has followed up. Using the Children's Images of and Attitudes towards Curiosity (CIAC) questionnaire and the Mindset questionnaire, we empirically examined attitude towards curiosity and implicit beliefs in different age groups. A large-scale survey study was conducted in grade 4, 5 and 6 of primary schools and grade 1 and 2 from secondary schools, measuring children's attitudes towards curiosity and their implicit theories of ability. The questionnaires were first successfully validated for both primary and secondary education using two exploratory factor analyses per questionnaire, one for primary education and one for secondary education. After this, five separate ANOVA analyses (2 x 2 x 2) were conducted with the between subject factors primary versus secondary education, high or low incremental belief and high or low entity belief. The results showed that no statistical significant decline took place in children's attitudes towards curiosity between primary and secondary education with a noteworthy effect size, but that within primary and secondary education the attitudes towards curiosity subscale 'societal relevance' significantly declined with a small effect size. Furthermore, implicit beliefs are shown to hold an influence over 'personal inclination' and 'societal relevance'. Based on our results, we concluded that the value that children put in their curious behaviour can be influenced by mostly their incremental beliefs. Our results also showed that, although the effect sizes are small, children's incremental beliefs influence children's scores on the attitude towards curiosity subscales personal inclination and societal relevance.

Introduction

With the upsurge of the implementation of 21st century skills in education, one can't deny that education is changing. These skills (such as critical thinking, creative problem solving, and computational thinking) are emphasized more and more often, based on the belief that the current century will demand a different skillset from individuals to work effectively (Ananiadou & Claro, 2009). The emphasis on 21st century skills calls for a slight shift in the way subject matter is taught (Rotherham & Willingham, 2010). Teaching students to take the lead in their trajectory is expected to become more important (Anseel, 2017; Lucas, Claxton, & Spencer, 2013). For this, children need a different skillset in their education (Silva, 2009), but the teacher will need to develop different teachings skills as well. Rather than a 'sage on the stage', the teacher should become more of a 'guide to the side'. An example of this more 'guide to the side' learning is inquiry learning. When students engage in inquiry-based learning, they examine a subject themselves in order to gain a better understanding, while the teacher may provide support wherever necessary (Lazonder, 2014). Curiosity is a vital skill for inquiry-based learning and critical thinking, fueling the need for knowledge and understanding (Grossnickle, 2014; Litman, Hutchins, & Russon, 2005). However, curious behaviour seems not to be as apparent as it should be in education (Engel 2011).

Curiosity

A variety of definitions regarding curiosity have been proposed (Jirout & Klahr, 2012), but curiosity is most commonly defined in two types, 'epistemic curiosity' and 'perceptual curiosity' (Berlyne, 1954). Epistemic curiosity (EC) entails a 'drive to know' while perceptual curiosity (PC) leads to 'increased perception of stimuli'. Berlyne (1954) states that EC is stimulated when gaps of knowledge are noticed, while PC is stimulated by arousal of the senses. Loewenstein (1994) confirms this thought, stating that curiosity surfaces when a discrepancy appears between what someone knows and what one wants to know. Furthermore, EC can be linked to acquiring knowledge (Berlyne, 1966; Litman & Spielberger, 2003), motivation to learn new ideas (Berlyne, 1954; Loewenstein, 1994), and experimentation (Berlyne, 1966). Therefore, the stimulation of EC in education can be vital for intellectual achievement. According to Litman et al (2005) the purpose of this curiosity is to motivate exploration aimed at resolving discrepancies in the knowledge of an individual. This curiosity can thrive in children when it is facilitated, guided and encouraged and seems to be instilled naturally in individuals (Engel, 2011). Everyone who has spoken to a toddler has had a chance to experience their ravenous curiosity, leading them to asking an average of 76 information seeking questions per hour (Engel, 2011).

However, Engel (2011) reports that when a child enters primary school education, this seemingly natural curiosity soon dies down to an average of two questions per hour. Maw and Maw (1966) also

confirm that children seem to become less curious when growing up. Therefore, instead of thriving with all the information the student has gained access to, the curiosity of the student diminishes. Post and Walma van der Molen (2018) found that while interviewing children, they often relate curious behaviour to social circumstances like gossip or eavesdropping, rather than to school circumstances or as a driver for epistemic learning. They even found that children reacted with surprise or apprehensively when prompted to talk about school-related curiosity.

Lucas et al (2013) refer to the high-stakes state-mandated testing as a possible reason for other skills underexposed, with no room left for not commonly tested abilities. Amrein and Berliner (2002) confirm that high-stakes testing affects students, mentioning that motivation diminishes for tests without high stakes attached. Thus, students may possibly feel like they are handed everything they need to know for getting the high scores they need, with no room or need left for curious behaviour. It is also possible that teachers don't feel comfortable enough to foster curiosity (Post & Walma van der Molen, 2018; Van Aalderen-Smeets, Walma van der Molen, & Asma, 2012), because it would demand deviations from the standard, established lesson plans. However, such considerations were not tested thus far. In fact, despite the seemingly diminishing occurrences of children's curious questions, hardly any research thus far empirically tested the development or decline of children's curiosity during primary or secondary education. Therefore, one of the aims of the present study was to study children's epistemic curiosity as they progress from primary to secondary education.

Measuring curiosity behaviour can prove to be difficult however, because curiosity is a latent construct that has been defined in many ways (see Grossnickle, 2014) and is difficult to measure or observe. In addition, much curious behaviour takes place covertly in someone's mind and not necessarily overtly through the verbal expression of curious questions. Furthermore, as Post and Walma van der Molen (2018) found in their research, children reacted with surprise when prompted to mention school-related curious behaviour, mentioning that displaying curiosity to the subject matter is often found disruptive and is not experienced as something that is valued by their classmates.

Attitudes towards curiosity

Thus, to shed more light on potential prerequisites of children's curious question asking in the classroom and to further delve in the thoughts of students concerning curiosity, Post and Walma van der Molen (in press) turned to children's perceptions of and attitudes towards curiosity, rather than their actual curious behaviour. As attitudes are acquired through experiences, studies of attitudes could possibly shed light on social components and experiences contributing to these attitudes (Antonak & Livneh, 2000). Finally, according to Cross (2004), behaviour influences attitudes, while in turn, attitudes can influence behaviour as well.

Based on the Theory of Planned Behaviour (Ajzen, 2001), the idea behind turning towards attitudes in this research is also that children's perceptions of the importance of question asking for their own learning, their perceived self-efficacy, and their perceptions of the social classroom norm (e.g., their fear of classmates' negative judgments when asking curious questions) may form an important condition for their actual curious behaviour and could provide schools with tools to create a stimulating and safe classroom environment where students are able to express their curious behaviour. Furthermore, as children showed to be disturbed when asked about school-related curiosity, getting an insight in their attitudes towards curiosity could prove to be valuable information for curiosity research.

For a large-scale longitudinal study, Post and Walma van der Molen (in press) developed and validated the Children's Images of and Attitudes towards Curiosity Questionnaire (the CIAC). In the present study, the five attitude sub-scales of this survey instrument were used to measure children's attitudes towards curiosity at different ages. Table 1 provides an overview and a description of each of the five components of children's attitudes towards curiosity that were measured using these five sub-scales. These attitude components were derived from the Theory of Planned Behaviour from Ajzen (2001) in order to determine the behavioural intention to perform curious behaviour like curious question asking.

Ajzen's Theory of Planned Behaviour distinguishes between three different attitude dimensions, namely perceptions of behavioural attributes, perceptions of the social norm and self-efficacy. Together, these three dimensions should determine behavioural intention. For the CIAC questionnaire of Post and Walma van der Molen (in press) the personal inclination and societal relevance subscales were derived from the perceptions of behavioural attributes dimension, the fear of classmates' negative judgments and the negative opinion subscale were derived from the perceptions of social norm dimension, and the self-efficacy subscale was directly derived from the self-efficacy dimension of the Theory of Planned Behaviour. Post and Walma van der Molen (in press) explain that these five components may constitute important components of children's attitudes towards epistemic curiosity

Table 1. *Subscales of the CIAC used to measure children's attitudes towards curiosity* (*Post & Walma van der Molen, in press).*

Subscale	**Description**
Personal inclination	Portrays a child's perception of the value of expressing epistemic questions and ideas in class to improve one's own learning
Self-efficacy	Portrays the perceived capability to express epistemic questions or ideas when an opportunity is provided
Societal relevance	Portrays children's perception of the value of curious thinkers to society
Fear of classmates' negative judgment	Portrays children's fears of their peers' or teachers' negative judgments about being curious in class.
Negative opinion	Portrays the negative judgment individuals hold about other people's curious question-asking and explanation-seeking behaviour

Implicit theories of ability

Implicit theories of ability concern the implicit beliefs that an individual holds about the nature and malleability of his/her abilities (Blackwell et al, 2010; Dweck & Legget, 1988). Formerly, implicit theories of ability were known as implicit theories of intelligence, but research has shown that 'abilities' was a better designation for these constructs (Van Aalderen-Smeets, Walma van der Molen, & Xenidou-Dervou, in press). This has also been supported by a pilot test in the PhD research of Tim Post, who investigated how children respond to the word intelligence and alternatives. This has shown that a better validity is achieved when intelligence is replaced by the word 'Denkslim' (literally translated: 'Thinksmart').

Beliefs about the malleability of abilities can take form of either an entity ('fixed') theory or an incremental ('growth') theory of abilities (Blackwell et al, 2010; Haimovitz & Dweck, 2017). An entity theory is defined in the literature as the belief that ability is a 'fixed or uncontrollable trait', while an incremental theory is defined as the belief that ability is a 'malleable, increasable, controllable quality' (Blackwell et al, 2010; Dweck & Legget, 1988). Consequently, when teachers place emphasis on growth,

students may show an increased motivation and achievement (Blackwell et al, 2007). Children who receive feedback only on their ability level are hereby more likely to see ability as a fixed trait, while children who are being praised for their hard work or perseverance are more likely to develop an incremental belief (Haimovitz & Dweck, 2017).

Many studies assumed implicit beliefs to be a one-dimensional construct (e.g. Blackwell et al, 2007), with one side representing a pure entity belief and the other side a pure incremental belief. However, evidence has been found for implicit beliefs to be a multidimensional construct (Van Aalderen-Smeets, Walma van der Molen, & Xenidou, in press), in which incremental and entity beliefs can be viewed as two separate constructs. Van Aalderen-Smeets et al (in press) state that relatively low correlations between the two constructs can be viewed as support for this multidimensionality. In this research, we assumed that implicit beliefs are a multidimensional construct.

While these implicit theories are often mentioned concerning educational settings, implicit theories might also influence social relationships of individuals. Rudolph (2011) has noted that children with an entity belief are less inclined to overcome emotional and behavioural difficulty when met with social challenge (Chiu, Hong, & Dweck, 2016). Thus, they view their own social competence as a fixed skill that cannot grow, and negative judgments they might receive are viewed as unchangeable.

The implicit belief an individual holds may also change the way an individual gives meaning to his/her own learning. Students are said to show greater motivation in their learning when they have the feeling that they have the potential to develop themselves (Yeagar, 2016). Influencing the mindset of an individual towards an incremental belief can stimulate motivation in learning. According to Blackwell, Trzesniewski and Dweck (2007), the belief an individual has regarding his abilities sets up different responses to challenges and setbacks. The absence of an incremental belief can lead children to lose interest in learning, become fearful of challenges, show less persistence and less likeliness to try something difficult (Blackwell, Trzesniewski, & Dweck, 2007; Haimovitz & Dweck, 2017; Hochanadel & Finamore, 2015). Individuals who have an incremental belief respond to challenge with more effort (Hochadel & Finamore, 2015).

