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Innovative learning and developments in motivation and achievement in upper primary school

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Although previous research has shown the potential of innovative learning for enhancing motivation and learning outcomes, further understanding is needed on which aspects of IL are most effective and whether these are equally motivating for different types of students. The present study investigated how developments in students' motivation and achievement related to different aspects of innovative learning (i.e. authentic learning, collaborative learning and focusing on self-regulation), and whether these relations varied by students' background characteristics. A sample of 722 grade five students from the Netherlands (average age 11 years old) and their teachers completed questionnaires during four measurements from grade five to grade six. Autoregression analyses were performed. Results showed both positive and negative relations between IL and developments in students' motivation and achievement, indicating that IL is not a unidimensional construct. Furthermore, the effectiveness of different aspects of IL depended on students' gender, and social and ethnic background characteristics.

Keywords: innovative learning; motivation; achievement; gender; socio-economic and ethnic background

Introduction

Research on motivation has been concerned with the interaction between the learning environment and motivation for many years to find out which types of learning environments are best suited to foster students' motivational needs (Weiner, 1990). As students get older, their motivation for school tends to decline. Many studies have shown such a decline for students in secondary school (Gottfried, Fleming, & Gottfried, 2001; Gottfried, Marcoulides, Gottfried, & Oliver, 2009; Martin, 2009; Van der Veen & Peetsma, 2009; Wilson, 2011) and there are indications that at least some aspects of motivation already start to decline during primary school (Gottfried et al., 2001; Hornstra, van der Veen, Peetsma, & Volman, 2013; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002). This may be due, partly, to factors associated with the learning context (Pintrich, 2000; Urdan & Schoenfelder, 2006), including teachers' instructional approach (Nolen, 2003; Volet & Järvelä, 2001; Wigfield, Eccles, Roeser, & Schiefele, 2008). Innovative learning (IL) environments were created, aimed at enhancing students' motivation and thereby learning (Volet & Järvelä, 2001; Wilson, 2011).

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Research on the relation between IL and developments in motivation is however scarce and especially, longitudinal research in this area is lacking. Moreover, not much is known on how the effectiveness of IL, in terms of both motivation and achievement, differs according to students' backgrounds. As students enter the school with different background characteristics, they can differ from each other in their learning needs. What constitutes an optimal learning environment may therefore depend on students' backgrounds. The present study examined how developments in motivation and achievement during the last two years of primary school differ between schools that vary in several aspects of innovativeness, and whether these relations depend on students' background characteristics.

Innovative learning

Innovative approaches to learning refer to a wide variety of instructional approaches – which have also been referred to as 'new learning', natural learning, powerful learning or active learning – that allow for a more active role of students in their own learning process compared to more traditional approaches (Blok, Oostdam, & Peetsma, 2006; Bolhuis & Voeten, 2001; De Kock, Sleegers, & Voeten, 2004; Hickey, 1997; Schuitema, Peetsma, & Van der Veen, 2011; Simons, Van der Linden, & Duffy, 2000). The theoretical basis of IL lies within socio-constructivism, which is a term that describes a wide range of views. These views share the basic assumption that learning can be defined as an active and social process of constructing knowledge and meaning rather than merely a process of knowledge transmission (Duffy & Cunningham, 1996; Gijbels, Watering, Dochy, & Bossche, 2006; Loyens & Gijbels, 2008; Phillips, 1995). In constructivist learning environments, responsibility of the learning process is transferred to students, in contrast to more traditional learning environments in which the teacher mostly directs the learning process (Bolhuis, 2003; Fosnot, 1996; Phillips, 1995; Simons et al., 2000; Wilson, 2011).

These principles of socio-constructivism suggest a different role for teachers. Therefore, teachers in IL environments focus on developing students' self-regulated learning skills for students to be able to direct their own learning (Boekaerts, 1996; Bolhuis, 2003; Corte, Verschaffel, & Masui, 2004; De Kock et al., 2004; Gijbels et al., 2006; Schuitema et al., 2011; Wilson, 2011), they focus on collaborative learning in order for students to construct knowledge in interaction with each other (Corte et al., 2004; De Lisi & Golbeck, 1999; Gijbels et al., 2006) and they provide students with authentic and meaningful learning experiences to activate an active process of learning (Gijbels et al., 2006; Loyens & Gijbels, 2008; Roelofs & Terwel, 1999).

In practice, most schools cannot be considered strictly constructivist or strictly traditional. The term constructivism is a multifaceted concept, it entails multiple aspects and for each of these aspects, schools can vary along a continuum (Duffy & Cunningham, 1996; Loyens & Gijbels, 2008; O'Donnell, 2012; Phillips, 1995; Wilson, 2011). Below, three main characteristics of innovative learning environments – collaborative learning, authenticity of learning and a focus on self-regulation of the learning process – will be described further.

According to socio-constructivist views, the process of knowledge construction is not an individual process (Corte et al., 2004; De Lisi & Golbeck, 1999; Gijbels et al., 2006; Wilson, 2011). Vygotsky (1978) argued that learning is a process of negotiating meaning, which implies that learning is a social process which takes

place in interaction. Learners construct their knowledge in interaction with the teacher, learning materials and with each other. Therefore, in innovative learning environments, students often learn collaboratively. The effectiveness of collaboration between students, mostly referred to as collaborative or cooperative learning has been studied extensively (Johnson & Johnson, 2009; Johnson, Johnson, & Stanne, 2000; Simons et al., 2000). Results indicate that collaborative learning enhances classroom relations (Tolmie et al., 2009) as well as learning outcomes (e.g. Johnson & Johnson, 2009; Johnson et al., 2000; Slavin, 1980), but only when certain conditions are met. Just working together in groups is not enough for collaborative learning to be successful. Students also need to share common goals and have individual accountability, and learning tasks must be suitable for collaboration and even more, evoke true collaboration between students (Johnson & Johnson, 2002, 2009; Johnson et al., 2000; Slavin, 1980; Tomcho & Foels, 2012).

Furthermore, IL environments can also be characterised by authentic learning (ALE) (O'Donnell, 2012; Roelofs & Terwel, 1999; Wilson, 2011). From this perspective, learning is considered a situated activity as it is bound to the specific social and cultural context in which learning occurs (Anderson, Reder, & Simon, 1996). As a result, it is assumed that learning contexts need to be authentic for transfer of knowledge from the classroom to the outside world to occur. In ALE contexts, learning is connected to students' real worlds outside of school and the learning content matches the interests and needs of students (Cronin, 1993; O'Donnell, 2012). Research has shown that embedding content into an authentic context is very important for successful learning (Hattie, Biggs, & Purdie, 1996; O'Donnell, 2012).

Another important aspect in which IL can be distinguished from more traditional approaches is the extent to which there is a focus on the process of learning rather than solely on the learning outcomes (Boekaerts, 1997; Bolhuis, 2003). IL tends to emphasise the process by which students learn in order to enhance learning and self-regulatory skills (Boekaerts, 1997; Loyens & Gijbels, 2008). Pintrich (2004) defined self-regulated learning as a complex process of four phases: orientation, monitoring, control and reflection and during each of these four phases, students regulate their cognitions, motivation and behaviours, while also regulating context conditions. Several meta-analyses (see e.g. Dignath, Buettner, & Langfeldt, 2008; Hattie et al., 1996) showed that teaching students self-regulatory skills effectively enhances learning processes and outcomes.

Over the last decades, various forms of IL have become very common in educational practice (Blok et al., 2006; Duffy & Cunningham, 1996; Hickey, 1997; Phillips, 1995; Simons et al., 2000; Volet & Järvelä, 2001). In the Netherlands, in 1998–1999, IL has been implemented nationwide in secondary education, and also many primary schools have adopted IL approaches (Blok et al., 2006). It is believed that IL offers students a more motivated learning environment (Blok et al., 2006; Boekaerts & Niemivirta, 2000; O'Donnell, 2012). However, not much research has actually examined whether IL actually promotes long-term developments in students' motivation and achievement and which specific aspects of IL are most effective in this respect.

Innovative learning and motivation

IL is believed to enhance students' motivation for learning. It has been argued that more innovative learning environments invite students to experiment and explore, to

learn with and from each other, and to be responsible for their own learning and therefore have great potential for enhancing students' motivation for school (Blumenfeld, 1992; Boekaerts & Niemivirta, 2000; Hickey, 1997; Newmann, Marks, & Gamoran, 1996). Although most learning environment research has focused on achievement outcomes (see for example, Creemers & Kyriakides, 2007; Newmann et al., 1996), several studies have examined the relationship between IL and students' motivational beliefs and motivated behaviour. Motivational beliefs entail many different aspects that refer to students' values. These include intrinsic motivation (Ryan & Deci, 2000), task value (Wigfield & Cambria, 2010), interest (Renninger, 2000) and task orientation, referring to the extent to which students are oriented towards mastering and understanding school-related tasks (Pintrich, 2000). Motivational beliefs also refer to students' feelings of competence and especially self-efficacy is a much studied competence-related construct (Wigfield & Eccles, 2000). It refers to judgements about one's capabilities to carry out actions that are needed to complete academic tasks successfully (Bandura, 1977).

Studies on IL and motivational beliefs have mostly found positive relations. Thoonen, Sleegers, Peetsma, and Oort (2010), for example, found ALE to relate positively to task orientation of upper primary school students, aged 9–12. Likewise, Salinas and Garr (2009) found upper primary school students to be more task-oriented and self-efficacious in learner-centred primary schools when compared to traditional schools. Moreover, Nie and Lau (2010) examined how innovative and traditional learning in English class related to students' task orientation and self-efficacy among a sample of secondary school students in Singapore. Their results indicated that an emphasis on ALE positively predicted both students' task orientation and self-efficacy. Likewise, Lau (2012) showed instructional practices that included ALE and a focus on self-regulation to enhance motivational beliefs of high school students.

