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Author(s): Tarnanen, Mirja; Räikkönen, Eija; Martin, Anne; Kaukonen, Vili; Kostiainen, Emma; Toikka, Teppo; Vauhkonen, Ville

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Pupils' Academic Self-efficacy in Subject-specific and Integrated Curriculum Instruction

The corresponding author

Mirja Tarnanen, University of Jyväskylä, Finland

mirja.tarnanen@jyu.fi *ORCID*: 0000-0002-4585-4822

Eija Räikkönen, University of Jyväskylä

eija.m.raikkonen@jyu.fi

Anne Martin, University of Jyväskylä

anne.martin@jyu.fi

Vili Kaukonen, University of Jyväskylä

vili.kaukonen@varkaus.fi

Emma Kostiainen, University of Jyväskylä

emma.kostiainen@jyu.fi

Teppo Toikka, University of Jyväskylä

teppo.t.toikka@jyu.fi

Ville Vauhkonen, University of Jyväskylä

ville.j.vauhkonen@gmail.com

This article reports on a pilot study on the academic self-efficacy (ASE) of 245 Finnish pupils when studying according to a subject-specific curriculum for one week and an integrated curriculum the following week. The data consisted of selected items from the Class Maps Survey and self-reported grades of L1 and mathematics and were analysed using latent growth curve modelling and multivariate linear regression analysis. According to the results, the mathematics grades were associated with the level of and change in ASE: pupils reporting lower skills had lower self-efficacy at the beginning of the study. During the first week, ASE increased similarly among all skills groups; during the second week, only the math grades positively predicted variation across all pupils in rate of change in ASE. The increase in ASE during the second week was faster among pupils with low or good math grades than the pupils with higher math grades.

Keywords: academic self-efficacy, integrated curriculum, inquiry-based learning, subject-specific curriculum, basic education

Pupils' Academic Self-efficacy in Subject-specific and Integrated Curriculum Instruction

Introduction

The rapid changes and increasing complexity of today's world induce teachers and students to question what kind of curriculum could best prepare pupils for their future life in the most appropriate way and enhance their active engagement in school.
For twenty years, there have been debates about whether the curriculum should be organised according to a subject-specific or integrated curriculum approach to promote learning through, for example, problem solving and collaboration skills and skills of inquiry (see Drake and Burns 2004; Lam et al.,2013). The pilot study discussed in this paper approaches the question from the perspective of academic self-efficacy because it is considered to be a significant factor in promoting pupils' active participation in learning (Doll et al. 2010) and it is associated positively with their interest and educational performance (Putwain, Sander, and Larkin 2013) in the classroom. Being aware of the need to learn both subject-specific and integrated skills and knowledge to be successful throughout one's life, we explored the relationship between pupils' self-efficacy and these two approaches when pupils are not used to studying according to an integrated curriculum with inquiry-based learning (Furtak et al. 2012).

Previous studies have mainly focused on pupils' self-efficacy beliefs when studying either 1) a subject-specific curriculum in a certain school subject, such as mathematics (Lazarides, Dietrich, and Taskinen 2019) or 2) an integrated curriculum applying active learning approaches and teamwork (Teasdale, Selkin, and Goodell 2018). This pilot study helps close this research gap by applying a novel perspective: investigating pupils' academic self-efficacy during a two-week period of studying according to a subject-specific curriculum for the first week and an integrated curriculum in the second week. Because it is evident that the learning tasks differ between these two weeks, we investigate the changes in 5th–8th grade pupils' self-efficacy beliefs between the two curriculums in relation to their self-reported grades in mathematics and first language (L1), which is Finnish. In doing so, this pilot study provides preliminary evidence as to whether a novel integrated curriculum approach has any effect on self-efficacy of pupils with different skill levels in two core school subjects.