Implicit ideas may thus guide behaviour (Tamir, John, Srivastava, & Gross, 2007), just as attitudes towards curiosity could possibly guide the curious behaviour of students. Furthermore, Haimovitz and Dweck (2017) mention that the kind of implicit belief an individual has, may also influence his/her inquisitive behaviour. Thus, the assumption can be made that children who have internalized an entity belief might engage in less exploratory and curious behaviour, as these behaviours involve more risk of failure. In the present study, we hypothesized that these differing responses to setback may be related to children's attitudes towards curiosity. Jirout and Klahr (2012) have stated that children who prefer lower levels of uncertainty seem to be less curious. Consequently, children who hold

an entity belief might be less inclined to engage in curious, exploratory behaviour because it involves a level of risk and uncertainty.

Goals of the present study

The goal of the present study was twofold: (1) to gain insight in the possible decrease of children's attitudes towards curiosity between younger and older children in a large sample of primary and secondary school students (roughly 9-14 years of age) and (2) to investigate whether having an entity or incremental belief is related to children's attitude towards curiosity. By studying these two concepts (attitudes and mindsets), we were also able to investigate potential interactions between changes in children's attitudes towards curiosity and their levels of entity or incremental beliefs. In addition to these two theoretical goals, in the present study we also aimed to revalidate the CIAC questionnaire for the secondary school sample.

Research Questions and Hypotheses

Validation for secondary education

Multiple research outcomes mention that curiosity in children either diminishes (Engel, 2011) or is lowered in education (Post and Walma van der Molen, 2018). In order to determine a possible decrease in attitude towards curiosity in both primary and secondary education, the CIAC and the Mindset questionnaire of Post and Walma van der Molen (in press) need to be able to validly measure the attitude towards curiosity and implicit theories for both these age groups. The CIAC and Mindset questionnaires were already validated for grades 4, 5, and 6 of primary education, but not yet for secondary education. In order to assess whether curiosity and implicit theories change in secondary education, the factor structure of the instruments had to be determined for secondary education. This leads to the following research question: “To what extend do the attitudes towards curiosity and mindset instruments of Post and Walma van der Molen (in press) display the same factor structure for primary and secondary education?”

We hypothesize that the items will load in the same factor structure in secondary education as in primary education with low cross-loadings. This would lead to a factor structure of five factors for the attitudes towards curiosity questionnaire and a factor structure of two factors for the mindset questionnaire. Furthermore, we expect that the reliability of these questionnaires will be sufficient for both primary and secondary education. This would ensure that both the questionnaires would be able to validly measure attitude towards curiosity and mindset in a similar way in primary and secondary education and that the questionnaires may be used to investigate differences between the two age groups.

Possible decrease of attitude towards curiosity

Curiosity seems naturally instilled in children (Engel, 2011), but this does not guarantee that children stay curious. Post and Walma van der Molen's (2018) research results support this, but this was not investigated using quantitative attitude measures. In this study, the attitudes towards curiosity questionnaire from the CIAC will be used to determine whether this attitude decreases for older children. This leads to the research question: "To what extend do children between 9-14 years of age display a difference in their attitudes towards curiosity in the classroom?"

As can be seen in Table 1, three components of the CIAC (personal inclination, societal relevance, and self-efficacy) can be defined as 'positive attitude components', which means that higher scores on these sub-scales can be interpreted as more positive attitudes towards curiosity. The other two components (fear of classmates' negative judgments and negative opinion of others) can be considered 'negative components', which means that higher scores on these components represent less positive attitudes towards curiosity. With respect to the positive attitude components (personal inclination, societal relevance, and self-efficacy) we hypothesized that students' scores will decrease as they grow older, leading to lower scores on these components for children in secondary school compared to children in primary school. With respect to the negative attitude components (fear of classmates' negative judgments and negative opinion of others), we hypothesized that students' scores will increase as pupils grow older, leading to higher scores on these components for children in secondary school compared to children in primary school.

Finally, in Dutch secondary education students can follow three types of education, based on their competence level. As these competence levels could possibly be of influence on curiosity, we formulated the following open research question: "To what extend do children attending different secondary school levels display a difference in their attitudes towards curiosity in the classroom?" As no previous research has been conducted regarding this subject, no specific hypotheses were formulated.

Relation between implicit theories and attitude towards curiosity.

Children with an entity belief more often concern themselves with looking smart (Blackwell et al, 2007) and are more averse to risks and exploratory behaviour (Haimovitz & Dweck, 2017; Hochanadel & Finamore, 2015), so they could possibly also hold aversion to curious behaviour in the classroom. Children with an incremental belief aren't as deterred by the possibility of failure and use challenges as an opportunity to grow (Blackwell et al, 2007). To measure this, a mindset questionnaire that was pilot tested by Post and Walma van der Molen will be used. This questionnaire measures both the entity belief and the incremental belief of the students. This could, in combination with the attitude towards curiosity scores from the students, provide insight in the effects of mindset on children's attitudes towards

curiosity. This leads to the final research question: "To what extend do children with an incremental belief display more positive attitudes towards curious behaviour in the classroom than children with an entity belief?" We hypothesize that the implicit belief a student holds could be of influence on the attitude towards curiosity for a student. We believe that all subscales of the attitude scale (the CIAC) could show tentative relationships with an incremental or entity belief. The different hypotheses for the subscales are described below.

'*Personal inclination'* – The personal inclination component concerns itself with whether a student feels that his or her curious behaviour leads to positive learning outcomes and whether they experience enjoyment from this (Post and Walma van der Molen, in press). However, individuals with an entity belief are rather averse to challenges and are less inclined to try something new, as it could involve risk (Blackwell, Trzesniewski, & Dweck, 2007; Haimovitz & Dweck, 2017; Hochanadel & Finamore, 2015). Furthermore, entity theorists seem less inclined to believe that their actions could lead to growth and concern themselves more with upholding their 'status' of looking smart (Blackwell et al, 2010; Dweck & Legget, 1988). Consequently, we hypothesize the following: children with a high incremental belief will display a higher score on the personal inclination subscale, while children with a high entity belief will display a lower score on personal inclination. .

Self-efficacy – Bandura (1986) has defined self-efficacy as the specific judgments of an individual of their capabilities to perform a task successfully. In the context of attitude towards curiosity, this refers to the capability that children feel to ask epistemic questions in the classroom (Post and Walma van der Molen, in press). When a student with an entity belief experiences a setback, they are most likely to give up on their endeavours and blame this on their own lack of skill (Haimovitz & Dweck, 2017), which may decrease their perceived self-efficacy. Dweck (2000) also stated that pupils' beliefs of the malleability of their learning abilities can influence their self-efficacy beliefs. Therefore, it can be assumed that children with a high level of entity beliefs have lower perceptions of self-efficacy regarding their curious question asking than children with lower entity beliefs. Conversely, it is expected that children with higher levels of incremental beliefs display higher levels of self-efficacy in question asking than children with lower levels of incremental beliefs. Thus we hypothesized that children with a higher incremental belief would score higher on the self-efficacy subscale, while children with a higher entity belief would score lower on the self-efficacy subscale.

'*Societal Relevance'* – With an increasing emphasis on 21st century skills (Ananiadou & Claro, 2009), being able to think curiously is more important than ever for both the individual and the society. Post and Walma van der Molen (in press) have stated that the nature of the current educational system might lead children to believe that the knowledge conveyed in school is already absolute and complete, skewing their perception of the societal relevance of curiosity. As children with an entity belief already

have a rather static view of knowledge and their own abilities (Blackwell et al, 2010), this could also imply that they have an increased tendency to believe that curiosity is not very relevant for society. This leads to the following hypotheses, namely that children with a high incremental belief would score higher on the societal relevance subscale and, conversely, that children with a higher entity belief would score lower on the societal relevance subscale.

'Fear of classmates negative judgments' - Yeagar and Dweck (2012) have stated that entity theorists mostly care about that they might be seen as dumb and that they want to look talented at all costs, instead of being eager to learn and making an effort to improve. Thus, the implicit belief a student holds may shape his/her learning goals or classroom behaviour. As Blackwell et al. (2007) have found that entity theorists also hold these beliefs for social relationships; it can be assumed that, in combination with striving to look talented, entity theorists could fear the possible negative judgment of their classmates when they engage in curious question asking. As entity theorists perceive judgments as a static opinion, getting a negative judgment from their peers about their questions could be more risky in their minds. Therefore, we hypothesized that children with an incremental belief would score lower on the fear of classmates' negative judgments subscale, while children with an entity belief would score higher.

'Negative opinion' - If children fear the negative judgment of others, they might also transfer such beliefs to the question-asking of their peers. Post and Walma van der Molen (in press) stated that it may be expected that the negative opinions children hold about other curious thinkers, may prevent children from asking their own epistemic questions in class. Furthermore, as with 'fear of classmates' negative judgments', if entity theorists aim to look talented all the time (Blackwell et al, 2007), they might hold a negative opinion towards question asking as a whole. Perhaps, if peers ask questions, they could analyse this behaviour as looking untalented as well. This leads to the final hypotheses, namely that children with a high incremental belief would score lower on the negative opinion subscale, while children with a high entity belief would score higher.

Method

Respondents

A total of 650 (*M* = 12.02, *SD* = 1.55, range 9 to 15 years old) students participated in this study, with 308 respondents being male and 342 being female. There were 277 students (*M* = 10.51**,** *SD* = 0.95**,** range 9 to 13 years old) from grades 4, 5 and 6 from five Dutch primary schools and 373 students (*M* = 13.13**,** *SD* = 0.76**,** range 11 to 15 years old) from grades 1 and 2 from two Dutch secondary schools. While some overlap between the age-ranges was present between primary and secondary education, this concerned only a few students. In the Dutch secondary education system, students can enrol in three different levels, which differ in how demanding they are. These levels are, from least to most demanding, preparatory middle-level vocational education (VMBO), higher general continued education (HAVO) and preparatory university education (VWO).

The participating schools were all located in the district of the University of Twente and were selected based on whether they were included in the network of the university. Furthermore, students of all levels of the Dutch secondary education were included in the study. Dutch primary education doesn't select children based on levels yet. The parents of the respondents authorized their children to participate in the research with a passive consent form, which informed them about the nature of the research and gave them the possibility to withdraw their children.

Measurements

For this study, the Children's Images of and Attitudes towards Curiosity Questionnaire and the 'Denkslim' Questionnaire were used. The questionnaires were administered together in a paper-and-pencil format. Both the questionnaires have a forced-choice Likert Scale format, allowing for quantitative analyses.

Children's Images of and Attitudes towards Curiosity questionnaire (CIAC)

The CIAC was developed and extensively validated by Post and Walma van der Molen (In press). The CIAC consists of two separate questionnaires, one measuring the images of curiosity and one measuring the attitude towards curiosity. For the aim of this research, only the attitude questionnaire was used. The attitude towards curiosity questionnaire consists of 18 Likert questions with answer options ranging from 1 ('completely don't agree') to 4 ('completely agree') for items concerning attitudes towards curiosity. For the purpose of this research, all attitude components of the CIAC were used ('personal inclination', 'societal relevance', 'negative opinion', 'fear of classmates' negative judgments' and, 'self-efficacy').

Exploratory and confirmatory factor analyses and measurement invariance tests showed that these attitude components constitute independent and reliable scales that can be used to measure these constructs validly across children in different grades in primary school (Post and Walma van der Molen, in press). After the first validation of the CIAC, a few minor changes were made regarding the original attitude towards curiosity questionnaire, changing the wording of some questions slightly. The questionnaire was re-validated in the present study for both primary and secondary school children. Examples of questions of the attitude to curiosity questionnaire are: 'I really like to wonder about all the things I can learn at school' (Personal inclination), 'I feel classmates are being stubborn when they always want to know all about everything in class' (Negative opinion), 'I'm afraid my classmates will think it's stupid if I want to know more about something we're learning in class' (Fear of classmates' negative judgment), and 'I'm really good at coming up with smart questions in class' (Self-efficacy).