In a study with 9- to 11-year-old students that specifically focused on reading instruction in third, fourth and fifth grade, it was found that concept-oriented reading instruction, which included collaboration and ALE, increased students interest in reading in comparison to traditional instruction (Guthrie, Wigfield, & VonSecker, 2000; Wigfield & Guthrie, 2010). Furthermore, in a study by Hänze and Berger (2007), cooperative learning was compared to traditional direct instruction in twelfth-grade science classrooms and it found students to feel more competent and to be more intrinsically motivated in cooperative learning environments than in traditional learning settings. Moreover, in their meta-analysis Dignath et al. (2008) showed that interventions that included process-oriented and collaborative learning considerably enhanced several aspects of motivational values and self-efficacy.

Furthermore, Hickey, Moore, and Pellegrino (2001) examined how an intervention based on principles of constructivism as well as broader educational constructivist reforms related to developments in motivation of grade five students. In schools that had changed their methods to align with constructivist principles, students' interest in school remained stable over time, while students in schools that were less reformed showed a decrease in interest. Results from the intervention showed a different picture, however. Students in the ALE condition reported more negative competence beliefs and found the learning tasks less relevant than students in the traditional learning environment. Other studies also found some negative relations between innovative learning and motivational beliefs. In the aforementioned study by Thoonen et al. (2010), process-oriented instruction related negatively to students' overall feelings of well-being.

A few studies focused specifically on the relation between the learning environment and students' motivated behaviour. An important aspect of motivated behaviour is students' investment of effort. Investment can vary in terms of the intensity, persistence and onset of school-related behaviours (Maehr & Braskamp, 1986; Pintrich, 2004; Schunk, Pintrich, & Meece, 2008). Schuitema et al. (2011) examined how IL was related to developments in students' school investment in the first year of secondary school. No differences were found between schools that were classified as either innovative or traditional. However, when students themselves perceived the learning environment to be more authentic, there was more growth in school investment. Furthermore, a number of studies showed that IL leads to increased use of self-regulated strategies (Lau, 2012) and deeper approaches to learning, meaning cognitive processes that lead to a deeper understanding of information (Baeten, Kyndt, Struyven, & Dochy, 2010; Nie & Lau, 2010; Marton & Säljö, 2011), while traditional teaching was associated with higher level of surface approaches to learning, referring to strategies such as selective memorisation (e.g. Baeten et al., 2010; Gow & Kember, 1993; Nie & Lau, 2010; Trigwell, Prosser, & Waterhouse, 1999). Moreover, in their meta-analysis Dignath et al. (2008) also showed that interventions aimed at collaborative and process-oriented learning increased students' use of meta-cognitive strategies.

Most of the studies described above are either cross-sectional or based on intervention studies. Although results appear to be somewhat mixed, most outcomes seem to show that IL indeed has the potential of enhancing motivational beliefs and behaviours. In addition, longitudinal research in real-life classroom settings can contribute to our understanding of how IL relates to long-term developments in motivation and achievement. In longitudinal studies, students' initial level of motivation or achievement can be taken into account in order to examine whether students' developments in motivation and achievement depend on the level of innovativeness of a school. This can further our understanding on how the learning context contributes to the observed decline in motivation (e.g. Jacobs et al., 2002) Furthermore, more research is needed to examine which specific aspects of IL are most effective and whether these aspects of IL are equally motivating for different types of students.

Innovative learning and students' social and ethnic background

The effectiveness of innovative learning may depend on students' socio-economic or ethnic backgrounds. Hornstra et al. (2013) examined developments in students' motivation in the last years of primary school and found that school investment developed less positively for ethnic minority students and students with less-educated parents than for other groups. A mismatch between these students' home environments and their learning environment may account for these findings as students' success in school is related to having a good person-environment fit (Roeser, Eccles, & Sameroff, 2000). Likewise, the 'cultural compatibility hypothesis' (e.g. Tharp, 1989) states that school environment needs to match students' cultural backgrounds. In other words, learning environments that are congruent with students' home environments, for example, in terms of the way of communicating or the amount of freedom and responsibility that is given to a child, will likely be more motivating and lead to better performance outcomes. Although students' home and school culture can differ in many different ways, the focus of this paper is on the extent to which students' ethnic and socio-economic background characteristics relate to the effectiveness of IL.

There are several reasons why effectiveness of IL may depend on students' ethnic or socio-economic background. Cross-cultural studies, for example, found parents from collectivist cultures to be more directive, while parents from western cultures tend to deliberate more with their children (Stewart & Bond, 2002). Also, less-educated parents have been found to show more authoritarian parenting behaviours in comparison to parents who attained higher educational levels (Shucksmith, Hendry, & Glendinning, 1995). In IL environments, the instructional situation is less stringent and more uncertain than traditional learning (Huber, 2003), which may conflict with the more directive or authoritarian parenting styles some students may be accustomed to at home, particularly those students from lower socio-economic backgrounds or ethnic minority students with backgrounds from collectivist cultures (Hermans, 1995).

Furthermore, IL requires students to be able to regulate their own learning. Research has indicated that students from more socio-economically disadvantaged backgrounds on average show less self-regulated learning behaviours (Cleary & Chen, 2009; Pappas, Ginsburg, & Jiang, 2003; Rowe, 2006), suggesting that they would benefit less from learning environments that requires them to self-regulate their learning (Rowe, 2006). On the other hand, however, this can also imply that for these students it is especially important to focus on developing self-regulatory strategies. Results on differential effects of IL are not conclusive. Some have found that students from lower socio-economic backgrounds would benefit mostly from a highly structured, teacher-centred learning environment with much direct instruction, but that is also authentic to them (Guthrie, 1989; Hopkins & Reynolds, 2001). Other studies only found small or no differences between different ethnic or socio-economic groups with regard to their motivational beliefs and behaviours (e.g. Salinas & Garr, 2009). It was also found that students at schools with a more disadvantaged student population achieved slightly higher in more traditional learning environments (Overmaat & Ledoux, 2002).

The few studies that have examined differential effects of IL for students with different social or ethnic backgrounds were mostly cross-sectional and focused mainly on achievement outcomes. Not much is known about the effectiveness of IL for different groups with regard to long-term developments in both achievement and motivation. To understand whether IL contributes to existing achievement and motivational gaps between students with varying backgrounds and gender, it is important to identify whether these background characteristics relate to the effectiveness of different learning environments.

Innovative learning and students' gender

More recently, boys have increasingly attracted attention in educational science, as there are indications that their educational careers throughout the years may be less successful than that of girls (Epstein, Elwood, Hey, & Maw, 1998; Tyre, 2006; Houtte, 2004; Veendrick, Tavecchio, & Doornenbal, 2004). Furthermore, Hornstra et al. (2013) showed that toward the end of primary school boys' investment in school declined, while girls' investment increased. It has been argued that learning styles differ by gender (Severiens & Dam, 1997) and that there are gender-specific processes involved in the development of motivation for school (Houtte, 2004), due to which some learning environments may not be equally motivating or effective in enhancing achievement outcomes for boys and girls. Johnson and Engelhard (1992),

for example, found girls tend to prefer collaborative learning more than boys. Philbin, Meier, Huffman, and Boverie (1995) studied learning environment preferences of adult learners and found men to prefer traditional learning environments. Demirbas and Demirkan (2007), on the other hand, did not find any differences in learning style preferences between male and female learners. Few studies have actually examined whether the effectiveness of learning environments differs by gender. One exception is an intervention study by Timmermans, Van Lieshout, and Verhoeven (2007) that found girls' motivation and achievement in mathematics increased in an innovative learning environment, whereas boys' achievement slightly increased in a traditional learning environment. These outcomes could suggest that innovative learning environments are more effective for girls and less able to suit the educational needs of boys. However, more empirical research is needed to examine whether innovative learning environments are differentially effective for boys and girls.

Research questions

The present study aimed at examining how IL relates to developments in motivation as well as achievement and how this may differ across groups. The following research questions were addressed:

(1) Does the extent of innovativeness of the learning environment (i.e. authenticity of the learning environment, collaborative learning and focusing on self-regulation) positively relate to developments in students' motivation and achievement during the last two years of primary school?
(2) To what extent do relations between innovativeness of the learning environment and developments in students' motivation and achievement during the last two years of primary school vary by gender, social and ethnic background?

Method

Design

From grade five to six, four waves of data were collected. Students filled out self-report questionnaires on their motivational beliefs twice a year: at the beginning of both years and halfway through both years. During each of these measurements, the participating teachers rated the motivated behaviour of each of their students. Furthermore, at the beginning of both school years, teachers reported on the extent to which the learning environment could be described as innovative. Table 1 shows a schematic overview of the data collection.

Participants

Students

A sample of 722 primary school students from 37 classes of 25 schools across the Netherlands participated in this study. At the first measurement, all students were in grade five and their average age was 11 years. Three hundred and sixty-one students (50.0%) were boys and 361 students (50.0%) were girls.

Table 1. Schematic overview of waves of data collection.