Pupils' Academic Self-efficacy

Academic self-efficacy refers to an individual's perception of his/her capacity to learn or perform a task in a given domain (Schunk and Pajares 2005). Self-efficacy is essential in learning; pupils who believe they can succeed behave in ways that promote their success. Consequently, they are more likely to succeed and develop stronger efficacy (Bandura 1997; Schnell et al. 2015; Honicke and Broadbent 2016). According to Bandura (1997), self-efficacy beliefs are developed as pupils interpret, weigh and integrate information from : 1) mastery experiences, serving as an indicator of capability; 2) verbal persuasion, i.e., verbal influences on perceived capability; 3) vicarious experiences, i.e., learning from role models, such as teachers or peers, about the knowledge and skills needed to complete a task; and 4) emotional arousal associated with perceived capability, influencing the process and outcomes of the task at hand.

Mastery experiences are considered to have the greatest impact as they provide authentic evidence of one's performance in different learning situations across the curriculum (Usher and Pajares 2008; Byars-Winston et al. 2017). Self-efficacy is seen as context-specific, task-specific and varying across several dimensions, such as level, i.e., the difficulty of a particular task; generality, i.e., the transferability of one's efficacy judgments across different tasks or activities; and strength of efficacy judgment, i.e., the certainty with which one can perform a specific task (Bong and Skaalvik 2003; Zimmerman and Cleary 2006).

Previous research shows that pupils with a high sense of self-efficacy are more likely to participate more readily, work harder and exert greater academic effort (Bandura 1997; Sakiz, Pape, and Woolfork Hoy 2012), to set more ambitious goals for learning and to self-regulate their learning more efficiently (Zimmerman and Cleary 2006; Schnell et al. 2015). High self-efficacy is connected to persisting longer and being more resilient when facing challenging tasks (Sagone et al. 2020; Schnell et al. 2015), being more motivated and engaged in learning (Lazarides, Dietrich, and Taskinen. 2019) and being more efficient problem solvers (Schunk and Pajares 2005; Sagone et al. 2020). Overall, pupils' self-efficacy in regulating their own learning processes and outcomes and becoming proficient in challenging skills across school subjects is associated with their interest and educational performance (Putwain, Sander, and Larkin 2013).

As self-efficacy beliefs have been found to be sensitive to subtle changes in pupils' performance context (Zimmerman 2000) and tasks (Bong and Skaalvik 2003), a classroom with an integrated curriculum can provide opportunities for pupils to develop academic self-efficacy when practicing their problem solving and collaboration skills and skills of inquiry. However, if pupils are not familiar with the active learning approach or are not scaffolded by the teacher or instructor, their confidence may decrease because their self-regulatory skills are insufficient for new task demands (Usher and Pajares 2008; Jansen, Scherer, and Schroeders 2015). Previous research has shown that the use of active learning in small groups seems to engage pupils in peer-to-peer interactions, emphasising higher-order thinking and resulting in improved learning

(Freeman et al. 2014). It has also been proven that support from peers helps pupils maintain or enhance self-efficacy (Zimmerman 2000). Britner and Pajares (2006, 494) note that, in the context of middle school science teaching, engaging pupils in authentic inquiry-oriented science investigations instead of more common textbook-based science instruction provides them with the mastery experiences they need to develop strong science self-efficacy beliefs. Thus, when using new learning approaches and pedagogical practices teachers, should scaffold and tailor them to their pupils by providing the level of challenge that will successfully support efficacy-building and minimise failures that will diminish confidence in new abilities (Britner and Pajares 2006).

To support pupils' natural need to think highly of themselves, they should be provided with opportunities to play an active role as a learner so they can address the pedagogical challenges that they believe they are capable of doing well and succeeding in multiple ways (Sharma and Nasa 2014; Jansen, Scherer, and Schroeders. 2015).

However, when looking at academic self-efficacy in light of scaffolding pupils and challenging them pedagogically, it is reasonable to note the possible correlations between the differences in the pupils' background characteristics, such as gender or grade level (age), and their self-efficacy. According to the review on gender differences in mathematics self-efficacy by Pajares (2005), male pupils have been shown to have higher mathematics self-efficacy than their female counterparts. The results of mainly cross-sectional studies based on pupils of varying ages suggest that the gap in mathematics self-efficacy between boys and girls seems to widen in favour of boys, even though the pupils may over- or under-estimate their efficacy in relation to their achievement (Pajares 2005; see also Huang, Zhang, and Hudson 2018). A meta-analysis by Huang (2013) has indicated that girls had higher language arts self-efficacy than boys, while boys had higher self-efficacy in math, computer studies and the social sciences than girls. A review of research literature on gender differences in writing self-efficacy also deduced that, in middle school, girls generally have higher L1 writing self-efficacy than boys (Pajares 2003).