'Denkslim' (Thinksmart) Questionnaire

The 'Denkslim' (Thinksmart) questionnaire was developed by Post and Walma van der Molen (in press), based on a translated Self-Theory Scale developed by De Castella and Byrne (2015). The questionnaire was pilot-tested along with the CIAC in the research of Post and Walma van der Molen (in press). During the pilot testing, a confirmatory factor analysis showed that the questionnaire measures the two factors (entity beliefs and incremental beliefs) as independent, although related factors. The questionnaire was re-validated in the present study. The questionnaire consists of 10 Likert scale items with answer options ranging from 1 ('completely don't agree') to 4 ('completely agree') and assesses students' implicit beliefs about the malleability of their thinking abilities.

The questionnaire was adapted to the target group of primary school children and secondary school children. The construct of intelligence was renamed to 'Denkslim' (literally Thinksmart) in order to prevent children from possibly interpreting the construct of intelligence differently. Examples of items of this survey are: 'I think I can make myself more 'Denkslim' (incremental belief) and 'I belief I will always stay 'Denkslim', because I cannot change that' (entity belief).

Procedure

Before conducting any research, ethical permission was gained from the ethical commission of the University of Twente. Following this, two weeks before the questionnaire was handed out, the parents of the students were informed of the purpose of the research by a passive consent form. They were able to withdraw their children from the research if they desired.

The respondents filled in the questionnaire in their own classroom during regular school hours. Beforehand, they were informed of the global nature of the research by the researcher. Emphasis was

placed on that the questionnaire was about students' own personal opinion and that there were no wrong answers. After this, the researcher administered the questionnaire. The filling in of the questionnaire took about 20 minutes. While the students were filling in the questionnaire, the researcher walked around the classroom in order to provide answers to questions individually. When every participant in the classroom was finished, the students were thanked for their participation and asked whether they had any questions left. After this, the researcher left the classroom and allowed the teacher to continue their lesson.

Data analysis

The data yielded from the questionnaire consisted of quantitative Likert scale responses that were processed in IBM SPSS 23. First of all, the dataset was reviewed for missing data and insincere answers. After this, discriminant power of the items was evaluated by reviewing the standard deviations of the responses of the students. No negative items were used; therefore, no recoding was needed.

The CIAC and the mindset questionnaire were successfully validated in previous research for Dutch primary education (Post and Walma van der Molen, in press). Therefore, a distinction was made between primary and secondary education. EFA analyses in IBM SPSS were conducted to ensure that the factor structure was the same for primary and secondary education. The internal consistency of the items was established by calculating a Cronbach's Alpha and an item-total correlation for each separate item.

In order to assess the possible decrease in attitude towards curiosity of the students and the influence of their implicit beliefs, all five subscales of the Attitudes towards Curiosity scale were treated as a dependent variable. Five separate ANOVA analyses (2 x 2 x 2) were conducted for each dependent variable. Each of these analyses had three between subject factors, namely primary versus secondary education, low versus high incremental belief and low versus high entity belief.

Furthermore, in order to get a more detailed insight in the possible decrease of attitude towards curiosity, ANOVA analyses were conducted for the different grades of primary education, the grades of secondary education and the levels of secondary education. Within primary education, five separate ANOVA (3 x 2 x 2) analyses were conducted with each Attitude towards Curiosity subscale as dependent variable. Each of these analyses had three between subject factors, namely grade 4 versus grade 5 versus grade 6 education, low versus high incremental belief and low versus high entity belief. Within the grades of secondary education, five separate ANOVA (2 x 2 x 2) analyses were conducted as well with each Attitude towards Curiosity subscale as dependent variable. These analyses had three between subject factors, namely grade 1 versus grade 2, low versus high incremental belief and low versus high entity belief. Finally, five separate ANOVA (3 x 2 x 2) analyses were conducted with the attitude towards curiosity subscales as dependent variables for the levels within secondary education. These final ANOVA

analyses also had three between subjects factors, namely the level of competence (VMBO, HAVO and VMBO), high or low incremental belief and high or low entity belief.

Results

Preliminary Data Checks

Prior to the data analysis, the dataset was examined and 4 students were removed. Students were removed before the data analysis when a full questionnaire had been filled in insincerely or had not been filled in. The answers of the students were deemed insincere if a full page of the questionnaire (10 questions) was answered with the same answer or in a clear pattern. Furthermore, seven students of primary education didn't report the grade they attended. Therefore, they were omitted in the grade specific analyses.

Following this, a Missing Value Analysis was conducted with the remaining dataset. This resulted in a percentage of missing data of 1.80%. Schlomer, Bauman and Card (2010) mention multiple cut-offs for missing data in their review, with the lowest cut-off being 5%. Therefore, the percentage of missing data seems to be acceptable. The standard deviations of the items ranged from 0.71 to 1.15, resulting in sufficient discriminant power as this should range around 1 (Post and Walma van der Molen, 2018; Coulson, 1992). Furthermore, all response options were used by the respondents and no floor or ceiling effects were found. Furthermore, several assumptions with regard to the data were checked. The Kaiser-Meyer-Olkin (KMO) and Bartlett test were conducted for each EFA. As displayed in Table 2, all values fitted the proposed requirements for the KMO test (Tabachnick & Fidell, 2001) and the Bartlett test ($p < 0.05$).

Table 2. *Results of the KMO and Bartlett test*

	Primary Education		Secondary Education	
Questionnaire	KMO	Bartlett	KMO	Bartlett
Attitude towards curiosity	.77	.00	.82	.00
'Denkslim'	.84	.00	.86	.00

Determining the factor structure of the instruments

The latent factor structures of the attitude towards curiosity scale and the mindset questionnaire were assessed using exploratory factor analyses (EFA). As this research concerns a new sample of students of both primary and secondary education, four separate EFA's were conducted, two (primary and secondary education) for the attitudes towards curiosity, two (primary and secondary education) for the mindset questionnaire. This way, it was also assessed whether or not the instruments could be used to compare individuals from primary and secondary education. Based on the validation research of Post and Walma van der Molen (2018), it was to be expected that the factor loadings of the items of the questionnaires

would cluster together in the proposed subscales. If items showed a factor loading lower than .30, they were omitted.

Factor structure of the attitudes towards curiosity questionnaire.

With the new sample of respondents, two EFA's were conducted for the attitudes towards curiosity scale of the CIAC to assess the factor structure for the students in primary education and the students in secondary education. EFA's were conducted with principal axis factoring and a direct oblimin rotation. According to the research of Post and Walma van der Molen (2018), the attitude scale of the CIAC should divide in the subscales 'Personal Inclination', 'Fear of Classmates' Negative Judgment', 'Self-efficacy', 'Societal Relevance', and 'Negative Opinion'. As shown in Table 3, the EFA's showed that all items loaded on the hypothesized subscales for both primary and secondary education with five Eigenvalues above one. With these Eigenvalues and sufficient factor loadings, all items were retained based on the factor analyses. One iteration was needed for these results.

The Cronbach's alpha values ranged from satisfactory to good. In order to improve the alpha of the fear of classmates' negative judgment items, the first question of this subscale was dropped. As the same factor structure came forward in primary and secondary education, it is highly probably that this questionnaire can be used in both primary and secondary education. Finally, the factor matrix showed that there were no factor correlations greater than .51, see Tables 5 and 6.

Table 3. *Exploratory Factor Analysis Results of the Attitude towards curiosity scale of the CIAC*

Item	Primary Education								Secondary Education							
	PI	FNJ	SE	SR	NO	*SD*	I-T cor.	Alpha if deleted	PI	FNJ	SE	SR	NO	*SD*	I-T cor.	Alpha if deleted
I really like to ask questions about all sorts of subjects in class	**.39**					.87	.46	.71	**.57**					.65	.53	.74
It is very important to me to come up with interesting questions at school, because then I learn more	**.65**					.93	.51	.69	**.53**					.76	.55	.73
It is very important to me to wonder about lots of things about what I learn in class, because then I learn more.	**.65**					.92	.53	.69	**.56**					.80	.54	.74
I really like to wonder about all the things I learn at school	**.44**					.97	.47	.71	**.75**					.75	.61	.71
I really like to come up with new questions about subjects we don't know a lot about yet.	**.54**					.99	.54	.68	**.40**					.79	.52	.75
I find it scary to show that I'd like to know more about a topic in class **(Dropped)**		**.33**				.96	.32	.75		**.65**				.80	.59	.82
I'm afraid that my classmates will think I'm a nerd if I ask a lot of smart questions in class		**.64**				.92	.49	.52		**.81**				.83	.71	.70
I'm afraid that my classmates will think it's stupid if I want to know more about something we're learning in class		**.95**				.88	.61	.36		**.87**				.79	.71	.71
I am really good at coming up with smart questions about all sorts of subjects at school			**.70**			.91	.59	.68			**.57**			.71	.60	.79
I think I am really good at figuring out new things at school			**.53**			.88	.47	.74			**.53**			.72	.56	.80
I am really good at coming up with smart questions in class			**.68**			.96	.58	.68			**.84**			.77	.70	.74
I am really good at coming up with new questions about all sorts of topics in lessons at school			**.66**			.89	.57	.69			**.75**			.70	.69	.74

Table 3 (continued). *Exploratory Factor Analysis Results of the Attitude towards curiosity scale of the CIAC*

	Primary education								Secondary education							
Item	PI	FNJ	SE	SR	NO	*SD*	I-T cor.	Alpha if deleted	PI	FNJ	SE	SR	NO	*SD*	I-T cor.	Alpha if deleted
I think people who often come up with interesting questions are very important to society				**.56**		.85	.42	.66				**.64**		.81	.52	.64
I think people who want to know a lot are very important to the economy of the Netherlands				**.73**		.95	.53	.53				**.66**		.84	.55	.60
I think people who ask good questions have a big impact on society				**.59**		.92	.52	.54				**.67**		.75	.53	.63
I feel classmates are being stubborn when they always want to know all about everything in class					**.64**	1.02	.37	.52					**.59**	.83	.46	.59
I find classmates to be annoying when they ask a lot of smart questions in class					**.63**	1.00	.48	.33					**.79**	.90	.56	.44
I feel people who ask a lot of questions come across as dumb					**.30**	.81	.34	.56					**.55**	.70	.42	.64
Initial Eigenvalues	4.19	2.23	1.79	1.14	1.04				4.70	2.38	1.93	1.41	1.08			
Initial % of explained variance	23.29	12.39	9.93	6.32	5.79				26.13	13.23	10.72	7.87	6.00			
Explained variance	2.88	1.66	2.43	2.10	1.65				3.11	1.97	1.70	2.35	3.10			
Cronbach's alpha	.74	.65	.76	.68	.58				.78	.82	.82	.71	.66			

Note.

[a] Factor analyses were run with principal axis factoring and a direct oblimin rotation. Values represent the rotated factor loadings. Cross loadings of <.30 were omitted.

[b] PI = the Personal Inclination subscale, SR = the Societal Relevance subscale, NO = the Negative Opinion subscale, FNJ = the Fear of Classmates' Negative Judgment subscale, SE = the Self-Efficacy subscale.

Factor structure of the mindset questionnaire.

For the mindset questionnaire separate EFA's with principal axis factoring and direct oblimin rotation were conducted as well to assess the factor structure for a new sample of primary school students and the secondary school students. The mindset items were hypothesized to load on two factors, namely 'Entity beliefs and 'Incremental beliefs' in an unpublished pilot by Post and Walma van der Molen. Table 4 shows that the items indeed load on the proposed two factors with sufficient Eigenvalues. Therefore, all the items of this questionnaire were retained. One iteration was needed for these results. Good Cronbach's Alpha values also came forward for the 'Denkslim' questionnaire, with the lowest value being .80. Therefore, it can be concluded that the questionnaire can be used in both primary and secondary education. Finally the factor matrix showed that there were no factor correlations greater than .54, see Tables 5 and 6.