Wave	Measure	Grade	Months
1	• Teacher reports of the learning environment • Student questionnaire on motivational beliefs • Teacher ratings of motivated behaviour	Beginning of grade 5	September/October, 2009
2	• Student questionnaire on motivational beliefs • Teacher ratings of motivated behaviour	Middle of grade 5	January–March, 2010
3	• Teacher reports of the learning environment • Student questionnaire on motivational beliefs • Teacher ratings of motivated behaviour	Beginning of grade 6	September/October, 2010
4	• Student questionnaire on motivational beliefs • Teacher ratings of motivated behaviour	Middle of grade 6	January–March, 2011

Schools provided information on the ethnic origin of the parents. A dichotomy was made between ethnic majority and non-western ethnic minority students, based on the country of origin of the mother. When a student was from a single-parent family, ethnicity was determined based on the ethnicity of this parent (see Table 2). The group of ethnic minority students consisted of students with backgrounds in non-western countries. These students had in common the fact that they are from immigrant backgrounds, their parents are from countries with collectivistic cultures, these students speak Dutch as a second language and, on average, these groups tend

Table 2. Ethnic background and PEL of participants in the study.

Ethnic background	%	*n*	Parental educational level	%	*n*
Ethnic majority (Dutch, other Western and European countries)	89.2	644	Low: maximum lower vocational education	16	96
Ethnic minority (Morocco, Turkey, Dutch-Antilles, Surinam, Iraq and other non-western countries)	10.8	78	Middle: maximum intermediate vocational education	50.1	301
			High: higher education	33.9	204

to lag behind in school compared to Dutch background students (Driessen, Mulder, Ledoux, Roeleveld, & Van der Veen, 2009). Because of these similarities in cultural background, language and school performance, these students are often treated as one group in research and educational policies. Schools in the Netherlands, for example, received similar additional funding for non-western ethnic minority student, regardless of their specific country of origin. To ascertain whether these students could also be treated as one group in the analyses of this study, additional analyses of variance (MANOVA's) were performed. These analyses were aimed at checking whether the subgroups within the ethnic minority group were indeed similar in motivation and achievement. Results demonstrated that the different ethnicities within the groups of ethnic minority students did not differ in terms of their task orientation, self-efficacy and school investment at any of the measurements, and only showed one a slight difference (small effect size) in reading comprehension (RC) and one small difference in mathematics achievement, while RC and math achievement scores were similar at all other measurements. Therefore, these subgroups were treated as one group in the analyses of this study. Likewise, MANOVA's demonstrated no significant differences in motivation or achievement between Dutch students and students with parents from another European or western country. Therefore, all ethnic majority students (Dutch and students with parents from other Western countries) were treated as one group in the analyses. In comparison to the group of majority students, the number of ethnic minority students was relatively small (644 vs. 78 students). However, this number is sufficient to perform multigroup latent growth curve analyses, especially because in longitudinal studies, power considerably increases and necessary sample size decreases with more measurements (Hedeker, Gibbons, & Waternaux, 1999; Zhang & Wang, 2009).

Information on parental educational level (PEL) was also provided by the schools. Although socio-economic status also depends on family income and occupation (Duncan, Featherman, & Duncan, 1972), PEL is considered a suitable proxy of SES, as it is one of the most stable aspects of SES and, moreover, it is also an indicator of family income (Sirin, 2005). Three groups were distinguished based on the highest educational level attained by either of the parents (see Table 2). From 121 students, PEL information was missing.

Analyses showed a small but significant relation between the ethnicity and PEL of the students in this sample (*Spearman's Rho* = .112, $p < .05$). In comparison to ethnic majority students, ethnic minority students are significantly more likely to be in the low PEL group ($\chi^2(2) = 8.706$, $p < .05$). There appears to be some, but not full overlap between PEL and ethnicity. Therefore, we decided to examine the role of PEL and ethnicity separately with regard to the relation between the learning context and motivation and achievement, while controlling for the other background variables.

Teachers

Thirty-seven grade five and 31 grade six teachers participated. There was a higher number of grade five teachers than grade six teachers, because three classes continued with the same teacher in grade six, one school combined two grade five groups in the following year to one grade six group, and two grade six teachers did not fill out the questionnaire. The grade five teachers were on average 37 years old,

68% women and 32% men. The grade six teachers were on average 41 years old, 63% women and 37% men. All teachers were of Dutch origin.

Instruments

During each data collection wave, questionnaires were administered to the students and their teachers during regular class time. All items were on a 5-point Likert scale ranging from totally not applicable to me (1) to totally applicable to me (5) The following measures were included in the study.

Motivation

Motivational beliefs were measured through self-reports. Although self-report measures have some limitations, as they are susceptible to self-presentation bias and require students to be fully aware of their underlying motivational beliefs (Jobe, 2000), the internal nature of motivational beliefs makes students' own ratings a suitable measure of motivation. Motivation-related behaviour, however, is a visible part of motivation and was, therefore, assessed through teacher ratings of students' school investment. Table 3 shows the instruments that were included.

Achievement

Math achievement. Students' mathematics achievement scores on national tests from the Dutch National Institute for Educational Measurement (CITO) were obtained from the school records. These tests are administered to students in the Netherlands twice a year to monitor student progress. For each student, four scores on these tests were available: from the end of fourth grade until the middle of sixth grade. Two different versions of this test were used by the schools because the test was updated by the CITO in 2007. Some schools ($N = 6$) in the sample used the older version, while other schools ($N = 18$) administered the updated version to their students. The

Table 3. Example items, number of items, and reliabilities of the motivation scales used in the study.

Scale	Example items	*N* of items	Internal consistency (α) m1–m4
Task-orientation from goal Orientation Questionnaire (Seegers, Van Putten, & De Brabander, 2002)	'I like when I learn something new in school'	5	.74–.82
Academic self-efficacy from 'Patterns of Adaptive Learning Survey' (PALS) (Midgley et al., 2000)	'I can do even the hardest work in school if I try'	6	.76–.84
School investment from COOL student profiles (Jungbluth, Peetsma, & Roeleveld, 1996).	'This student quickly gives up when he/she does not succeed.' 'This child works accurately'	3	.82–.85

scores on both versions were not comparable; therefore, scores of the older version were transformed so that the mean and standard deviation of the scores on the older version of the test were the same as those of the newer version. One school did not administer CITO tests to their students ($N = 30$). The CITO math tests are found to have good reliability ($\alpha > .80$) (Evers, 2002; Feenstra, Kamphuis, Kleintjes, & Krom, 2010).

Reading comprehension (RC) achievement. Students' RC scores on the national tests (CITO) were also obtained from the school records. The RC tests are administered once a year to monitor student progress. For each student, three scores on these tests were available: from the middle of fourth grade until the middle of sixth grade. The RC tests were updated by the CITO in 2008. Sixteen schools in the sample used the older version, while eight schools administered the updated version to their students. Both versions of the test use the same scale and indeed analyses showed scores on both versions to be comparable (Feenstra et al., 2010). Both versions had good reliability ($\alpha > .80$) (Evers, 2002; Feenstra et al., 2010).

Innovative learning

To gain insight into the extent students' learning environments could be considered innovative, teacher perceptions of the learning environments were measured through a questionnaire. The use of teacher perceptions of the learning environment has been critiqued because it would be biased by teacher ideals or self-serving strategies (Wubbels, Brekelmans, & Hooymayers, 1992). However, Kunter and Baumert (2006) have investigated whether ideals or self-serving strategies indeed affected teacher perception measures and could find no evidence for that claim. They showed that teacher perceptions showed considerable overlap with student measures of the learning environment in predicting student outcomes, but both types of measures also had their own unique contribution. In general, teachers tend to rate the learning environment a bit more favourable than their students, but in all, the level of agreement between teachers and students tends to be rather high (Fraser, 1982).

At the beginning of the school year, the teachers in both grade five and six reported the extent to which the learning environment was innovative. The questionnaire on IL consisted of three scales, collaborative learning, ALE and focus on self-regulated learning (see Table 4), which are three key aspects of innovative learning (e.g. Blok et al., 2006; Boekaerts, 1997; Bolhuis, 2003; Roelofs, Visser, & Terwel, 2003; Simons et al., 2000). Collaborative learning was measured by a scale by Thoonen et al. (2010). The items represent the extent to which teachers let students collaborate according to the conditions that make collaborative learning effective, i.e. sharing common goals, individual accountability and learning tasks must evoke collaboration (Johnson & Johnson, 2002; Slavin, 1980). ALE was also measured by a scale by Thoonen et al. (2010). The items represent the extent to which learning is related to students' lives, their interests and needs of students (Cronin, 1993). The third scale, focus on self-regulation, consisted of a combination of five items by Thoonen et al. (2010) and four items from the Questionnaire on Instructional Behaviour (Lamberigts & Bergen, 2000). The items represent the extent to which teachers emphasise the process by which students learn in order to enhance learning and self-regulatory skills (Boekaerts, 1997; Loyens & Gijbels, 2008). All scales were answered on a 5-point Likert scale and demonstrated satisfactory to good reliability.

Table 4. Items, factor loading on their respective scales and reliabilities of the IL scales.

Scale	Items	Factor loading CL	Factor loading AL	Factor loading SR	Internal consistency (α) m1; m3
Collaborative learning	*During group work, I ask students to come to a joint result*	.61			.63; .77
	I let students present their assignments to each other	.46			
	After group work, I discuss in class how their collaboration in groups went	.53			
	Assessment of group work is the result of joint deliberation between me and the students	.40			
	I invest effort in good group assignments	.56			
Authentic learning	*I give students opportunities to share information or their own experiences in class*		.61		.76; .74
	I adapt the content of my lessons as much as possible to the students' perceptions of their environments		.68		
	When choosing topics, I use students' ideas		.80		
	I choose examples that relate to students		.57		
Focus on self-regulation	*I explain to students that the approach of discovering the right answer is at least as important as the answer itself*			.55	.75; .71
	I ask students how they came to a solution			.68	
	I encourage students to discover the solution to a problem themselves			.58	
	When a student asks a question, I don't give them the answer, but I give them directions			.52	
	I try to teach in such a way that students hink about the way to approach a learning task			.85	
	I focus on how to study for a test			.58	
	Students are allowed to decide how they want to work on tasks			.75	
	I let students decide the pace in which they want to work			.69	
	I give students freedom to plan their own work			.68	

Factor analyses with the data from both the grade five and grade six teachers supported the underlying factor structure of this questionnaire in these three scales. All items had factor loadings over .40 on the scale they represented.