Integrated Curriculum and the Finnish Multidisciplinary Learning Modules

Contributing to the educational discussion on supporting pupils' learning through integrated curriculum (see Drake and Burns 2004; Lam et al. 2013), we examined Finnish comprehensive school pupils' academic self-efficacy first in the context of a subject-specific approach and then using an integrated curriculum approach. Using an integrative curriculum or curriculum integration approach enables pupils to see the relationships and interdependencies between the studied phenomena and to connect knowledge and skills across school subjects to help them perceive the significance of their learning. According to Drake and Burns (2004, 7-15), curriculum integration varies from multidisciplinary integration (addressing a unifying phenomenon in separate subjects) and interdisciplinary integration (addressing a unifying phenomenon by drawing from multiple disciplines or school subjects) to transdisciplinary integration (melding together or reforming disciplines or school subjects to focus on the unifying phenomenon).

Various pedagogical methods can be used to support and implement curriculum integration. Integrated curriculum approaches, which include social and affective characteristics and promote pupils' active participation, can enable the creation of learning environments that promote pupils' academic engagement (Doll et al. 2010). Curriculum integration has been studied in the field of STEM and STEAM education, where positive impacts have been reported on learning and pupil engagement (Land

2013; Ozkan and Topsakal 2020). Inquiry-based learning is one significant and promising pedagogical approach for implementing curriculum integration (Furtak et al. 2012); it prioritises pupils' questions, ideas, analyses, evidence-based reasoning, collaborative learning and creative problem solving to reach a conclusion that pupils defend or present in various interactive ways (Pedaste et al. 2015). Although teachers and pupils can benefit from curriculum integration as it provides opportunities for collaboration and peer learning (Bautista et al. 2016; Peltomaa and Paterson 2020), there is a need to support teachers and equip them with research-based knowledge about curriculum integration (Braskén, Hemmi, and Kurtén 2020; Niemelä and Tirri 2018). To date, research on curriculum integration in relation to pupils' self-efficacy is scarce, with some exceptions, such as MacMath et al. (2010), who suggest that involving curriculum integration can be beneficial for at-risk pupils' learning and self-efficacy.

In Finland, the provision of basic education is mainly founded on a subject-specific curriculum. However, the mandatory multidisciplinary learning modules of Finnish schools fall under the umbrella of an integrative curriculum, which is seen as a pedagogical process crossing the boundaries between and connecting separate school subjects (Niemelä and Tirri 2018, 121). According to the current National Core Curriculum for Basic Education, enforced in 2016 (FNAE 2014), curriculum integration is a vital part of school culture. Schools are expected to provide at least one multidisciplinary learning module per school year, and it should be long enough to give pupils enough time to focus on the contents of the module and to work in a goal-oriented and versatile manner (FNAE 2014, 62). Multidisciplinary learning modules aim at strengthening pupils' participation and involvement in planning and setting goals, offering opportunities for combining what pupils have learned in different settings, giving space for intellectual curiosity and creativity and reinforcing the application of knowledge and skills in practice and practising agency (FNAE 2014, 62).

Research on integrated learning and multidisciplinary learning modules in the Finnish school context ranges from discussing aspects of teacher development and collaboration (Haapaniemi et al. 2020) to integrating a specific subject, such as history (Mård 2020) or science and mathematics (Braskén, Hemmi, and Kurtén 2020). Some evidence shows that, in context of the current Finnish curriculum, curriculum integration can be beneficial for pupils' learning. For example, multidisciplinary learning modules in Finnish education have been shown to enhance pupils' social skills and participation and enable meaningful learning experiences through group work and positive social interaction (Niemi and Kiilakoski 2019).