Table 4. *Exploratory Factor Analysis results of the 'Denkslim' questionnaire*

	Primary Education					Secondary Education				
I believe that…	EN	IN	*SD*	I-T cor.	Alpha if deleted	EN	IN	*SD*	I-T cor.	Alpha if deleted
I cannot change how thinksmart I am, because I am born this way	**.55**		1.00	.56	.86	**.51**		.75	.51	.84
I will always remain equally thinksmart, because I cannot change that	**.78**		.92	.68	.83	**.74**		.73	.68	.79
I will always remain equally thinksmart, because that is fixed in my brain	**.80**		.95	.68	.83	**.74**		.71	.62	.81
It is fixed how thinksmart I can and I cannot change that anymore	**.77**		.89	.72	.82	**.81**		.73	.70	.78
It is fixed in my brain how thinksmart I am, I cannot change anything about that.	**.78**		.98	.74	.81	**.74**		.72	.68	.79
I can make myself more thinksmart		**.64**	.88	.53	.79		**.41**	.65	.41	.81
step by step, that I can become more thinksmart		**.75**	.80	.67	.75		**.62**	.64	.59	.76
I can become more thinksmart by practicing with assignments that become increasingly difficult		**.63**	.84	.58	.78		**.72**	.67	.64	.74
I can become more thinksmart by making an effort.		**.73**	.82	.64	.76		**.84**	.66	.67	.73
I can always become a little more thinksmart		**.65**	.75	.58	.78		**.71**	.65	.60	.75
Initial Eigenvalues	4.13	2.05				4.40	1.54			
Initial % of explained variance	41.32	20.51				43.96	15.40			
Explained variance	3.17	2.83				3.37	3.16			
Cronbach's alpha	.86	.81				.84	.80			

Note.

[a] Factor analyses were run with principal axis factoring and a direct oblimin rotation. Values represent the rotated factor loadings. Cross loadings of <.30 were omitted

[b] EN = the Entity belief subscale, IN = the Incremental belief subscale.

Table 5. *Factor correlations of the attitudes to curiosity and mindset questionnaires for primary education*

	Attitudes to curiosity					Mindset	
	PI [a]	FNJ [a]	SE [a]	SR [a]	NO [a]	EN [a]	IN [a]
Attitudes toward epistemic curiosity							
Personal inclination	--	.08	.46**	.44**	-.32**	-.02	.48
Fear of classmates' negative judgment		--	-.01	.03	.26**	.15**	-.00
Self-efficacy			--	.21**	-.12	.03	.29**
Societal relevance				--	-.26**	-.01	.37**
Negative opinion					--	.32**	-.29**
Mindset							
Entity belief						--	-.36
Incremental belief							--

Note.

[a] PI = the Personal Inclination subscale, SR = the Societal Relevance subscale, NO = the Negative Opinion subscale, FNJ = the Fear of Classmates' Negative Judgment subscale, SE = the Self-Efficacy subscale, EN = the Entity belief subscale, IN = the Incremental belief subscale.

* Factor correlation is statistically significant at $p < .05$

** Factor correlation is statistically significant at $p < .01$

Table 6. *Factor correlations of the attitudes to curiosity and mindset questionnaires for secondary education*

	Attitudes to curiosity					Mindset	
	PI [a]	FNJ [a]	SE [a]	SR [a]	NO [a]	EN [a]	IN [a]
Attitudes toward epistemic curiosity							
Personal inclination	--	.06	-.51**	.42**	-.26**	-14*	.34**
Fear of classmates' negative judgment		--	-.11*	.01	.14**	.11*	-.14*
Self-efficacy			--	-34**	-.06	.08	.20**
Societal relevance				--	-.18**	-.15**	.34**
Negative opinion					--	.35**	-.31**
Mindset							
Entity belief						--	-.49**
Incremental belief							--

Note.

[a] PI = the Personal Inclination subscale, SR = the Societal Relevance subscale, NO = the Negative Opinion subscale, FNJ = the Fear of Classmates' Negative Judgment subscale, SE = the Self-Efficacy subscale, EN = the Entity belief subscale, IN = the Incremental belief subscale.

* Factor correlation is statistically significant at $p < .05$

** Factor correlation is statistically significant at $p < .01$

Influence of age and implicit beliefs on attitudes towards curiosity

As discussed before, ANOVA analyses were conducted in order to determine the influence of age and mindset on children's attitudes towards curiosity. Table 7 shows the means and standard deviations of the respondents divided in different age groups. In order to determine the influence of implicit beliefs, two new variables were computed to represent the entity and incremental belief of the respondents based on their scoring on the mindset questionnaire. Respondents scoring a lower than or equal to 2.5 on a specific subscale received the designation 'low' for that subscale, while respondents who scored an average higher than 2.5 received the designation 'high' for that specific subscale. Thus, every respondent either had a high or low entity belief and a high or low incremental belief. Please refer to Table 8 for the distribution of the incremental and entity beliefs of the students. Regarding this distribution, it should be taken into account that a large amount of students report having a high incremental belief and a low entity belief. This could possibly result in less reliable results, with a higher chance for statistical significant results for children with a high incremental belief. We will elaborate on this in the discussion.

Following this, multiple ANOVA analyses were conducted with the five scales of the attitude to curiosity questionnaire as dependent variables to determine whether the perceived differences between primary and secondary education, grades, secondary school levels and implicit theories were significant and whether any interaction effects influenced these results. Five separate ANOVA analyses (2 x 2 x 2) were conducted with three between subject factors (primary versus secondary education, high versus low incremental belief, and high versus low entity belief) for each attitude towards curiosity subscale. The statistical ANOVA results are reported in Table 9. Table 7 reports the means and standard deviations of each group of students.

Table 7 *Means and standard deviations on the attitudes towards curiosity and mindset subscales divided per class and educational level*

	Attitudes to curiosity										Mindset			
	PI [b]		FNJ [b]		SE [b]		SR [b]		NO [b]		EN [b]		IN [b]	
Level	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Primary education (*n* = 254)	2.86	.65	1.70	.71	2.50	.68	2.80	.71	1.70	.70	1.95	.76	3.22	.62
Grade 4 (*n* = 79)	3.02	.57	1.73	.72	2.61	.69	2.94	.60	1.75	.63	1.97	.80	3.28	.60
Grade 5 (*n* = 93)	2.79	.71	1.68	.74	2.49	.73	2.70	.76	1.83	.79	1.95	.78	3.23	.60
Grade 6 (*n* = 75)	2.77	.65	1.70	.69	2.39	.56	2.80	.74	1.66	.66	1.90	.68	3.17	.65
Secondary education (n = 352)	2.44	.54	1.77	.69	2.29	.58	2.61	.64	1.83	.62	1.98	.56	3.01	.49
Grade 1 (*n* = 145)	2.53	.57	1.82	.67	2.36	.64	2.65	.62	1.89	.62	1.92	.54	3.06	.47
Grade 2 (*n* = 207)	2.38	.52	1.74	.71	2.24	.53	2.58	.64	1.79	.61	2.02	.58	2.98	.49
VMBO[a] (*n* = 159)	2.36	.58	1.78	.68	2.18	.60	2.49	.58	2.00	.67	2.13	.58	2.90	.51
HAVO[a] (*n* = 138)	2.52	.50	1.77	.72	2.43	.55	2.74	.68	1.67	.56	2.02	.58	2.98	.49
VWO[a] (*n* = 65)	2.45	.52	1.78	.72	2.30	.53	2.62	.66	1.72	.49	1.84	.41	3.10	.37

Note.

[a] The Dutch secondary school education is divided in three levels, varying in how much they demand of the student. These levels are, from least to most demanding, preparatory middle-level vocational education (VMBO), higher general continued education (HAVO) and preparatory university education (VWO).

[b] PI = the Personal Inclination subscale, SR = the Societal Relevance subscale, NO = the Negative Opinion subscale, FNJ = the Fear of Classmates' Negative Judgment subscale, SE = the Self-Efficacy subscale, EN = the Entity belief subscale, IN = the Incremental belief subscale.

First, the difference in attitudes towards curiosity and implicit beliefs between primary and secondary education was assessed. We expected a main effect, where older children showed lower levels on the positive attitude towards curiosity subscales (personal inclination, societal relevance and self-efficacy) and higher levels on the negative attitude towards curiosity subscales (fear of classmates' negative judgment and negative opinion). The results show that only the personal inclination subscale shows the expected statistical significance. This effect, however, was qualified by a statistically significant interaction effect between educational level and incremental beliefs, see Figure 1. Thus, the results show that while educational level had a statistical significant effect on personal inclination, this effect could be explained better by an interaction between incremental beliefs and educational level. As shown in Figure 1, it seems that the expected difference between primary and secondary students on personal inclination was only present among children with high incremental beliefs. For those children holding low incremental beliefs, no age differences were observed.

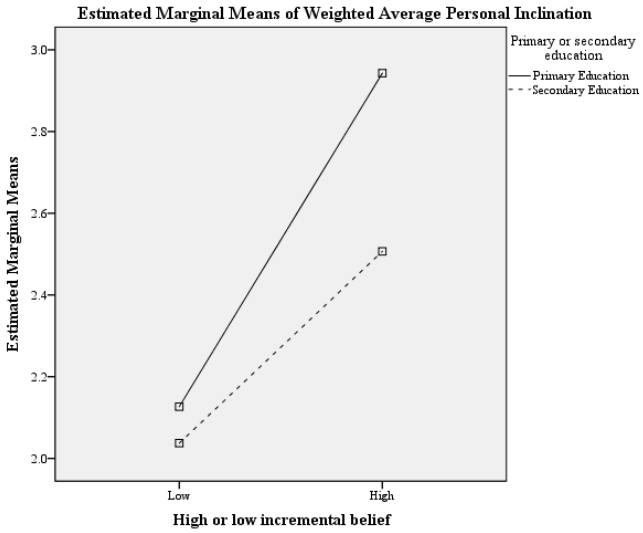

Figure 1. Interaction effect between incremental beliefs and educational level for the personal inclination subscale.

We also expected a main effect where children with a high incremental belief would score higher on positive attitude towards curiosity subscales and lower on the negative attitude towards curiosity. We found this expected main effect on the personal inclination, self-efficacy, societal relevance and negative opinion subscales, with small effect sizes for the personal inclination and the societal relevance scale and negligible effect sizes for the self-efficacy and negative opinion subscales (Table 9). The effect on the personal inclination subscale has been qualified however by the aforementioned interaction effect between educational level and incremental beliefs. The main effects on the societal relevance were

qualified by an interaction effect between incremental belief and entity belief, while the main effects on the negative opinion subscale were qualified by an interaction effect between incremental belief, entity belief and educational level. This result thus indicates that, while incremental beliefs seem to have an influence on attitude towards curiosity, an interaction between age and incremental beliefs and/or entity beliefs explains the differences for some of the subscales better. For the distribution of the incremental and entity beliefs of the students, please refer to Table 8. As mentioned before, please note that the distribution of the students is skewed.

Table 8. *Distribution of students' incremental and entity beliefs between primary and secondary education*

	Low entity belief	High entity belief
Primary education (n = 254)		
Low incremental belief	8	16
High incremental belief	184	36
Secondary education (n = 352)		
Low incremental belief	21	20
High incremental belief	268	35

As shown in Figure 2, the expected difference between primary and secondary students on societal relevance was only present among children with low incremental beliefs. For children who scored high on incremental beliefs, no differences were observed. The effect size of this result was negligible.