To furthermore validate the use of teacher questionnaires, we observed lessons at three schools and interviewed grade five teachers at nine schools that differed in the extent the teachers rated the learning environment as more innovative. A clear relation was found between the teacher reports of the learning environment and their responses in the interviews, and the actual teaching behaviours that they showed in their lessons (Koomen, Hornstra, Peetsma, & Van der Veen, 2011). Furthermore, a year later nine grade six teachers and 45 students were interviewed. The interview responses of both the teachers and their students were coded on the level of innovativeness and these responses were significantly positively related to each other ($r = .24$ for ALE and $r = .44$ to $r = .80$ for other aspects of innovative learning). Moreover, the interview responses of both teachers and their students correlated positively with responses of the teachers on the questionnaire scales. Teachers' questionnaire responses on collaborative learning correlated positively with their own interview responses as well as students' interview responses on collaborative learning ($r = .52$ and $r = .59$, respectively). The questionnaire scale on ALE also correlated positively with teachers' and students' interview responses on ALE ($r = .26$ and $r = .43$, respectively). In these interviews, we also asked whether responsibility of the learning process was transferred to students, and both students' and teachers' interview responses correlated highly with all three questionnaire scales ($r = .63$ to $r = .85$) and we asked whether their assessment methods were innovative which also correlated positively with the questionnaire scales ($r = .17$ to $r = .38$).

Data analyses

Autoregression analyses were performed. With these analyses, it is possible to examine how a predictor relates to growth in a dependent variable from one specific time point to another, by controlling for a previous measurement of that dependent variable (Bast & Reitsma, 1997). Other types of longitudinal data analyses (e.g. Latent Growth Modelling) estimate one variable to represent overall growth from the first to the last measurement. As we examined the relations between two sets of predictors at different time points, relating those two sets to one estimate for growth was not suitable. With autoregression analyses, it was possible to examine how aspects of IL in grade five related to the initial level and growth of motivation or achievement in grade five, and how aspects of IL in grade six related to further growth after grade five.

The autoregression models were estimated using structural equation modelling with the programme Mplus (Muthén & Muthén, 1998). Participants with missing values were not removed from the analyses. Instead, missing values were estimated by full-information maximum-likelihood estimation (FIML). The FIML estimation is based on the assumption that missing values are missing at random (MAR). MAR assumes that missing values can be predicted from the available data. Removing all cases with missing values (listwise deletion) is based on the more strict assumption that the missing values are completely at random.

As the number of participants did not allow for full inclusion of the measurement (i.e. factor) model of every variable, the factor scores of each variable were included as observed variables. To support this decision, the factor structure of each variable

was explored and all factor models showed good fit to the data (CFI and TLI were above .95). Furthermore, before the autoregression analyses were performed, we checked for measurement invariance across measurement occasions and groups. For measurement invariance across groups (boys vs. girls, Dutch vs. ethnic minority students and low vs. middle vs. high PE), a model was estimated for each variable in which factor loadings and covariances were held equally across groups. Likewise, to check for measurement invariance across measurement occasions, multi-group factor analyses were performed with groups being the measurement occasions. All models fitted the data well (CFI and TLI were above .95) and fit was not significantly better in less restrictive models.

Separate autoregression models were estimated for each motivational construct and for both achievement measures. To examine how IL related to developments in motivation or achievement, autoregressive paths were estimated for each of the motivation and achievement variables, all of which were measured four times (with the exception of RC achievement, which was measured three times). Moreover, paths between innovative learning environments and motivation or achievement were included in the model to examine whether IL contributed to motivation or achievement beyond what was predicted by a previous measurement of that variable. The level of significance was set at 5%. See Figure 1 for an example of the autoregression model for task orientation. Comparable models were estimated for self-efficacy and school investment.

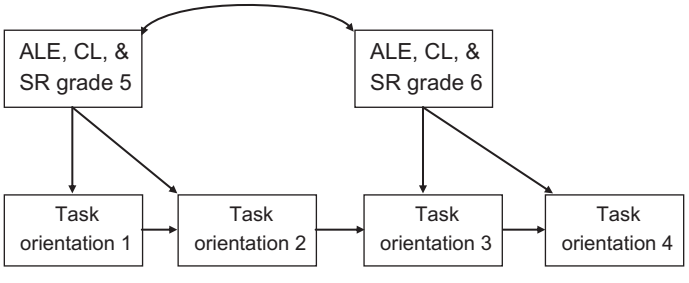

Figure 1. Autoregression model for the relation between innovative learning environments and task orientation.

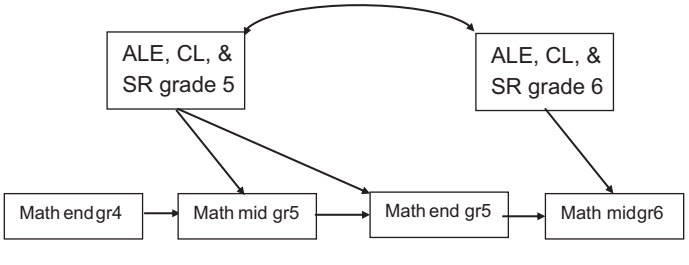

Figure 2. Autoregression model for the relation between innovative learning environments and math achievement.

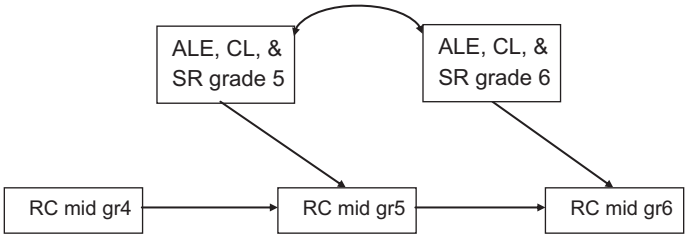

Figure 3. Autoregression model for the relation between innovative learning environments and RC achievement.

Because achievement in math and RC was measured at different time points than motivation, those models looked a bit different. Figures 2 and 3 show the models that were estimated to examine the relations between innovative learning environments and achievement in math and RC, respectively.

All models were first estimated for the total group of students (research question 1) while controlling for gender, ethnicity and PEL. As the data have a nested structure (students within classes), we corrected for the multilevel structure of the data. Non-significant paths were omitted from the model to find the most parsimonious model. Model fit was determined by Chi-square difference tests, the comparative fit index (CFI) and the root mean square error of approximation (RMSEA). A significant Chi-square difference indicates whether or not model fit significantly worsened by omitting an estimate. A CFI above .90 indicates good fit of a model, and an RMSEA below .05 indicates good fit and scores between .05 and .08 indicate reasonable fit (Hu & Bentler, 1999).

Next, to answer research question 2 regarding whether relations between the learning environment and developments in motivation and achievement differed across groups, multi-group comparisons were made with groups being boys vs. girls, ethnic minority vs. majority students, and low PEL students vs. middle and high PEL students, while controlling for the remaining control variables. For these multi-group analyses, first a model with no equality constraints was defined. One by one, equality constraints were added to the model. Fit indices indicated whether or not model fit significantly declined by adding the equality constraint, indicating that a parameter differed across the groups. If the model fit did not significantly worsen by adding the equality constraint, the parameter was considered equal.

To evaluate the size of the relations between learning context and developments in motivation or achievement, standardised coefficients (i.e. correlations) of the relations were calculated and the size of the effect was indicated by means of Cohen's *d*. A standardised correlation of .1 is indicative of a small, .3 of a medium, and .5 of a large correlation (Cohen, 1988).

Results

Descriptive statistics

Table 5 provides an overview of the descriptive statistics of the total group of students and separately for boys and girls, ethnic minority and majority students, and for low, middle and high PEL students. It also reports intra-class correlations (ICC) of each variable. The ICC shows the proportion of the total variance that occurs at

Table 5. Descriptive statistics of TO, SE, SI, Mathematics, and RC for the total group of students and by gender, ethnicity and PEL.

				Gender				Ethnicity				Parental education level					
	Total group			Boys		Girls		Majority		Minority		Low		Middle		High	
Variable	*M*	*sd*	*ICC*	*M*	*sd*	*M*	*sd*	*M*	*sd*	*M*	*sd*	*M*	*sd*	*M*	*sd*	*M*	*sd*
TO start grade 5	4.05	.54	.07	4.04	.55	4.06	.54	4.03	.53	4.24	.58	4.19	.51	4.08	.53	4.01	.56
TO middle grade 5	3.93	.60	.04	3.90	.63	3.95	.56	3.90	.59	4.20	.59	4.06	.54	3.98	.60	3.92	.63
TO start grade 6	3.92	.59	.08	3.87	.61	3.98	.57	3.89	.57	4.25	.66	4.12	.66	3.91	.56	3.94	.60
TO middle grade 6	3.85	.61	.08	3.84	.64	3.86	.59	3.81	.59	4.23	.65	4.02	.65	3.90	.64	3.85	.60
SE start grade 5	3.62	.51	.04	3.68	.50	3.57	.51	3.60	.49	3.82	.57	3.72	.55	3.58	.49	3.62	.50
SE middle grade 5	3.66	.57	.03	3.73	.55	3.58	.58	3.63	.56	3.95	.65	3.82	.62	3.56	.57	3.69	.52
SE start grade 6	3.73	.57	.08	3.77	.56	3.68	.59	3.69	.57	4.02	.55	3.85	.58	3.63	.55	3.78	.55
SE middle grade 6	3.76	.61	.07	3.81	.62	3.72	.60	3.73	.59	4.04	.67	3.87	.64	3.67	.55	3.83	.61
SI start grade 5	3.44	.93	.05	3.19	.94	3.68	.86	3.46	.91	3.21	1.04	3.42	1.04	3.25	.93	3.60	.90
SI middle grade 5	3.44	.98	.11	3.19	.98	3.70	.90	3.48	.94	3.08	1.23	3.32	1.21	3.08	1.00	3.66	.87
SI start grade 6	3.43	.88	.11	3.15	.88	3.70	.78	3.47	.86	3.16	.94	3.32	.92	3.22	.80	3.59	.88
SI middle grade 6	3.53	.87	.05	3.26	.89	3.79	.78	3.57	.84	3.23	1.05	3.33	1.01	3.34	.78	3.70	.82
Math end grade 4	85.78	15.22	.26	88.38	14.73	82.82	15.25	86.49	15.20	79.66	14.06	83.38	12.65	87.30	14.03	91.03	13.80

(*Continued*)

Table 5. (*Continued*).