Study Aim and Research Questions

This study examines one school's pupils' (grades 5–8, ages 11–15) academic self-efficacy during a two-week period in which the first week was organised according a subject-specific curriculum (control week) and the second week was organised as a multidisciplinary learning module (intervention week) integrating several school subjects, for example math, L1 and physical education, with an emphasis on inquiry-based learning. We chose L1 and math to be the self-reported skills as they are needed for learning across the curriculum. Our study addresses the following research questions:

1) How does the pupils' self-reported academic self-efficacy vary within and between the subject-specific curriculum week and the multidisciplinary learning module week?

2) How do the pupils' self-reported L1 and mathematics grades relate to the level of and

change in academic self-efficacy across the subject-specific curriculum week and the multidisciplinary learning module week?

As previous research has indicated gender and age differences in the academic self-efficacy of pupils (Pajares 2003, 2005), we controlled for these variables in the analyses.

Research Context, Data and Methods

Participants

This pilot study was part of the Creative Expertise – Bridging Pre-service and In-service Teacher Education project funded by the Ministry of Education and Culture, Finland (2017–2021) to develop initial and in-service education for teachers. The project aimed at building a new operational culture within the cooperating schools in collaboration between university staff, teacher students, school leaders, teachers, school pupils and education providers in order to promote professional development, create hybrid learning environments and share pedagogical expertise across disciplines. The study was conducted as a collaboration project among in-service teachers and other staff of a comprehensive school in a medium-sized city and pre-service teachers and teacher educators from a Finnish university. At the partner school, the lower and upper comprehensive level pupils participated in a multidisciplinary learning module that was planned, implemented and assessed in cooperation between the school and the university.

The partner school participated in a long-term development project during an organisational change where the school was transformed into a unified primary school, which conducted grades 1–9 (ages 7–16). Data were collected from lower (grade 5, n = 58; grade 6, n = 64) and upper (grade 7, n = 59; grade 8, n = 64) comprehensive school pupils from 13 classes in 2018. Prior to the study, grades 5–9 were in the same school building, but there was little cooperation between students of different ages.

Research design

The present pilot study adopted a quasi-experimental prospective interrupted time-series research design (see Handley et al. 2018; Shadish, Cook, and Cambell 2002), which included five days of subject-specific curriculum instruction (control week) followed by a multidisciplinary learning module spanning five school days (intervention week) on the theme 'Healthy life' and general skills (for example, teamwork, problem solving, multiliteracy) in the partner school (see Figure 1). This multidisciplinary learning module integrated the goals of several school subjects, such as L1, math, the arts and health science. The control week and intervention week differed in their pedagogy, approach to instruction, the roles of the teachers, pupils and collaborators and the division of work. For the school's students, the instruction received during the control week and intervention week was comparable to the lessons encountered in one school week. A multidisciplinary learning module is long enough when it entails at least one week of lessons (FNAE 2014). However, the design considered that the number of lessons per week varied between different grade levels. During the control week, the pupils were instructed using the subject-specific approach. Teachers taught individual subjects to specific classes largely independently. The pupils also worked in their designated classroom in separate age groups. According to the teachers' diaries during the control week, one teacher could teach in as many as seven different classrooms, and learning was reported to be mainly teacher-led.

During the intervention week, an integrated curriculum approach within a multidisciplinary learning module was utilised. The theme under study was 'Healthy life'; this combined the objectives of several subjects, such as Finnish language and literature, environmental studies, health education, mathematics and visual arts. The week was implemented in cooperation with a Finnish publishing house (Otava Learning), which produces experimental learning material for schools. The theme was studied for five school days, applying the phases of inquiry-based learning: orientation, conceptualisation, investigation, conclusion, and discussion (see Pedaste et al. 2015, 51). Planning and implementing the multidisciplinary learning module required cooperation between the teachers, teacher educators and pre-service teachers, and they worked in teacher-teams. The pupils worked in mixed-aged teams (grades 5 to 8, ages 11–15) each consisting of five pupils, and the same teacher-team guided the same mixed aged pupil-teams. The school teachers planned the composition of the pupil teams based on their knowledge of their pupils. During the intervention week, the teacher served as a facilitator of learning, and knowledge was considered to be socially constructed (see Drake and Burns 2004).