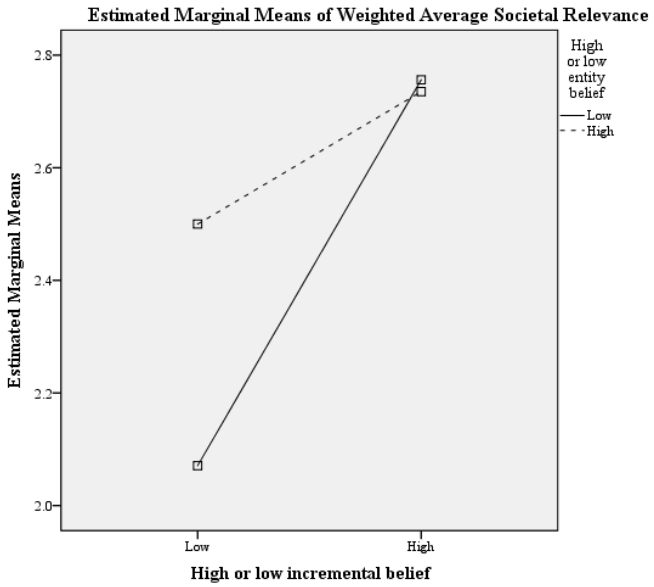

Figure 2. Interaction effects between incremental beliefs and entity beliefs for the societal relevance subscale.

Finally, Figure 3 shows the interaction effect between the factors educational level, incremental belief and entity belief for the negative opinion subscale. The two graphs show that the expected differences between students on the negative opinion subscale was only present when students held a low incremental belief and were of different age groups. This result had a negligible effect size as well.

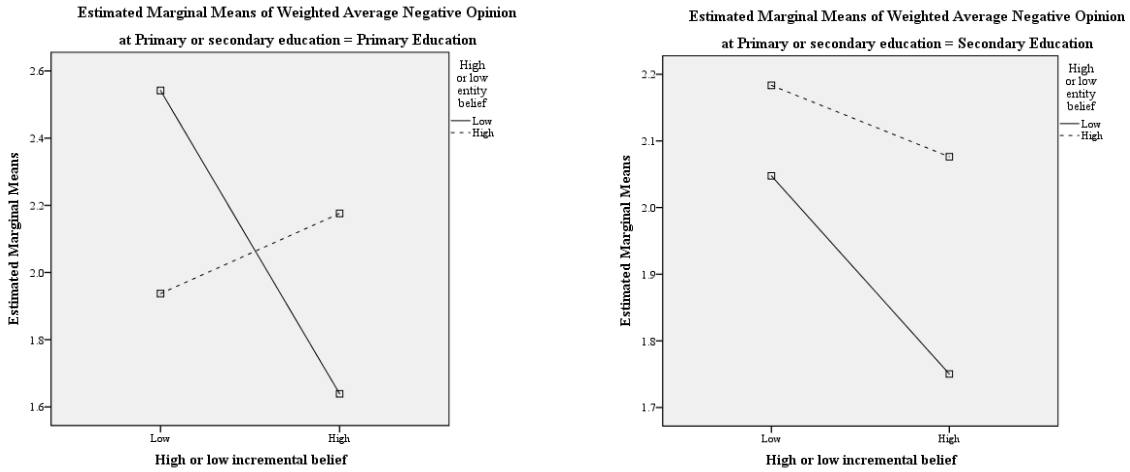

Figure 3. Interaction effect between educational level, incremental beliefs and entity beliefs for the negative opinion subscale.

Finally, we expected having a high entity belief to result in a decrease in the positive subscales and an increase in the negative subscales. The results in Table 9 show that this main effect has been found for the personal inclination subscale and the societal relevance subscale. The effect sizes of these results are negligible. However, the effect on the societal relevance subscale has been qualified by the aforementioned and explained interaction effect between the factors entity belief and incremental belief.

Table 9. *ANOVA results for primary and secondary education and levels of implicit theories on their attitudes towards curiosity.*

	PI[b]	FNJ[b]	S-E[b]	SR[b]	NO[b]
Education level (Primary vs Secondary)					
F	9.571	.73	2.93	2.09	.41
df	1-573	1-582	1-582	1-584	1-583
p	.00	.39	.09	.15	.53
η^2	.02	.00	.01	.00	.00
Level of incremental belief [a]					
F	57.30	.10	9.69	22.52	.83
df	1-573	1-582	1-582	1-584	1-583
p	.00	.76	.00	.00	.00
η^2	.09	.00	.02	.04	.01
Level of entity belief [a]					
F	6.59	3.70	.02	4.43	1.12
df	1-573	1-582	1-582	1-584	1-583
p	.01	.06	.90	.04	.30
η^2	.01	.01	.00	.01	.00
Interaction effect education al level and incremental belief					
F	4.17	.39	.42	.78	.49
df	1-573	1-582	1-582	1-584	1-583
p	.04	.53	.10	.38	.49
η^2	.01	.00	.01	.00	.00

Table 9 (Continued). *ANOVA results for primary and secondary education and levels of implicit theories on their attitudes towards curiosity*.

	PI[b]	FNJ[b]	S-E[b]	SR[b]	NO[b]
Interaction effect educational level and entity belief					
F	2.64	.07	2.65	.00	2.02
df	1-573	1,582	1-582	1-584	1-583
p	.10	.80	.10	.96	.16
η^2	.00	.00	.01	.00	.00
Interaction effect incremental belief and entity belief					
F	3.82	.12	.14	5.39	12.81
df	1-573	1-582	1-582	1-584	1-583
p	.05	.73	.71	.02	.00
η^2	.01	.00	.00	.01	.02
Interaction effect educational level, incremental belief and entity belief					
F	2.39	.18	.87	.29	6.54
df	1-573	1-582	1-582	1-584	1-583
p	.12	.67	.35	.62	.01
η^2	.00	.00	.00	.00	.01

Note.

[A] If a child scored equal to 2.5 or lower on the entity belief or incremental belief scales they were marked as having a low entity or incremental belief. If they scored above 2.5, they were marked as having a high entity or incremental belief.

[b] PI = the Personal Inclination subscale, FNJ = the Fear of Classmates' Negative Judgment subscale, SE = the Self-Efficacy subscale, SR = the Societal Relevance subscale, NO = the Negative Opinion subscale.

Analyses within primary education

In the previous section, we analysed the differences between primary and secondary education. In this section, the differences between classes of primary education were assessed. For this, five separate ANOVA analyses (3 x 2 x 2) were conducted with three between subject factors (grade 4 versus grade 5 versus grade 6, high versus low incremental belief, high versus low entity belief) for each attitudes towards curiosity subscale. The statistical ANOVA results are reported in Table 11. For the mean and standard deviations of the scores of the primary school children, please refer to Table 7.

The main effects that we expected were the same main effects that we expected for the previous ANOVA analyses, with older children scoring lower on the positive attitude towards curiosity subscales and higher on the negative scales. We only found this effect with a small effect size for the societal relevance subscale (Table 7). This effect however has been qualified by an interaction effect between the factors grade and incremental beliefs. This result thus indicates that, while grades seem to have an influence on attitude towards curiosity, an interaction between grades and incremental beliefs explains the differences better.

Figure 4 depicts this interaction effect in a graph. It seems that the expected difference between the primary school grades on societal relevance was only present among children with low incremental beliefs. For the children holding high incremental beliefs, no age group difference was observed.

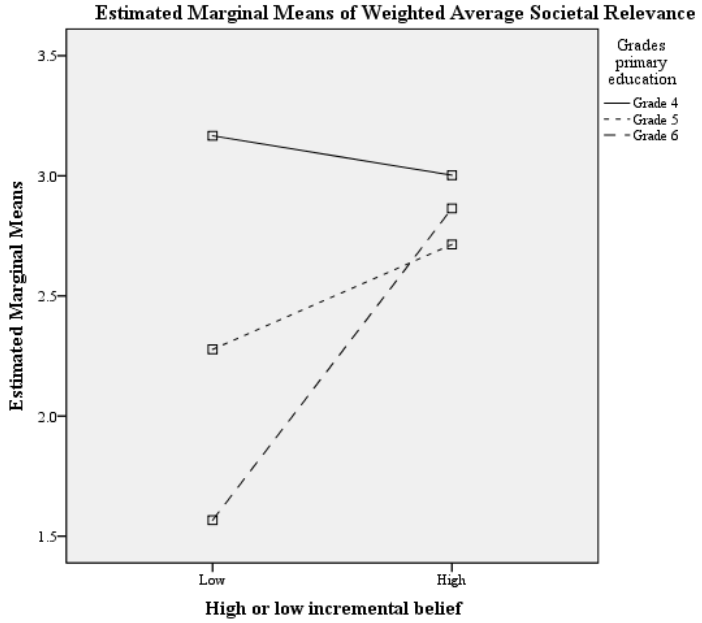

Figure 4. Interaction effects between incremental beliefs and grades of the primary education for the societal relevance subscale.

We also expected main effects for the influence of having a high or low incremental belief. We hypothesized that children with a high incremental belief would score higher on the positive attitude subscales and lower on the negative attitude subscales than children with a low incremental belief. We found the expected main effects, but please note that the distribution was yet again not even (Table 10). For the incremental belief we found statistical significant effects for the personal inclination, self-efficacy, societal relevance and negative opinion subscales with a small effect sizes for personal inclination and negligible effect sizes for the remaining subscales. The statistical significant effect for the societal relevance subscale has been qualified however by the aforementioned interaction effect between the primary school grades and incremental belief. The main effect on the negative opinion subscale has been qualified by an interaction effect between incremental belief and entity belief. This indicates that, while incremental beliefs seem to have an influence on attitude towards curiosity, an interaction between grades and incremental beliefs explains the differences better.

Table 10. *Distribution of students' incremental and entity beliefs between Grade 4, 5 and 6.*

	Low entity belief	High entity belief
Grade 4 (n = 76)		
Low incremental belief	1	5
High incremental belief	57	13
Grade 5 (n = 89)		
Low incremental belief	4	6
High incremental belief	63	16
Grade 6 (n = 73)		
Low incremental belief	2	5
High incremental belief	61	5

The interaction effect portrayed in Figure 5 shows that that the difference between high or low incremental mindset on the negative opinion subscale was only present when children held low entity beliefs. For children with high entity beliefs, no differences in scores were observed.

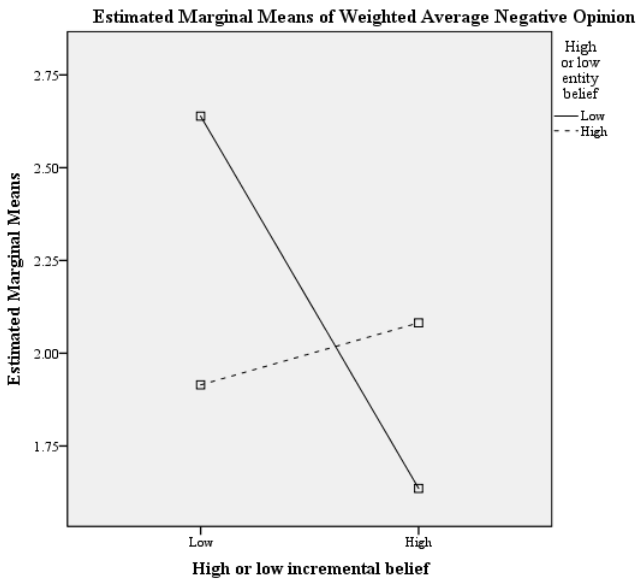

Figure 5. Interaction effects between incremental belief and entity belief for the societal relevance subscale.

Finally we hypothesized to find main effects for the influence of having a high or low entity belief. We expected that children with a high entity belief would score lower on the positive attitude scales and higher on the negative subscales. No statistical significant effects were found however to support this. Taking into account the interaction effect in Figure 5, it is probable that no statistical significance between entity beliefs and negative opinion could be found because of the low amount of students reporting a high entity belief (Table 10).