				Gender				Ethnicity				Parental education level					
	Total group			Boys		Girls		Majority		Minority		Low		Middle		High	
Variable	*M*	*sd*	*ICC*	*M*	*sd*	*M*	*sd*	*M*	*sd*	*M*	*sd*	*M*	*sd*	*M*	*sd*	*M*	*sd*
Math middle grade 5	95.68	15.56	.24	98.07	15.57	92.95	15.12	96.26	15.56	91.08	14.86	94.70	9.98	95.94	15.42	98.91	15.40
Math end grade 5	103.22	12.46	.14	105.76	12.38	100.28	11.93	104.71	11.08	94.64	16.15	99.18	9.70	103.96	11.94	107.63	10.13
Math middle grade 6	107.71	15.13	.17	109.98	15.98	104.98	13.60	107.80	14.99	106.94	16.38	102.73	13.24	107.96	14.01	108.11	18.86
RC middle grade 4	34.58	13.80	.24	33.72	14.29	35.45	13.26	35.64	13.67	26.37	12.07	30.35	12.16	31.36	13.86	37.63	13.49
RC middle grade 5	44.02	14.50	.12	42.97	14.48	45.09	14.46	44.89	14.54	36.30	11.67	40.20	13.22	38.12	14.45	49.94	15.10
RC middle grade 6	57.93	16.58	.06	58.05	17.24	57.83	15.96	59.06	16.57	48.38	13.40	54.52	17.96	51.92	13.08	64.95	17.36

the classroom level. It is a measure of the extent to which the values of individuals in the same group resemble each other as compared to those from different groups. The remaining variance is variance at the individual (student) level. Table 6 displays the descriptive statistics of and correlations between the teacher variables ALE environment, focus on self-regulation and collaborative learning in grade five and grade six. The correlations between aspects of IL in grade five and grade six represent the degree of correspondence between the grade five and six teachers on aspects of IL. Table 6 shows that the level of correspondence is rather low.

Autoregression analyses of relations between innovative learning environments and developments in students' motivation and achievement

For each aspect of motivation and achievement, a model was estimated for the total group of students and separate models for the multi-group comparisons. After omitting non-significant paths and adding equality constraints in the multi-group models, all final models showed good fit to the data (see Table 7). The outcomes of these analyses are reported in Table 8, including the autoregression coefficients, the regression coefficients for relations between the control variables and motivation and achievement, and the regression coefficients for relations between aspects of IL and motivation and achievement. Even though data were analysed separately for each motivational and achievement variable (as was shown in Figures 1 –3), in the next sections, the results are presented according to the different aspects of the learning context for the sake of presenting the data in an orderly way.

The relations of authenticity of the learning environment, collaborative learning and focusing on self-regulation with motivation and achievement are displayed in Figures 4–6, respectively (in addition to Table 8). In these figures, arrows represent

Table 6. Descriptive statistics of teacher variables ALE environment, focus on self-regulation, and collaborative learning in grade five and grade six.

	Descriptive statistics				Correlations					
	M	*SD*	Min	Max	1	2	3	4	5	6
Grade 5										
1. Authentic learning environment	3.74	.38	2.75	4.50	1.00					
2. Collaborative Learning	3.68	.51	2.80	5.00	.17*	1.00				
3. Focus on Self-Regulation	3.94	.34	3.22	4.56	.12*	.51**	1.00			
Grade 6										
4. Authentic learning environment	3.84	.48	3.00	5.00	.16*	.37*	.21*	1.00		
5. Collaborative Learning	3.78	.62	2.50	5.00	−.19*	.24*	−.01	.63**	1.00	
6. Focus on Self-Regulation	4.00	.38	3.44	4.89	.07	.17*	.21*	.67**	.62**	1.00

**$p < .001$; *$p < .05$.

Table 7. Fit statistics of the autoregression models.

	Total group	Multigroup comparisons		
		Gender	Ethnicity	PEL
Task orientation				
χ^2 (df)	13.203 (13)	28.793 (25)	24.652 (17)	37.047 (31)
CFI	.999	.978	.937	.955
RMSEA	.005	.022	.037	.032
Self-efficacy				
χ^2 (df)	11.151 (12)	24.118 (22)	21.271 (16)	36.289(31)
CFI	1.000	.989	.949	.964
RMSEA	.000	.017	.032	.030
School investment				
χ^2 (df)	12.423 (12)	22.702 (22)	19.695 (17)	28.701 (28)
CFI	.995	.993	.973	.992
RMSEA	.007	.009	.021	.011
Reading comprehension				
χ^2 (df)	15.631 (12)	30.868 (23)	24.297 (18)	39.216 (28)
CFI	.980	.971	.965	.948
RMSEA	.020	.031	.031	.045
Math				
χ^2 (df)	10.209 (12)	19.883 (24)	19.916 (18)	34.143 (31)
CFI	1.000	1.000	.990	.972
RMSEA	.000	.000	.017	.023

significant relations. With regard to the multi-group comparisons, only when there were significant differences between groups, the specific results for each group are displayed. When specific groups are not explicitly mentioned, results for these groups were similar to the results of the total group. All motivational and achievement variables are included in these figures with the exception of RC, as there were no significant relations between innovative learning and RC at any time point or for any of the groups.

Relations between collaborative learning and developments in motivation and achievement

Figure 4 shows the relations between collaborative learning and developments in motivation and achievement. No significant relations were found between collaborative learning and developments in task orientation and self-efficacy. A positive relation ($r = .30$) between collaborative learning, as reported by the grade 6 teacher, and school investment at the first measurement in grade six was found to be significant. When teachers rated the learning environment one standard deviation (.62 points) higher on collaborative learning, the growth in school investment

from fifth grade to the middle of sixth grade was on average .19 (.62 × .30) points higher. This was found across all groups.

Authenticity of the learning environment and developments in motivation and achievement

Figure 5 shows the relations between authenticity of the learning environment and developments in motivation and achievement. First, the results show a positive relation between authenticity with task orientation at the first measurement and a negative relation with task orientation at the second measurement in grade five. That is, after autoregression of the second measurement on the first measurement, there is a negative relation between authenticity and growth in task orientation. This suggests that in classes where teachers reported higher levels of authenticity, students are initially more task oriented but they also show a more negative development in task orientation over time.

Such a pattern was found for all groups, only the three PEL groups showed significant differences in the relation between authenticity and task orientation. The positive relation between authenticity of the learning environment with task orientation at the first measurement and the negative relation with task orientation at the second measurement were only found for middle PEL students, and were somewhat stronger than what was found for the total group. For both low and high PEL students, the degree of authenticity did not significantly relate to task orientation at any of the measurements.

More specifically, in classes where teachers rated themselves 1 *sd* (.38) higher on authenticity, scores on task orientation would on average be .11 (.38 × .28) points higher. Moreover, 1 *sd* higher in authenticity would be furthermore associated with a decrease in task orientation from the first to the second measurement of .08 (.38 × .21) points. Task orientation is already found to decrease from the first to the second measurement (as can be deducted from Table 5). For middle PEL students, a more authentic environment would thus be associated with an even stronger decrease.

Furthermore, the results also showed a positive relation of authenticity of the learning environment with self-efficacy at the first measurement. This was found across all groups, except high PEL students. For high PEL students, no relation between authenticity and self-efficacy was found. Moreover, multi-group analyses showed a negative relation between growth in self-efficacy from the first to the second measurement and authenticity for low and middle PEL students, suggesting that for both low and middle PEL students, a teacher rating of one *sd* higher in authenticity was associated with .10 (.38 × .26) points higher self-efficacy at first measurement, but also a decrease in self-efficacy of .07 (.38 × .18) points from the first to the second measurement.

ALE in grade five furthermore related negatively to growth in mathematics achievement. Multi-group comparisons between boys and girls showed that this negative relation between authenticity and growth in mathematics achievement was only found for boys. While on average boys' math achievement increased 7.69 points from the middle of grade five until the end of the year, boys showed 2.27 (.38 × 5.97) points less growth in math when the learning context in grade five was rated one *sd* higher on authenticity. For girls, authenticity was not related to growth in mathematics achievement. Likewise, a negative relation was only found for low PEL students, while no significant relation was found for middle and high PEL

Table 8. Unstandardized autoregression coefficients and regression coefficients for relations of motivation/achievement with control variables and with ALE, collaborative learning (CL), and focus on self-regulation (SR) for the total group and by PEL, ethnic background, and gender.