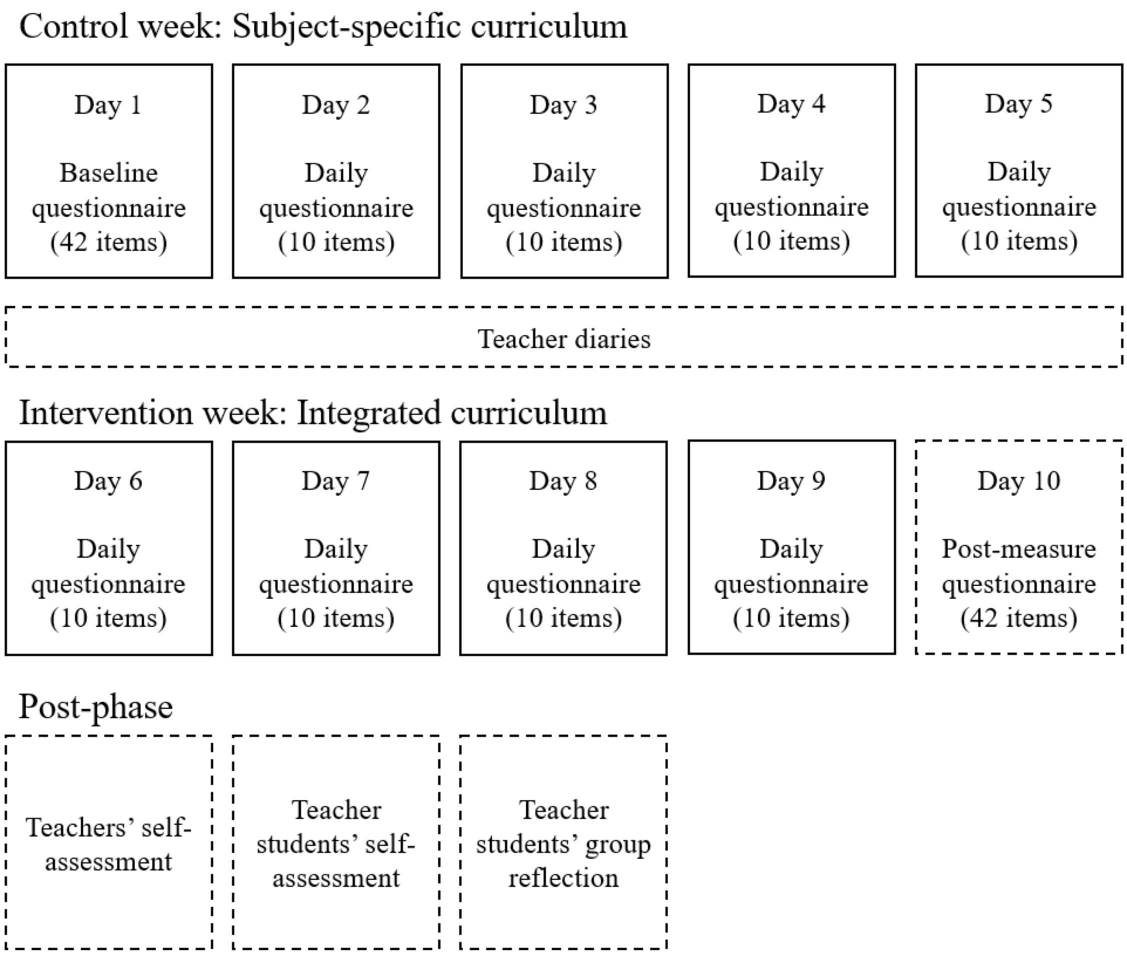

Figure 1.