Table 11. *ANOVA results for grade 4, 5, and 6 of primary education and levels of implicit theories on their attitudes towards curiosity.*

	PI[b]	FNJ[b]	S-E[b]	SR[b]	NO[b]
Primary school grades (4, 5, 6)					
F	2.275	1.80	.10	6.04	.81
df	2-231	2-233	2-234	2-236	2-235
p	.11	.17	.91	.00	.53
η^2	.02	.02	.00	.05	.01
Level of incremental belief [a]					
F	19.56	.16	6.76	7.91	5.20
df	1-231	1-233	1-234	1-236	2-235
p	.00	.69	.01	.01	.02
η^2	.08	.00	.03	.03	.02
Level of entity belief [a]					
F	2.95	.37	1.19	.90	.57
df	1-231	1-233	1-234	1-236	2-235
p	.09	.54	.28	.34	.45
η^2	.01	.00	.01	.00	.00
Interaction effect grades and incremental beliefs					
F	.65	1.22	.11	4.47	.22
df	1-231	2-233	2-234	2-236	2-235
p	.53	.30	.89	.01	.80
η^2	.01	.01	.00	.04	.00

Table 11 (Continued). *ANOVA results for grade 4, 5, and 6 of primary education and levels of implicit theories on their attitudes towards curiosity.*

	PI[b]	FNJ[b]	S-E[b]	SR[b]	NO[b]
Interaction effect grades and entity beliefs					
F	.71	.57	1.40	.19	1.62
df	2-231	2-233	2-234	2-236	2-235
p	.10	.56	.25	.83	.20
η^2	.01	.01	.01	.00	.01
Interaction effect incremental beliefs and entity beliefs					
F	3.22	.12	.20	.78	10.20
df	1-231	1-233	1-234	1-236	2-235
p	.07	.73	.65	.38	.00
η^2	.01	.00	.16	.00	.04
Interaction effect grades, incremental beliefs and entity beliefs					
F	1.03	1.56	.87	.16	.31
df	2-231	2-233	2-234	2-236	2-235
p	.36	.21	.35	.86	.74
η^2	.01	.01	.00	.00	.00

Note.

[a] If a child scored equal to 2.5 or lower on the entity belief or incremental belief scales; they were marked as having a low entity or incremental belief. If they scored above 2.5, they were marked as having a high entity or incremental belief.

[b] PI = the Personal Inclination subscale, FNJ = the Fear of Classmates' Negative Judgment subscale, SE = the Self-Efficacy subscale, SR = the Societal Relevance subscale, NO = the Negative Opinion subscale.

Analyses within secondary education

Secondary school grades

In the previous sections we examined the differences between primary and secondary education and the differences within primary education. In this section, we assessed the difference between the two secondary school grades. Five separate ANOVA analyses (2 x 2 x 2) were conducted with three between subject factors (Grade 1 versus Grade 2, high or low incremental belief, high or low entity belief). The statistical results of the ANOVA analyses have been reported in Table 13 and the mean and standard deviations have again been reported in Table 7.

Main effects were first of all expected where grade 2 showed lower levels on the positive attitude towards curiosity subscales and higher levels on the negative subscales. The only subscale that showed a statistical significant decrease was the societal relevance subscale with a small effect size.

Furthermore, we expected main effects where children with a high incremental belief would score higher on the positive attitudes towards curiosity subscales and lower on the negative attitude towards curiosity scales, than children with a low incremental belief. We found the expected main effects, but please note that the distribution of the students' implicit beliefs was again not even (Table 12). We found a statistical significant effect in the personal inclination, societal relevance and the negative opinion subscales with the factor incremental belief, with a small effect size for the personal inclination subscale and negligible effect sizes for the remaining two subscales. The main effect on the personal inclination and societal relevance subscale were qualified by an interaction effect. This indicates that, while incremental beliefs seem to have an influence on attitude towards curiosity, an interaction between grades and incremental beliefs explains the differences in the personal inclination better, while an interaction between incremental and entity beliefs explain the differences for the societal relevance subscale better.

Table 12. *Distribution of students' incremental and entity beliefs between grade 1 and 2*

	Low entity belief	High entity belief
Grade 1 (n = 141)		
Low incremental belief	6	7
High incremental belief	114	14
Grade 2 (n = 203)		
Low incremental belief	15	13
High incremental belief	154	21

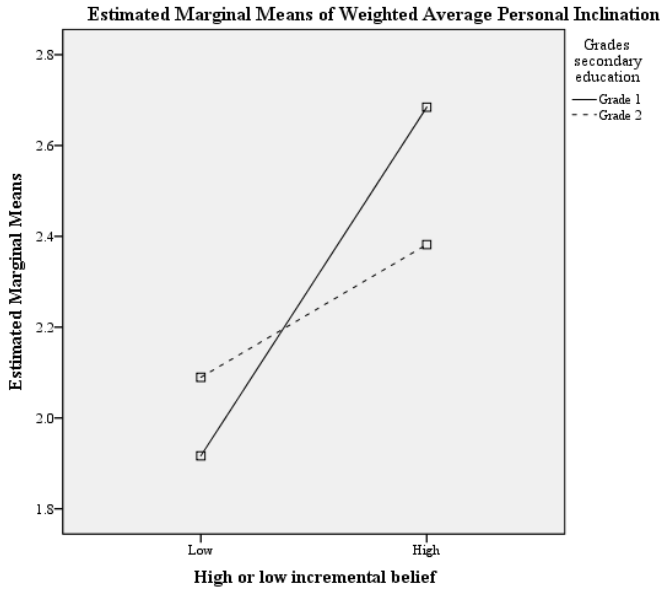

Figure 6. The interaction effect between incremental belief and secondary school grades on the subscale personal inclination.

Figure 7 shows that the expected differences between high and low entity beliefs on the societal relevance subscale were only present among children with low incremental beliefs. For children who scored high on the incremental belief subscale, no difference in scores was observed.

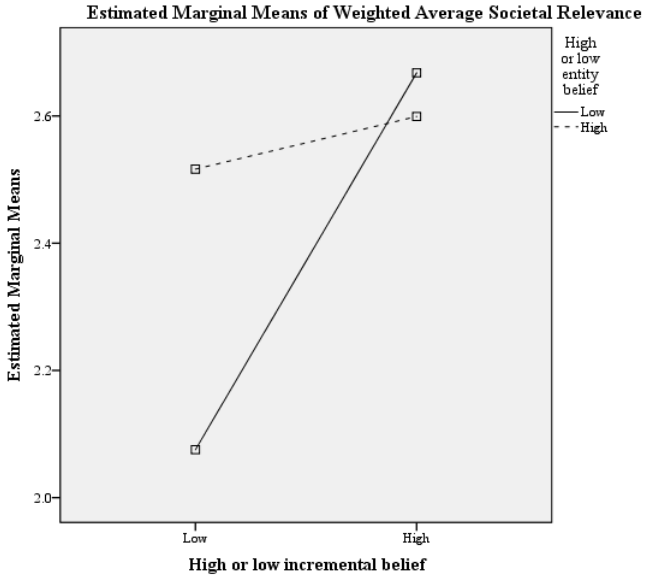

Figure 7. The interaction effect between incremental belief and entity belief on Societal Relevance.

Finally, we expected a main effect where children with a high entity belief would score lower on the positive attitudes towards curiosity subscales and higher on the negative attitudes towards curiosity subscales. The results show that no statistical significance could be found when entity beliefs were related to the attitude towards curiosity subscales. For this result, please take note that very few students reported having a high entity belief. Therefore, we didn't find any main effects to support our hypothesis.

Table 13. *ANOVA results for grade 1 and 2 of secondary education and levels of implicit theories on their attitudes towards curiosity.*

	PI[b]	FNJ[b]	S-E[b]	SR[b]	NO[b]
Secondary school grades (1, 2)					
F	.40	.19	3.87	.80	1.15
df	1-336	1-342	1-341	1-341	1-342
p	.53	.66	.05	.00	.29
η^2	.01	.00	.01	.05	.00
Level of incremental belief [a]					
F	26.83	.18	2.36	7.96	4.56
df	1-336	1-342	1-341	1-341	1-342
p	.00	.67	.13	.01	.03
η^2	.08	.00	.03	.02	.01
Level of entity belief [a]					
F	1.45	1.91	2.10	2.42	2.12
df	1-336	1-342	1-341	1-341	1-342
p	.23	.17	.15	.12	.15
η^2	.00	.01	.01	.01	.01
Interaction effect grades and incremental beliefs					
F	5.40	1.68	.01	.63	.53
df	1-336	1-342	1-341	1-341	1-342
p	.02	.20	.93	.43	.47
η^2	.02	.01	.00	.00	.00

Table 13 (Continued). *ANOVA results for grade 1 and 2 of secondary education and levels of implicit theories on their attitudes towards curiosity.*

	PI[b]	FNJ[b]	S-E[b]	SR[b]	NO[b]
Interaction effect grades and entity beliefs					
F	2.35	.14	.35	.22	2.40
df	1-336	1-342	1-341	1-341	1-342
p	.13	.71	.56	.64	.21
η^2	.01	.00	.00	.00	.01
Interaction effect incremental beliefs and entity beliefs					
F	.19	.19	1.68	4.54	1.55
df	1-336	1-342	1-341	1-341	1-342
p	.66	.67	.20	.03	.21
η^2	.00	.00	.01	.01	.01
Interaction effect grades, incremental beliefs and entity beliefs					
F	.06	1.67	.41	.09	.63
df	1-336	1-342	1-341	1-341	1-342
p	.81	.42	.52	.77	.43
η^2	.00	.01	.00	.00	.00

Note.

[a] If a child scored equal to 2.5 or lower on the entity belief or incremental belief scales; they were marked as having a low entity or incremental belief. If they scored above 2.5, they were marked as having a high entity or incremental belief.

[b] PI = the Personal Inclination subscale, FNJ = the Fear of Classmates' Negative Judgment subscale, SE = the Self-Efficacy subscale, SR = the Societal Relevance subscale, NO = the Negative Opinion subscale.

Secondary school levels

In the previous sections, we assessed the differences between primary and secondary education, within primary education and within secondary education. Finally, we examined whether the competence level of secondary school education had any influence on children's attitude towards curiosity. For this, five separate ANOVA analyses (3 x 2 x 2) were conducted with three between subject factors (VMBO versus HAVO versus VWO, high versus low incremental belief, high versus low entity belief). The statistical results of these ANOVA analyses are reported in Table 15 while Table 7 again reports the means and standard deviations of the scores.

We wondered whether the competence levels of education would have any influence on attitudes towards curiosity. The main effects we found suggest that children following education at a higher level score higher on the personal inclination and self-efficacy subscale and lower on the negative opinion subscale. These results show negligible effect sizes for the personal inclination and negative opinion subscales to low effect sizes for the self-efficacy subscale. Furthermore, please note that the distribution of implicit beliefs was not even (Table 14). Interestingly, the amount of high entity beliefs and low incremental beliefs over the different competence levels suggests that the amount of children with low incremental beliefs and high entity beliefs decreases as children enter a higher competence level in their education.

Table 14. *Distribution of students' incremental and entity beliefs between Grade 4, 5 and 6.*

	Low entity belief	High entity belief
VMBO (n = 154)		
Low incremental belief	13	13
High incremental belief	105	23
HAVO (n = 135)		
Low incremental belief	7	6
High incremental belief	111	11
VWO (n = 55)		
Low incremental belief	1	1
High incremental belief	52	1

Note.

The Dutch secondary school education is divided in three levels, varying in how much they demand of the student. These levels are, from least to most demanding, preparatory middle-level vocational education (VMBO), higher general continued education (HAVO) and preparatory university education (VWO).

Table 15. *ANOVA results the secondary school levels VMBO, HAVO and VWO and levels of implicit theories on their attitudes towards curiosity*.