		Parental educational level			Ethnicity		Gender	
	Total group	Low	Middle	High	Majority	Minority	Boy	Girl
Autoregression coefficients for task-orientation								
TO1 → TO2	.57 (.04)	.30 (.11)	.58 (.06)	.67 (.07)	.58 (.04)	.49 (.12)	.61 (.06)	.51 (.05)
TO2 → TO3	.51 (.04)	.48 (.11)	.52 (.07)	.50 (.05)	.54 (.04)	.39 (.12)	.50 (.06)	.53 (.06)
TO3 → TO4	.48 (.03)	.58 (.13)	.46 (.06)	.51 (.07)	.47 (.04)	.35 (.12)	.53 (.05)	.42 (.05)
Regression coefficients for control variables and task-orientation[*]								
Etn Min → TO1	.10 (.04)	*ns*	*ns*	.09 (.04)	*ns*	*ns*	*ns*	.11 (.04)
Etn Min → TO2	.13 (.04)	.23 (.08)	.11 (.04)	.15 (.06)	*ns*	*ns*	*ns*	.18 (.05)
Etn Min → TO3	.12 (.03)	*ns*	*ns*	.06 (.03)	*ns*	*ns*	*ns*	.14 (.04)
Etn Min → TO4	.09 (.02)	*ns*	*ns*	*ns*	*ns*	*ns*	.16 (.05)	*ns*
Girl → TO1	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
Girl → TO2	*ns*	*ns*	*ns*	*ns*	*ns*	.16 (.07)	*ns*	*ns*
Girl → TO3	*ns*	*ns*	*ns*	*ns*	*ns*	.15 (.06)	*ns*	*ns*
Girl → TO4	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
Regression coefficients for relations between task-orientation and aspects of innovative learning								
ALE5 → TO1	.20 (.07)	*ns*	.28 (.08)	*ns*	.19 (.06)	.19 (.06)	.19 (.07)	.19 (.07)
ALE5 → TO2	−.13 (.08)	*ns*	−.21 (.09)	*ns*	−.21 (.06)	−.21 (.06)	−.13 (.07)	−.13 (.07)
Autoregression coefficients for self-efficacy								
SE1 → SE2	.66 (.05)	.61 (.08)	.85 (.06)	.61 (.07)	.65 (.04)	.57 (.13)	.60 (.05)	.69 (.06)
SE2 → SE3	.56 (.03)	.51 (.08)	.59 (.08)	.58 (.08)	.57 (.03)	.38 (.07)	.61 (.05)	.51 (.04)
SE3 → SE4	.45 (.03)	.47 (.06)	.44 (.04)	.41 (.06)	.42 (.03)	.67 (.13)	.42 (.03)	.47 (.04)
Regression coefficients for control variables and self-efficacy[*]								
Etn Min → SE1	.10 (.03)	*ns*	.26 (.09)	.17 (.05)	*ns*	*ns*	*ns*	*ns*
Etn Min → SE2	.09 (.04)	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
Etn Min → SE3	.08 (.03)	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
Etn Min → SE4	.06 (.03)	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*

Girl → SE1	−.07 (.03)	*ns*	−.12 (.06)	−.17 (.04)	−.10 (.03)	*ns*	*ns*	.18 (.04)
Girl → SE2	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	.10 (.04)
Girl → SE3	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	.06 (.03)
Regression coefficients for relations between self-efficacy and aspects of innovative learning								
ALE5 → SE1	.16 (.07)	.26 (.08)	.26 (.08)	*ns*	.10 (.01)	.10 (.01)	.16 (.08)	.16 (.08)
ALE5 → SE2	*ns*	−.18 (.06)	−.18 (.06)	*ns*	*ns*	*ns*	*ns*	*ns*
Autoregression coefficients for school investment								
SI1 → SI2	.78 (.08)	.83 (.12)	.74 (.07)	.88 (.15)	.88 (.09)	.87 (.12)	.87 (.07)	.84 (.07)
SI2 → SI3	.61 (.07)	.52 (.12)	.54 (.17)	.64 (.16)	.69 (.09)	.61 (.10)	.60 (.06)	.56 (.10)
SI3 → SI4	.56 (.11)	.84 (.15)	.83 (.10)	.81 (.12)	.86 (.08)	.98 (.13)	.83 (.09)	.85 (.13)
Regression coefficients for control variables and school investment[*]								
Etn Min → SI1	−.12 (.01)	*ns*	*ns*	*ns*	*ns*	−.29 (.08)	*ns*	
SES → SI1	.15 (.06)	*ns*	*ns*	*ns*	.16 (.05)	.50 (.16)	*ns*	.18 (.08)
SES → SI2	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	.16 (.07)	*ns*
Girl → SI1	.30 (.06)	.030 (.14)	.17 (.08)	.36 (.10)	.34 (.05)	.65 (.09)	*ns*	*ns*
Girl → SI3	.16 (.05)	*ns*	*ns*	.19 (.06)	*ns*	*ns*	*ns*	*ns*
Regression coefficients for relations between school investment and aspects of innovative learning								
CL6 → SI3	.30 (.09)	.27 (.06)	.27 (.06)	.27 (.06)	.34 (.12)	.34 (.12)	*ns*	*ns*
SR5 → SI2	.43 (.21)	*ns*	.46 (.18)	.46 (.18)	.43 (.20)	*ns*	*ns*	*ns*
SR6 → SI3	*ns*	*ns*	*ns*	*ns*	*ns*	−.64 (.23)	*ns*	*ns*
Autoregression coefficients for mathematics								
Math1→Math2	.58 (.04)	.60 (.06)	.61 (.05)	.67 (.06)	.59 (.04)	.62 (.10)	.51 (.05)	.58 (.08)
Math2→Math3	.64 (.06)	.70 (.11)	.69 (.10)	.46 (.10)	.45 (.06)	.70 (.09)	.61 (.07)	.60 (.09)
Math3→Math4	.72 (.07)	1.08 (.15)	.68 (.14)	1.16 (.34)	.84 (.05)	.73 (.09)	.80 (.07)	.55 (.10)
Regression coefficients for control variables and mathematics[*]								
Etn Min → Math1	*ns*	−7.15 (2.59)	*ns*	*ns*	*ns*	*ns*	*ns*	−3.94 (1.43)
Etn Min → Math2	*ns*	2.65 (1.15)	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
Etn Min → Math3	−2.45 (.67)	*ns*	*ns*	−3.48 (.06)	*ns*	*ns*	*ns*	*ns*
Etn Min → Math4	3.11 (1.28)	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*

(*Continued*)

Table 8. (*Continued*).

		Parental educational level			Ethnicity		Gender	
	Total group	Low	Middle	High	Majority	Minority	Boy	Girl
SES → Math1	2.131 (1.08)	*ns*	*ns*	*ns*	2.77 (1.14)	*ns*	2.44 (1.18)	*ns*
SES → Math3	1.83 (.85)	*ns*	*ns*	*ns*	2.22 (.65)	*ns*	−2.58 (1.06)	*ns*
SES → Math4	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	−2.28 (1.04)
Girl → Math1	−4.01 (.07)	*ns*	−5.39 (1.37)	*ns*	−3.27 (1.10)	−5.73 (1.78)	*ns*	*ns*
Girl → Math3	−1.60 (.60)	*ns*	−2.25 (1.10)	*ns*	−1.88 (.85)	*ns*	*ns*	*ns*
Regression coefficients for relations between mathematics and aspects of innovative learning								
ALE5 → Math3	−4.21 (2.64)	−7.25 (2.89)	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
ALE6 → Math4	*ns*	*ns*	*ns*	*ns*	*ns*	−10.73 (4.51)	−5.98 (2.38)	*ns*
SR6 → Math4	−15.48 (6.35)	*ns*	−17.77 (5.59)	−17.77 (5.59)	−10.80 (5.21)	−10.80 (5.21)	−19.12 (7.03)	*ns*
Autoregression coefficients for reading comprehension								
RC1 → RC2	.73 (.03)	.73 (.09)	.66 (.06)	.76 (.07)	.71 (.03)	.70 (.07)	.67 (.03)	.79 (.04)
RC2 → RC3	.75 (.04)	.56 (.09)	.60 (.02)	.76 (.06)	.72 (.04)	.86 (.03)	.78 (.04)	.72 (.05)
Regression coefficients for control variables and reading comprehension[*]								
Etn Min → RC1	−5.03 (1.02)	*ns*	*ns*	*ns*	*ns*	*ns*	−6.90 (1.61)	−3.59 (1.13)
Etn Min → RC2	−1.29 (.64)	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
Etn Min → RC3	*ns*	−4.17 (1.41)	*ns*	*ns*	*ns*	*ns*	−4.26 (1.75)	*ns*
SES → RC1	2.06 (.85)	*ns*	*ns*	*ns*	1.94 (.89)	*ns*	2.31 (1.13)	2.87 (.75)
SES → RC2	3.07 (.49)	*ns*	*ns*	*ns*	3.14 (.50)	*ns*	3.30 (.87)	2.92 (.76)
SES → RC3	2.35 (.61)	*ns*	*ns*	*ns*	2.39 (.67)	*ns*	*ns*	*ns*
Girl → RC1	*ns*	4.77 (1.94)	*ns*	*ns*	*ns*	3.46 (1.58)	*ns*	*ns*
Girl → RC2	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
Girl → RC3	*ns*	*ns*	1.88 (.81)	*ns*	*ns*	*ns*	*ns*	*ns*

Note: Standard errors are in parentheses. TO = task-orientation. SE = self-efficacy. SI = school investment. RC = reading comprehension. Rows with only non-significant results were omitted from this table.

[*]Reference categories for dummy variables are ethnic majority students, low SES students, and boys, respectively.