Data collection procedure

The pupils responded to the baseline questionnaire at the beginning of the control week. The same questionnaire was also completed at the end of the intervention week as a post measure (Figure 1). The pupils responded to selected items from the baseline questionnaire after each school day during the study. The baseline questionnaire on the pupils' self-reported learning experiences (SSLE) included self-reported grades of L1, math and teamwork skills. The questionnaire included two measures. With the first measure, the Achievement Emotions Questionnaire (AEQ) redeveloped by Pekrun and colleagues (2005), the pupils assessed their emotions towards learning with 20 items divided into two dimensions: classroom-related enjoyment (10 items) and learning-related enjoyment (10 items). The second measure, the Class Maps Survey (CMS) redeveloped by Doll et al. (2010), was used to assess the pupils' perceptions of classroom learning environments via 22 items covering three dimensions: 1) Believing in me (8 items), 2) Taking care (8 items) and 3) Following classroom rules (6 items). For the daily questionnaire, 10 items of the AEQ and CMS were selected, two items from each of their dimensions. All the original English survey items were translated into Finnish by a certified translator and localised to address the Finnish school context. The proposed changes mainly concerned the meanings of the words, for example, in the translated statement, 'I can do my work correctly in this class', 'correctly' referred to the situated expectations of given tasks. Back translation (translation of Finnish items back into English, comparison of new translations with the original items and revision of new translations) was used to ensure the accuracy of the translated items and the proposed changes.

Measures

The pupils assessed their self-efficacy daily using two items modified from the CMS (Doll et al. 2010): 'I can do my work correctly in this class' and 'I can help other kids understand the work in this class'. These items were also included in the baseline and post-questionnaires. The items were jointly selected by the researchers, as they are relevant in terms of the learning goals of both subject-specific and integrated approaches in the Finnish curriculum (FNAE 2014); one focuses on academic effort (Sakiz, Pape, and Woolfork Hoy 2012) and the other focuses on collaboration (Freeman et al. 2014). In addition to the CMS items, the daily questionnaires contained items related to the functionality of the learning materials and the current stage of learning. The pupils responded to the items on a 4-point scale: 1 = never, 4 = almost always. A mean score for each measurement point was computed. Reliabilities for the scores are shown in Table 1.

The pupils rated their L1 and mathematics skills in the baseline questionnaire on a Finnish school numerical scale of 4–10, with 4 as the lowest grade and 10 as the highest grade. For both skills, the grades were divided into three categories: 1 = low skills (grades 4–6), 2 = good skills (grades 7–8), and 3 = excellent skills (grades 9–10). For the analyses, the skill variables were divided into three dummy variables: low (0 = other, 1 = low skills), good (0 = other, 1 = good skills), excellent (0 = other, 1 = excellent skills). 'Excellent skills' was used as a reference category for both skills in the analyses.

Gender (0 = boy, 1 = girl) and grade level were controlled for in the analyses. Grade level (range 5 to 8) was used as a continuous variable in the analyses. For the analyses, it was mean-centred.

Data analysis

All data analyses were conducted using the Mplus statistical package (Version 8.4; Muthén and Muthén 1998–2017). As the self-efficacy variables were somewhat skewed, maximum likelihood with robust standard errors was used as the method of estimation. The range for missing data was 8–24%. Little's (1998) test indicated that missingness was not completely random: $\chi^2(335) = 424.13$, $p = .001$. More thorough analyses revealed that on the first, second and fourth day of the control week, the grade 7 students were over-represented among those having missing values. Therefore, consideration of grade level in all analyses is essential in order to improve the plausibility of the missing at random (MAR) assumption, which is essential for the full information maximum likelihood (FIML) estimation used in our study (see Enders 2010). Moreover, gender of the student was controlled for in all analyses. The data were also hierarchical as the pupils were nested within 16 classes at the beginning of the study. The intra-class correlations for the self-efficacy variables ranged from .00–.09 indicating that, depending on the measurement point, 0% to 9% of the variation between the pupils' self-efficacy assessments were due to differences between the classes. The hierarchical nature of the data was taken into account by estimating the unbiased standard errors using the COMPLEX option in Mplus.