	PI[c]	FNJ[c]	S-E[c]	SR[c]	NO[c]
Secondary school level (VMBO, HAVO, VWO)[a]					
F	3.23	.27	4.86	1.93	3.85
df	2-336	2-342	2-341	2-341	2-342
p	.04	.76	.01	.15	.02
η^2	.02	.00	.03	.01	.02
Level of incremental belief [b]					
F	7.27	.22	1.12	3.16	.33
df	1-336	1-342	1-341	1-341	2-342
P	.01	.64	.29	.08	.33
η^2	.02	.00	.00	.01	.00
Level of entity belief [b]					
F	.17	.04	2.86	2.24	1.27
df	1-336	1-342	1-341	1-341	2-342
p	.68	.85	.09	.14	.26
η^2	.00	.00	.01	.01	.00
Interaction effect secondary levels and incremental belief					
F	.91	.60	.27	.01	2.92
df	1-336	2-342	2-341	2-341	2-342
p	.41	.55	.77	.99	.06
η^2	.01	.00	.00	.00	.02

Table 15 (Continued). *ANOVA's of the differences within the secondary school levels and the levels of their implicit theories in their attitude towards curiosity.*

	PI[c]	FNJ[c]	S-E[c]	SR[c]	NO[c]
Interaction effect secondary levels and entity belief					
F	1.85	.41	1.26	.43	.62
df	2-336	2-342	2-341	2-341	2-342
p	.16	.67	.29	.63	.54
η^2	.01	.00	.01	.00	.00
Interaction effect incremental belief and entity belief					
F	.32	1.03	2.84	.99	3.64
df	1-336	1-342	1-341	1-341	2-342
p	.58	.31	.09	.32	.06
η^2	.00	.00	.01	.00	.01
Interaction effect secondary levels , incremental belief and entity belief					
F	1.13	2.1	.75	.44	1.68
df	2-336	2-342	2-341	2-341	2-235
p	.32	.11	.47	.65	.19
η^2	.01	.01	.01	.00	.01

Note.

[a] The Dutch secondary school education is divided in three levels, varying in how much they demand of the student. These levels are, from least to most demanding, preparatory middle-level vocational education (VMBO), higher general continued education (HAVO) and preparatory university education (VWO).

[b] If a child scored equal to 2.5 or lower on the entity belief or incremental belief scales, they were marked as having a low entity or incremental belief. If they scored above 2.5, they were marked as having a high entity or incremental belief.

[c] PI = the Personal Inclination subscale, FNJ = the Fear of Classmates' Negative Judgment subscale, SE = the Self-Efficacy subscale, SR = the Societal Relevance subscale, NO = the Negative Opinion subscale.

Discussion

The goal of the study was to assess the possible decrease of positive attitude towards curiosity in primary and secondary education and to determine whether implicit beliefs possibly correlate with this construct. For this, three research goals had been set up, namely testing whether the instruments would be valid to use in secondary education, assessing the possible decrease of attitude towards curiosity and examining a possible interaction between implicit beliefs and attitude towards curiosity. Finally, we also proposed an open research question which concerned the secondary school competence levels and whether those influenced curiosity.

Main research outcomes

The results of our study are among the first to empirically examine a possible decrease of attitude towards curiosity between different age groups and the relationship between attitudes towards curiosity and implicit beliefs. For this, the attitudes towards curiosity questionnaire of Post and Walma van der Molen (in press) was successfully validated for secondary education by running separate EFA's for both primary and secondary education along with multiple reliability analyses. Therefore, the first hypothesis was proven to be correct, showing that children in secondary education interpret the questions the same way as children from primary education.

This enabled us to examine the levels of attitude towards curiosity for a larger age group. We hypothesized that children of higher age groups would score lower on the positive attitude towards curiosity scales personal inclination, self-efficacy, and societal relevance than children of lower age groups. Furthermore, we hypothesized that children of higher age groups would score higher on negative subscales fear of classmates' negative judgment and negative opinion than children of lower age groups. We did not find much statistical support for this, as most statistical significant effects had been qualified by interaction effects between primary and secondary.

These results are interesting, as these findings are not consistent with the findings of Maw and Maw (1966) and Engel (2011), who mentioned a possible decrease in curious behaviour. A possible explanation for this is that curiosity is a complex construct (Jirout & Klahr, 2012). It is very possible that curiosity is not solely influenced by age, but by multiple factors, for example, implicit beliefs. Furthermore, we specifically looked at attitude towards curiosity, so possibly curiosity could be decreasing while this does not show up in the attitude. The age range that was examined could be expanded upon. Five years is still a small age group. Possibly, attitude differences could be found if the age range is larger.

Furthermore, because almost all the effect sizes of the results that were found were negligible, the magnitude of these results is very low. Interestingly, when solely the primary or secondary school students were considered, statistically significant influence of grades could be found with a small but noteworthy effect size for the societal relevance subscale. In primary education, this effect was qualified by an interaction effect between grades and incremental beliefs with a small effect size. Apparently, in primary education the difference between age groups interacts with incremental beliefs while this finding does not come forward in secondary education. Therefore, it can be concluded that while age seems to have an influence on attitudes towards curiosity, more accurate conclusions can be provided when implicit theories are considered as well. Therefore, our two hypotheses can be rejected except for the societal relevance subscale in secondary education. It appears that children's attitude towards curiosity does not decrease as they go through education.

This however, leads to another potentially important precursor of attitude towards curiosity that we proposed, namely the implicit beliefs that children hold (Van Aalderen-Smeets, Walma van der Molen, & Xenidou-Dervou, in press). Therefore, using the mindset questionnaire, we also investigated the influence of the implicit beliefs on attitudes towards curiosity. In order to assess this, two new variables were computed to represent the high or low entity and incremental belief of the respondents based on their scoring on the mindset questionnaire. Surprisingly, the distribution of the students between high or low incremental/entity beliefs was very skewed, which we will elaborate upon at the limitations of this research. We expected that the amount of incremental and entity belief of children would interact with their attitude towards curiosity. For the influence of incremental beliefs, we found main effects that were clearer for some of the attitude towards curiosity subscales than the effects that we found for age with larger effect sizes. We found these main effects between primary and secondary education, within primary education, within secondary education and within the secondary school levels for multiple subscales. Furthermore, because we conducted ANOVA analyses, multiple interaction effects were found. This would imply that whether children believe that their abilities can either grow with effort or stay fixed has an influence on their attitude towards curiosity. However, even though statistical significant effects were found, most of the effect sizes of these results were very low. Therefore, the magnitude of most of these results are negligible as well.

Nevertheless, a few results that were found reported noteworthy effect sizes, albeit still small. The personal inclination subscale showed the highest effect sizes when related with the level of incremental beliefs of the students. This subscale was qualified by an interaction effect however with a negligible effect size. This poses an interesting question whether the main effect should be considered or the interaction effect with an irrelevant effect size that holds no magnitude at all. However, if the main

effect of incremental belief is taken into account, this leads to some interesting implications when the results of another subscale are considered.

Namely, another subscale that showed a very small but still noteworthy effect size was the societal relevance subscale when primary and secondary school were both considered. Interestingly, these subscales both consider a kind of value that children put in their curious question asking. The personal inclination scale portrays the child's perception of the value they put in expressing their own curious behaviour, while the societal relevance portrays the child's perception of the value of curious thinkers to society. Coincidentally, these subscales are the only two subscales of the attitudes towards curiosity questionnaire that consider 'value' of curious behaviour and have both been derived from the perceptions of behavioural attributes dimension from the Theory of Planned Behaviour. Taking into account the nature of implicit beliefs, it is not a stretch to consider why these specific subscales would interact with more of a magnitude with an incremental belief. Children with a high incremental belief are more inclined to believe that their efforts will lead to a growth of their abilities and therefore respond to challenges with more effort (Blackwell et al, 2007; Haimovitz & Dweck, 2017). Therefore, if they believe their effort leads to something, it would also be probable that children with a high incremental belief place more value in expanding their knowledge and would also view it as more relevant for society to do so.

In review, we accepted the proposed hypotheses that children with a high incremental belief display a higher score on the personal inclination and the societal relevance subscales. In return, based on the results that were found, we rejected the remaining hypothesis that considered relationships between incremental beliefs and the attitudes towards curiosity questionnaire subscales either due to no statistical significance or the negligible effect size. The same can be said for the entity beliefs, as we rejected the hypotheses considering relationships between entity beliefs and attitudes towards curiosity. While statistical significant results came forward for some of the attitude towards curiosity subscales, the effect sizes were negligible. Please note that very few children reported having a high entity belief, which also further calls into question the statistical significant results.

We also proposed an open research question regarding the competence levels in secondary education. We wondered whether different competence levels on secondary education would have an influence on their attitude towards curiosity. We found that the secondary school level had a statistical significant influence on the personal inclination subscale, the self-efficacy subscale and the negative opinion subscale. However, the effect sizes of these results were negligible and therefore, our hypotheses were rejected. Nevertheless, when investigating the means and standard deviations, it was seen that the lowest competence level, VMBO, scored lowest on the positive attitudes towards curiosity scales personal inclination and self-efficacy and highest on the negative opinion subscale, while the middle competence level HAVO scored the highest. Also, we found that in the higher competence levels, even less students

reported having an entity belief than in the lower competence levels. This is in line with the results of Wang (2009), who found that children's perceived competence level affected their incremental and entity beliefs, with children with a higher perceived competence being more inclined to having higher incremental beliefs than children with lower perceived competence. Even though the magnitude of these results was too low, perhaps it would be worth investigating the effect of competence levels on children's attitudes towards curiosity further and investigate whether the general classroom climate of these three levels is different as well. Ames (1992) mentioned that children's perceptions of the classroom climate and treatment by teachers influence their motivation and Yeagar (2016) mentioned that students show greater motivation to learn when they have the potential to develop their abilities.

Limitations and future research

A few limitations of this study should be addressed. First and foremost, this study was not conducted longitudinally. Therefore, it should be taken into account that other factors, such as the differences between classes, could also influence the results that were found. Furthermore, because of the cross-sectional nature of this research, it is not possible to conclude anything about the causality of the results that were found. Therefore, for further research longitudinal research would be recommended in order to rule out any effects caused by the difference in experiences of the students on the results and to determine the role of causality in constructs attitude towards curiosity, age and mindset.

Regarding the incremental and entity beliefs, it should be mentioned that very few students reported having a high entity belief or a low incremental belief. Therefore, with such an uneven distribution, it is difficult to determine whether the effects that were found can be truly attributed to the low or high incremental/entity beliefs of students. With these results, we would like to express hesitation for whether changing the term 'intelligence' to 'denkslim' in the mindset questionnaire has led to the desired reliable results. While the factor structure of the questionnaire was fine with the items loading on the two proposing factors, the interpretation of the term 'denkslim' by the children can be questioned due to the skewed distribution of the children. It is possible that this term is more sensitive to socially desirable answering or is interpreted differently by children. At the same time, it would be possible that the 'Denkslim' questionnaire *did* measure the intended construct and that therefore, this is a more accurate representation of the distribution of incremental and entity beliefs. Intelligence is a difficult construct to interpret, especially for younger children. In any case, we therefore recommend that the construct of 'denkslim' is examined more carefully before it is utilized in any further research.

Furthermore, the decision for a cut-off score to decide whether a child had a high or low incremental/entity belief could have been examined more carefully. For this research, a cut-off score of 2.5 was chosen. This cut-off score was chosen because it was the average of the 1-4 likert scale. Possibly,

choosing a different, more scientifically supported, cut-off score would yield a different balance. A suggestion would be to apply a third category of students whose scores are more 'average', in order to distinguish between the real outliers and children who score more averagely.

Regarding other suggestions for further research, as multiple researchers pointed at high-stakes assessments as a reason for the diminishing of motivation and other skills staying underexposed (Amrein & Berliner, 2002; Lucas et al, 2013), this could provide a new direction to research towards the attitude towards curiosity. Post and Walma van der Molen (in press) based their attitude towards curiosity questionnaire on the Theory of Planned Behaviour. The five subscales were derived from the three components that the Theory of Planned Behaviour consists of, which together should lead to intention for behaviour (Ajzen, 2001). These intentions for behaviour are assumed to be the motivational factors for people to influence their behaviour. Therefore, it would not be a stretch to assume that attitudes towards curiosity are related to the decrease of general motivation, as the attitudes towards curiosity subscales are supposed to lead to intention as well as behaviour. A possible direction for future research would therefore be to examine a possible relationship between motivation and attitude towards curiosity.