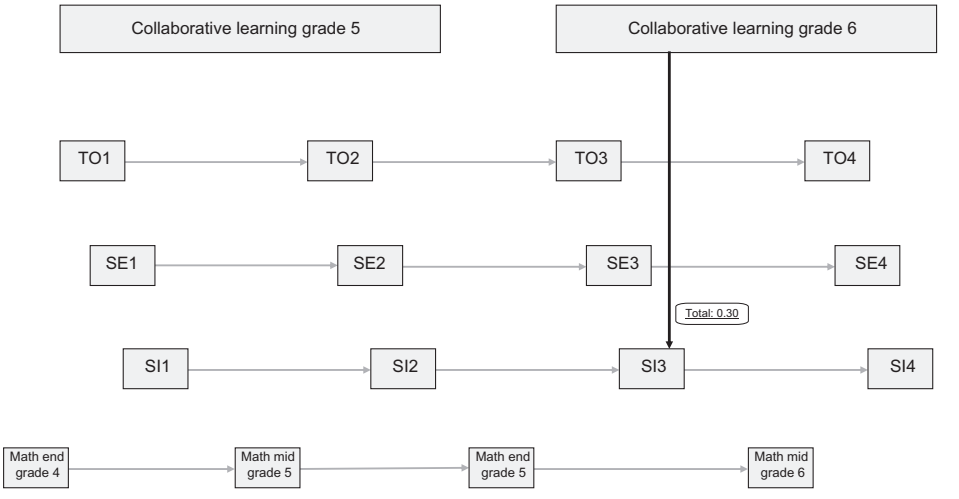

Figure 4. Unstandardized relations between collaborative learning and developments in task-orientation (TO), self-efficacy (SE), school investment (SI), and math achievement.

students. For low PE students, one *sd* higher in authenticity on average related to 2.76 (.38 × 7.25) points less of an increase in math.

Multi-group analyses furthermore revealed a significant negative relation between authenticity reported by the grade six teacher and growth in mathematics achievement of ethnic minority students. On average, ethnic minority students increased 12.30 points in math from the end of fifth grade until the middle of sixth grade. However, one *sd* (=.48) higher in authenticity was associated with 5.15 (.48 × 10.73) points less growth in math for ethnic minority students, while authenticity did not relate to growth in math achievement of majority students.

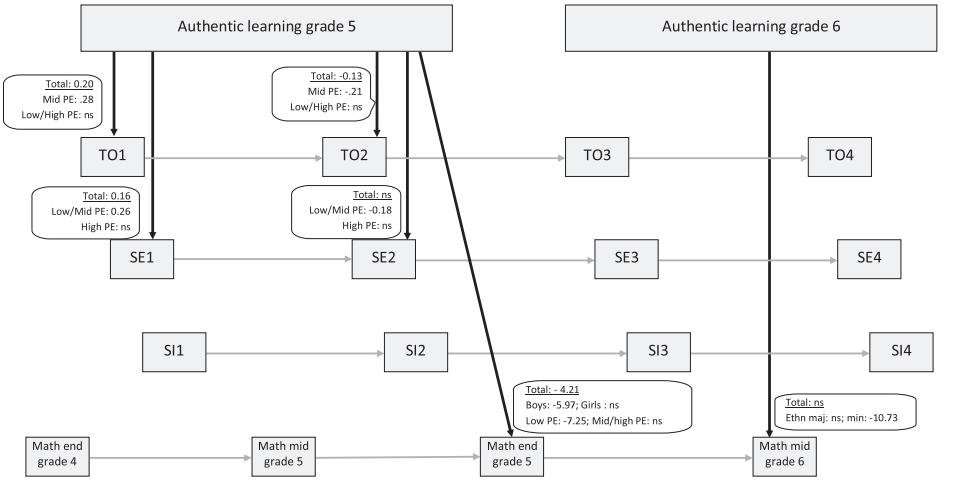

Figure 5. Unstandardized relations between ALE and developments in TO, SE, SI, and math achievement.

No relations for any of the groups were found between authenticity of the learning environment and developments in school investment.

Relations between focusing on self-regulation and developments in motivation and achievement

Figure 6 shows the relations between focusing on self-regulation and developments in students' motivation and achievement. No relations were found between focusing on self-regulation and developments in task orientation and self-efficacy. With regard to school investment, the results showed that when teachers reported a stronger focus on self-regulation, students' school investment increased in grade five. One *sd* (=.34 points) extra in self-regulation in grade five was associated with an increase of .15 (.34 × .43) points in school investment from the first to the second measurement. Multi-group analyses showed this positive relation held for all groups except for low PEL and ethnic minority students. For these two groups, no relation between focusing on self-regulation and growth in school investment was found.

Furthermore, in grade six, a significant negative relation between self-regulation and school investment was found for ethnic minority students. More specifically, in classes where grade six teachers reported a greater focus on self-regulation of 1 *sd* (=.38), ethnic minority students showed .24 (.38 × .64) points less growth in school investment from the last measurement in grade five to the first measurement in grade six. For majority students, a focus on self-regulation did not relate to their school investment.

The results furthermore showed that a greater focus on self-regulation of the learning process in grade six related negatively to math achievement. When the sixth grade teachers rated the extent to which they focused on self-regulation 1 *sd* higher, students' increase in math achievement in grade six was 5.88 (.38 × 15.48) points less. Multi-group comparison showed that this negative relation was similar for ethnic majority and minority students and for the varying PE groups, but not for boys

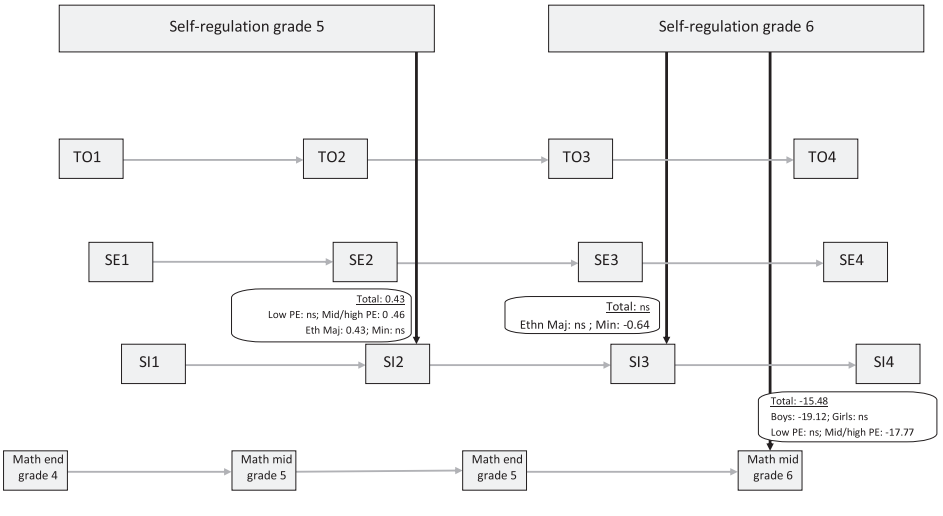

Figure 6. Unstandardized relations between focus on self-regulation and developments in TO, SE, SI, and math achievement.

Table 9. Summary of significant relations and effect sizes.

Learning environment	Dependent variable	Total group	Gender		Ethnicity		Parental educational level		
			Boys	Girls	Majority	Minority	Low	Middle	High
Task orientation									
ALE gr 5 →	Task orientation start gr 5	.12 (+)	.12 (+)	.12 (+)	.12 (+)	.12 (+)		.20 (+/++)	
	Task orientation mid gr 5	−.08 (−)	−.07 (−)	−.08 (−)	−.12 (−)	−.10 (−)		−.13 (−)	
Self-efficacy									
ALE gr 5 →	Self-efficacy start gr 5	.11 (+)	.11 (+)	.11 (+)	.07 (+)	.05 (+)	.20 (+/++)	.19 (+/++)	
	Self-efficacy middle gr 5						−.13(−)	−.11(−)	
School investment									
SR gr 5 →	School investment middle grade 5	.15 (+)	.10 (+)	.13 (+)	.08 (+)			.20 (+/++)	
SR gr 6 →	School investment start grade 6					−.24 (− −)			
CL gr 6 →	School investment start grade 6	.27 (++)	.21 (+/++)	.23 (+/++)	.32 (++)	.31 (++)	.27 (++)	.21 (+/++)	.21 (+/++)
Mathematics									
ALE gr 5 →	Mathematics end gr 5	−.12 (−)	−.17 (−/− −)				−.27(− −)		
ALE gr 6 →	Mathematics middle gr 6					−.31 (− −)			
SR gr 6 →	Mathematics middle gr 6	−.34 (− −)	−.39 (− −)		−.27 (− −)	−.20 (− /− −)		−.39 (− −)	−.38(− −)

and girls. Only for boys, a greater focus on self-regulation of the learning process in grade six relates negatively to math achievement, while for girls no significant relation was found.

Summary of results and effect sizes

To present the outcomes in an efficient and comprehensive way, Table 9 summarises relations that were found to be significant and indicates its effect sizes. Small effect sizes are indicated with a + for positive relations and a − for negative relations, small to medium effect sizes were indicated with either +/++ or −/− − and medium effect sizes were indicated by either ++ or − −. Note that only significant relations are depicted in Table 6 and many relations were not significant.[1]

Overall, the largest effect sizes (medium) were found for the relations between the learning environment and math achievement. Table 6 shows that for the total group, the effect size of the negative relation between authenticity of the learning environment and growth in math achievement was small, but in some of the groups, namely boys, ethnic minority students and low PEL, medium size negative relations between authenticity and growth in math achievement were found. The size of the negative relation between focusing on self-regulation and growth in mathematics was medium for the total group and for all separate groups, with the exception of girls. For girls, focusing on self-regulation did not relate to growth in mathematics.

ALE furthermore related to students' motivation beliefs. For both task orientation and self-efficacy, scores were initially higher in more authentic classes, but the development in these motivational beliefs was found to be more negative. This was especially the case for low and middle PEL students, where effect sizes ranged from small/medium to medium. Finally, collaborative learning related positively to developments in school investment. For each group, the effect size of this relation was medium.

Discussion

The aim of the present study was to examine (1) whether the extent of innovativeness of the learning environment (i.e. authenticity of the learning environment, collaborative learning and focusing on self-regulation) positively related to developments in students' motivation and achievement during the last two years of primary school, and to examine (2) to what extent relations between innovativeness of the learning environment and developments in students' motivation and achievement varied by gender, social and ethnic background. In all, the results for the first research question show that innovative learning related both positively and negatively to developments in students' motivation and achievement, indicating that aspects of IL can either contribute to or diminish the reported decline in students' motivation. Collaborative learning showed to be more effective than ALE and focusing on self-regulation in enhancing student motivation. As different aspects of IL yielded different results, these outcomes furthermore demonstrate that IL is not a unidimensional construct. Moreover, with regard to the second research question, results indicated that the effectiveness of different aspects of IL depends on individual student characteristics, such as gender and socio-ethnic background. Below the outcomes of the present study are discussed in more detail.

First, most noticeable are the relations that were found between different aspects of IL and mathematics achievement. When the learning environment was rated as more authentic and with a greater focus on self-regulation, students showed less growth in math achievement. This was especially the case for boys, low PEL and ethnic minority students, whereas for girls, middle and high PEL, and majority students, these aspects of IL did not relate to their math achievement. Several explanations may account for these findings. It could simply be that ALE and focusing on self-regulation are not very effective approaches for mathematics achievement, especially when it comes to boys, low PEL and ethnic minority students. It could be that especially these groups need more structure and would therefore benefit more from a more traditional teacher-centred learning environment, as has previously been suggested by others (Guthrie, 1989; Hermans, 1995; Hopkins & Reynolds, 2001). However, especially with regard to focusing on self-regulatory strategies, but also for ALE, there is a great quantity of studies that shows positive effects of focusing on self-regulation for students of different ability levels (see, e.g. the following meta-analyses, Dignath et al., 2008; Hattie et al., 1996).

Another explanation for the negative relation between innovative learning and developments in math for especially boys, ethnic minority and low PEL backgrounds could be that these students would actually benefit from an innovative learning context, that connects to their everyday lives and is meaningful to them (see e.g. Guthrie, 1989; Hopkins & Reynolds, 2001), but teachers may find it harder to relate to the lives of students that have a different background or are of different gender than themselves. All teachers were of Dutch origin, most of them were female, and all had finished higher education as this is a requirement to become a teacher. An incongruence between teachers' and students' backgrounds may cause attempts of teachers to teach in an authentic manner to have adverse effects.

Furthermore, as we used teacher self-reports to assess the innovativeness of the learning context, we do not have insight in how teachers' focused on self-regulation or how they attempted to create a context for authentic and meaningful learning. The quality by which teachers implemented these approaches could be another explanation for our findings. Many teachers may be more accustomed to more traditional ways of teaching. IL requires teachers to gradually transfer control of the learning process to the students. Totally unguided learning, however, may have adverse effects (Jang, Reeve, & Deci, 2010). Although teachers in our study reported rather high levels of IL, they may find it difficult to find a balance between a learner-centred approach in which students learn to regulate their own learning process, while still providing appropriate guidance. Teachers may find it difficult to diagnose students' learning needs and teach in a contingent way through scaffolding (Van de Pol, Volman, & Beishuizen, 2011). Especially for ethnic minority students, low PEL students and boys, it may be important that teachers provide appropriate guidance. Previous research has, for example, shown that boys less frequently use self-regulatory strategies during math (e.g. Cleary & Chen, 2009), which may indicate that boys may be less able to effectively make use of the strategies that are offered to them.

With regard to relations between the learning environment and developments in students' motivation, the picture becomes more complex. Positive relations were found between aspects of ALE environment and motivational beliefs at the first

measurement, which could suggest that teachers are more likely to engage in IL approaches when their students are more motivated and confident, but this then seemed to result in less growth in motivational beliefs. Most relations between innovative learning and developments in students' task orientation and self-efficacy, were however either not significant or small. Especially for motivational beliefs, the variances at the classroom level were quite small, indicating that motivation is much more strongly affected by individual student factors than classroom factors. Still, even if it is only a small proportion of students' motivation that can be affected by effective educational practices, it is important to find out how these practices can take shape. Other reasons can also account for the small effect sizes. IL was measured through teachers' self-reports and such measures only provide information on the extent to which teachers employ innovative methods. As mentioned it does not provide information on the quality of the instructional methods. Observations could have provided further insight into how teachers employed the innovative methods. Moreover, the differences between teachers were not very large. All teachers reported that they employed innovative methods at least to some extent. As such, relations with student outcomes are not likely to be very strong.

In contrast to the mixed findings on motivational beliefs, students' investment in school seemed to be promoted by aspects of IL, especially collaborative learning, but also self-regulation. That is in line with research that suggests that innovative learning environments invite students to become more engaged and to take on a more active role in their own learning process (e.g. Boekaerts & Niemivirta, 2000; Boekaerts, de Koning, & Vedder, 2006). However, one group, namely ethnic minority students, showed less investment in school when the learning context relied more on self-regulation of their learning process. Ethnic minority students in our sample had a non-western background, and previous research has shown the parenting style of non-western parents to be more directive than that of western parents (Stewart & Bond, 2002). Students who are accustomed to a directive parenting style may feel more comfortable when teachers are more in control of the curriculum than when they have to regulate their own learning process. That does not necessarily imply that focusing on self-regulation cannot be effective for ethnic minority students. Instead, it may imply that for these students, it may be harder for teachers to find a suitable balance between transferring responsibility to the student, while still providing the optimal level of guidance.

Furthermore, only for mathematics, a relation between the learning environment and student achievement was found, while no relation was found for achievement in RC. Students' RC may be less susceptible for effects of the learning environment to occur than their achievement in mathematics, as RC is more strongly affected by intelligence, language abilities and social background characteristics that students bring to the school (Stevenson & Newman, 1986), indicating that RC may be less susceptible to classroom effects. However contrarily to our results, other studies have found innovative learning environments to promote student achievement in RC, even though effects are usually greater in mathematics (e.g. Dignath et al., 2008; Wigfield & Guthrie, 2010). Again, the fact that we did not have insight in the quality of the instructional practices that teachers reported may account for these findings.

Many of the relations that were found between IL and developments in motivation and achievement were not consistent across grades, and most relations were found only in grade five. This inconsistency across grades could perhaps be

attributed to the fact that in the Netherlands, all students are administered a final test in their last year of primary school. This test is administered in early February and referral of students to vocational, intermediate, and academic tracks in secondary education depends to a great extent on the outcomes of this test. Furthermore, results on this test are often considered an important indication of the quality of a school. It has been reported that in the months or weeks prior to the test, teachers tend to use more traditional teaching strategies and focus mostly on the main cognitive subject domains. After the test, they focus more on other aspects of the learning process (Roeleveld, Mulder, & Paas, 2011). The fourth measurement of our study took place in the same period that the final test was administered. It could be that the IL scores of teachers at the beginning of grade six may not be a good reflection of their actual teaching practices between measurement three and four.

Our results furthermore showed that for the grade five teachers, correlations between instructional approaches were low, which furthermore demonstrates that IL is not a unidimensional construct. Also, the correlations between the scores of the grade five and six teachers were rather small, indicating that students' learning environment may greatly vary from year to year. This can indicate that teachers are rather autonomous in deciding on the way they want to teach. However, for innovative approaches to effectively enhance students' achievement outcomes over time, consistency across grades is a necessary condition (Thoonen, Sleegers, Oort, Peetsma, & Geijsel, 2011). These results could be an indication that many schools do not succeed in offering their students such consistency.

Some limitations of the study need to be acknowledged. First, the groups of ethnic minority students and low PEL students were both relatively small. Therefore, the results have to be interpreted with caution. Still, the study shows different patterns to emerge for different groups of students, indicating that it is important to take students' background characteristics into account when examining or evaluating the effectiveness of educational approaches. Finally, in the present study, we related developments in task orientation, self-efficacy and school investment to different aspects of the learning context, but not to each other, as the sample size did not allow for more complex models that include such interactions. Further research could help unravel the relations between these different aspects of motivation and the learning environment over time.

In conclusion, the results suggest that innovative learning may have certain drawbacks. The results of the study show that not all aspects of IL that were implemented in the schools we studied are equally effective. It is therefore important that in research and practice, the multifaceted nature of IL is taken into account and IL is not considered to be a singular educational concept. In practice, caution is warranted when implementing educational innovations. Firstly, a thorough analysis of how different aspects of any educational reform may work for a specific school population always needs to precede or at least accompany those reforms. Secondly, a high level of pedagogical skills is required to teach innovatively and teachers who are expected to implement educational reforms should be well prepared. Thirdly, continuity from one school year to another, hence, consensus and consistency between teachers in a school, could be a crucial factor for making aspects of innovative learning methods successful. Finally, the results indicate that education is not a 'one size fits all matter'. The effectiveness of innovative approaches to learning appears to be related to students' background characteristics. That underlines that teachers need to be able to diagnose the learning needs of individual students and be able to adapt to

differences in learning needs. Only then it is possible to create learning environments, innovative or traditional, that are beneficial to all students.

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Note

1. To ensure that the significant relations we found were not just attributable to chance, we examined this by reanalysing our models and correcting for the measurement errors of the variables. Similar, but stronger relations between IL and the outcome variables were obtained. We also explored alternative longitudinal techniques and again obtained similar results.

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