Another possible direction for future research stems from the interaction effects for different attitudes towards curiosity scales between grades and incremental beliefs. Even though the magnitude of the results was too low to prove our hypotheses, the results showed that the influence of having a high incremental belief changed when children aged for some subscales. It would be interesting to look at this specific aging effect on an incremental belief as it could determine what the optimal age for children could be to provide an intervention to improve their incremental belief. Examining this could be done, for example, in the shape of interviews with children to get more in depth insight in children's attitudes towards curiosity and their implicit beliefs.

Practical implications

Based on our results, we would also like to provide some practical implications. First of all, we would like to propose that teachers pay more attention to metacognitive skills in the classrooms. Our results showed that having a high incremental mindset specifically influences the value children put in expressing their curious behaviour. Therefore, fostering a high incremental belief could possibly aid in influencing children's attitude towards curiosity. But even though most research is focused on how to stimulate children to lower their entity beliefs and increase their incremental beliefs, most of the children participating in this research reported already having a high incremental belief and a low entity belief, with a considerably small portion of the children reporting otherwise. This would imply that most children already carry positive implicit beliefs. Therefore, instead of combating high entity beliefs, stimulating children's high incremental mindsets even further and encourage children to keep these high

incremental beliefs seems to be the preferred direction to take. In order to stimulate these high incremental beliefs, we believe that children should be provided with more metacognitive skills to take direction and responsibility in their learning, showing to them that their learning can grow even more and that displaying curious behaviour indeed has value.

Teachers should consider putting more emphasis on the value of curious behaviour of students as well. Even though some of the results had a negligible effect size, the decrease in mean scores of personal inclination and societal relevance over the grades are a worrying development. Teachers should aim to create a classroom environment where curious behaviour is encouraged and fostered. Teachers should prompt their students to ask questions and talk to their students about how valuable curious behaviour is, both for them individually and for society as well, creating a positive attitude towards curious behaviour. Along with fostering a high incremental belief, this could possibly lead to children feeling more inclined to express their curious behaviour.

Conclusion

In this study, we attempted to contribute to research of the possible decrease of children's attitude towards epistemic curiosity in education. Furthermore, we examined the possible influence of implicit beliefs on children's attitude towards curiosity. Based on our results, we could conclude within primary and secondary education, the relevance children believe their curiosity has for society decreases between grades. Our results also showed that, although the effect sizes are small, children's incremental beliefs influence children's scores personal inclination and societal relevance.

We therefore believe that teachers should put emphasis on creating a positive attitude towards curiosity and creating a classroom environment that welcomes curious behaviour. If children put more value in their curious behaviour, they should. Additionally, as almost all children reported having a high incremental belief, we propose that children should be further stimulated in those beliefs and that less emphasis needs to be placed on the diminishing of entity beliefs.

References

Amrein, A. L., & Berliner, D. C. (2002). High-Stakes Testing & Student Learning. *education policy analysis archives*, *10*, 18. doi:10.14507/epaa.v10n18.2002

Ananiadou, K., & Claro, M. (2009). 21st century skills and competences for new millennium learners in OECD countries. Retrieved from: http://repositorio.minedu.gob.pe/bitstream/handle/123456789/2529/21st%20Century%20Skills%20and%20Competences%20for%20New%20Millennium%20Learners%20in%20OECD%20Countries.pdf?sequence=1&isAllowed=y

Anseel, F. (2017). Agile learning strategies for sustainable careers: a review and integrated model of feedback-seeking behavior and reflection. *Current Opinion in Environmental Sustainability*, *28*, 51-57. doi:10.1016/j.cosust.2017.07.001

Antonak, R. F., & Livneh, H. (2000). Measurement of attitudes towards persons with disabilities. Disability and Rehabilitation, 22(5), 211-224. doi:10.1080/096382800296782

Bandura, A. (1986). Social foundations of thought and actions: A social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall

Berlyne, D. E. (1954). A theory of human curiosity. *British Journal of Psychology, 45, 180–191.*

Berlyne, D. E. (1960). Conflict, arousal, and curiosity. *New York: McGraw-Hill.*

Berlyne, D. E. (1966). Curiosity and exploration. Science, 153, 25–33.

Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development*, *78*(1), 246-263. doi:10.1111/j.1467-8624.2007.00995.x

Brown, T. A., & Moore, M. T. (2012). Confirmatory factor analysis. *Handbook of structural equation modeling*, 361-379. Retrieved from: https://www.researchgate.net/profile/Michael_Moore8/publication/251573889_Hoyle_CFA_Chapter_-_Final/links/0deec51f14d2070566000000/Hoyle-CFA-Chapter-Final.pdf

Clark, I. (2008). Assessment Is for Learning: Formative Assessment and Positive Learning Interactions. *Florida Journal of Educational Administration & Policy*, *2*(1), 1-16. Retrieved from: http://files.eric.ed.gov/fulltext/EJ902994.pdf

Coulson, R. (1992). Development of an instrument for measuring attitudes of early childhood educators towards science. *Research in Science Education*, *22*(1), 101-105. doi:10.1007/bf02356884

De Castella, K., & Byrne, D. (2015). My intelligence may be more malleable than yours: the revised implicit theories of intelligence (self-theory) scale is a better predictor of achievement, motivation, and student disengagement. *European Journal of Psychology of Education*, *30*(3), 245-267. doi:10.1007/s10212-015-0244-y

Chen, J., & Pajares, F. (2010). Implicit theories of ability of Grade 6 science students: Relation to epistemological beliefs and academic motivation and achievement in science. *Contemporary Educational Psychology*, *35*(1), 75-87. doi:10.1016/j.cedpsych.2009.10.003

Chiu, C., Hong, Y., & Dweck, C. S. (1997). Lay dispositionism and implicit theories of personality. *Journal of Personality and Social Psychology*, *73*(1), 19-30. doi:10.1037//0022-3514.73.1.19

Dooley, D. (2009). *Social research methods*. Pearson Education Limited: Edinburgh

Dweck, C. S., Chiu, C., & Hong, Y. (1995). Implicit Theories and Their Role in Judgments and Reactions: A Word From Two Perspectives. *Psychological Inquiry*, *6*(4), 267-285. doi:10.1207/s15327965pli0604_1

Dweck, C. S., & Leggett, E. L. (1988). A social cognitive approach to motivation and personality. *Psychological Review*, *95*(2), 256-273. doi:10.1037//0033-295x.95.2.256

Haimovitz, K., & Dweck, C. S. (2017). The Origins of Children's Growth and Fixed Mindsets: New Research and a New Proposal. *Child Development*, *88*(6), 1849-1859. doi:10.1111/cdev.12955

Hochanadel, A., & Finamore, D. (2015). Fixed And Growth Mindset In Education And How Grit Helps Students Persist In The Face Of Adversity. *Journal of International Education Research (JIER)*, *11*(1), 47. doi:10.19030/jier.v11i1.9099

Grossnickle, E. M. (2014). Disentangling Curiosity: Dimensionality, Definitions, and Distinctions from Interest in Educational Contexts. *Educational Psychology Review*, *28*(1), 23-60. doi:10.1007/s10648-014-9294-y

IBM Knowledge Center. (n.d.). Retrieved July 30, 2018, from https://www.ibm.com/support/knowledgecenter/en/SSLVMB_24.0.0/spss/tutorials/fac_telco_kmo_01.html

Jirout, J., & Klahr, D. (2012). Children's scientific curiosity: In search of an operational definition of an elusive concept. *Developmental Review*, *32*(2), 125-160. doi:10.1016/j.dr.2012.04.002

Lazonder, A.W. (2014). Inquiry Learning. *University of Twente, Department of Instructional Technology.* doi: 10.1007/978-1-4614-3185-5_36

Litman, J., Hutchins, T., & Russon, R. (2005). Epistemic curiosity, feeling-of-knowing, and exploratory behaviour. *Cognition & Emotion*, *19*(4), 559-582. doi:10.1080/02699930441000427

Litman, J. A., & Spielberger, C. D. (2003). Measuring Epistemic Curiosity and Its Diversive and Specific Components. *Journal of Personality Assessment*, *80*(1), 75-86. doi:10.1207/s15327752jpa8001_16

Loewenstein, G. (1994). The psychology of curiosity: A review and reinterpretation. Psychological Bulletin, 116, 75-9

Lucas, B., Claxton, G., & Spencer, E. (2013). Progression in student creativity in school: First steps towards new forms of formative assessments. *OECD education working paper No. 86.* Paris, France: OECD. Retrieved from: http://repositorio.minedu.gob.pe/bitstream/handle/123456789/2493/Progression%20in%20Student%20Creativity%20in%20School%20First%20Steps%20Towards%20New%20Forms%20of%20Formative%20Assessments.pdf?sequence=1

Maw, W. H., & Maw, E. W. (1966). Children's Curiosity and Parental Attitudes. *Journal of Marriage and the Family*, *28*(3), 343. doi:10.2307/349885

Mercer, S., & Ryan, S. (2009). A mindset for EFL: learners' beliefs about the role of natural talent. ELT Journal, 64(4), 436-444. doi:10.1093/elt/ccp083

Muthén, L.K., & Muthén, B.O. (2007). *Mplus user's guide (5th ed.).* Los Angeles: Muthén & Muthén

Patrick, H., Ryan, A. M., & Kaplan, A. (2007). Early adolescents' perceptions of the classroom social environment, motivational beliefs, and engagement. *Journal of Educational Psychology*, *99*(1), 83-98. doi:10.1037/0022-0663.99.1.83

Post, T., & Walma van der Molen (in press). Development and Validation of a Questionnaire to Measure Primary School Children's Images of and Attitudes Towards Curiosity (the CIAC Questionnaire). *Motivation and Emotion*

Post, T., & Walma van der Molen, J. H. (2018). Do children express curiosity at school? Exploring children's experiences of curiosity inside and outside the school context. *Learning, Culture and Social Interaction*. doi:10.1016/j.lcsi.2018.03.005

Rotherham, A. J., & Willingham, D. T. (2010). "21st-Century" skills. *American Educator*, *17*.Retrieved from: http://www.aft.org/sites/default/files/periodicals/RotherhamWillingham.pdf

Rudolph, K. D. (2010). Implicit Theories of Peer Relationships. *Social Development*, *19*(1), 113-129. doi:10.1111/j.1467-9507.2008.00534.x

Savalei, V., & Bentler, P. M. (2010). Structural equation modeling. *Corsini encyclopedia of psychology*.

Schlomer, G. L., Bauman, S., & Card, N. A. (2010). Best practices for missing data management in counseling psychology. *Journal of Counseling Psychology*, *57*(1), 1-10. doi:10.1037/a0018082

Silva, E. (2009). Skills for 21st-Century Learning. *Phi Delta Kappan*, *90*(9), 630-634. doi:10.1177/003172170909000905

Tabachnick, B.G., & Fidell, L.S. (2001). *Using multivariate statistics.* Boston, MA: Allyn and Bacon.

Tamir, M., John, O. P., Srivastava, S., & Gross, J. J. (2007). Implicit theories of emotion: Affective and social outcomes across a major life transition. *Journal of Personality and Social Psychology*, *92*(4), 731-744. doi:10.1037/0022-3514.92.4.731

Van Aalderen-Smeets, S. I., Walma van der Molen, J. H., & Asma, L. J. (2012). Primary teachers' attitudes toward science: A new theoretical framework. Science Education, 96(1), 158-182. doi:10.1002/sce.20467

Van Aalderen-Smeets, S.I., Walma van der Molen, J.H., & Xenidou-Dervou, I. (in press). Implicit STEM ability beliefs predict secondary school students' STEM self-efficacy beliefs and their intention to opt for a STEM field career. *Journal of Research Science in Teaching.*

Wang, C. (2009). Sport Ability Beliefs, 2 × 2 Achievement Goals, and Intrinsic Motivation: The Moderating Role of Perceived Competence in Sport and Exercise. *Research Quarterly for Exercise and Sport*, *80*(2). doi:10.5641/027013609x13087704028679