To examine the shape and pace of change in the pupils' academic self-efficacy and variations in it during the control week and the intervention week, latent growth curve modelling (LGM) was employed (Bollen and Curran 2006). We explored two different specifications of growth trajectories to find the LGM that best described the data: a linear model and a non-linear model specification using piecewise linear growth modelling (PLGM) (Bollen and Curran 2006; Flora 2008). Both models included nine time points (days). PLGM was used to model the potential non-linear change, instead of the traditional polynomial LGM, because PLGM is easier to interpret as it represents non-linear change by splitting the study period into two or more time periods, or 'pieces', and modelling the change within a piece with a linear slope factor. In contrast, polynomial LGMs represent non-linear change over the entire study period with additional slope factors based on higher-order polynomial terms (Flora 2008; Kohli and Harring 2013). Furthermore, PLGM facilitates analysis of differences in the relationship between the level and slope factors and the predictors (Diallo and Morin, 2015), which is needed in the examinations related to research question 2. In line with our research design (Figure 1), we used a two-piece PLGM (Bollen and Curran 2006; Flora 2008) with a separate linear slope factor for both time periods (pieces) to examine whether the pupils' self-efficacy ratings changed during the control and intervention weeks.

Fit indices (see below) of the chosen LGMs were both acceptable (linear model: $\chi^2(54) = 125.38$, $p < .001$, CFI = .93, TLI = .93, RMSEA = .07; 2-piece model: $\chi^2(48) = 107.56$, $p < .001$, CFI = .95, TLI = .94, RMSEA = .07). The Satorra-Bentler χ^2 difference test ($\Delta\chi^2(6) = 18.09$, $p = .006$) favoured the two-piece model over the linear model. Therefore, we chose the two-piece model as our final model; it takes more truly into account our research design than the linear model.

Next, the associations of the pupils' self-rated L1 and math grades with the variation across pupils in the initial level and the pace of change in self-efficacy were investigated. The level and slope factors of the two-piece model were the dependent variables; the baseline measures of the pupils' L1 and math skills were used as the independent variables. They were included in the two-piece model and analysed separately.

The goodness-of-fit of all the models was assessed using the chi-square (χ^2) test as well as the comparative fit index (CFI), Tucker-Lewis index (TLI) and root mean squared error of approximation (RMSEA). According to Hu and Bentler (1999), the fit between the hypothesised model and the observed data is indicated by a non-significant *p* value of the χ^2 test, CFI and TLI values greater than .95 and RMSEA values lower than .08. Alternatively, Bollen and Curran's (2006) recommended cut-off criteria are .90 for TLI and .10 for RMSEA.

Results

The descriptive statistics and Pearson correlations of the academic self-efficacy variables are shown in Table 1 and Table 2, respectively.

Table 1. Descriptive statistics for the studied variables.

Variables	Cronbach's α	*M* (*SD*)	Skewness	Kurtosis	*N*	%
Dependent variables (Time point)						
Self-efficacy (1)	0.64	2.82 (0.62)	-0.13	-0.37	213	86.94
Self-efficacy (2)	0.51	2.86 (0.54)	-0.07	0.08	221	90.2
Self-efficacy (3)	0.66	2.83 (0.53)	-0.17	0.74	216	88.2
Self-efficacy (4)	0.63	2.90 (0.54)	-0.13	0.73	186	75.9
Self-efficacy (5)	0.69	2.84 (0.61)	-0.36	0.73	221	90.2
Self-efficacy (6)	0.71	2.82 (0.62)	-0.33	0.48	225	91.8
Self-efficacy (7)	0.68	2.90 (0.59)	-0.14	0.22	220	89.8
Self-efficacy (8)	0.69	2.96 (0.57)	-0.11	0.48	216	88.2
Self-efficacy (9)	0.71	2.99 (0.58)	-0.06	0.22	219	89.4
Independent variables						
Gender						
boys (= 0)					125	51.02
girls (= 1)					120	48.98
Self-rated L1 skills						
Low skills (4–6)		6.00 (0.00)	-	-	13	6.1
Good skills (7–8)		7.62 (0.49)	-0.49	-1.79	115	53.7
Excellent skills (9–10)		9.13 (0.34)	2.27	3.22	86	40.2
Self-rated mathematics skills						
Low skills (4–6)		5.69 (0.48)	-0.90	-1.39	16	7.5
Good skills (7–8)		7.56 (0.50)	-0.26	-1.97	103	48.1
Excellent skills (9–10)		9.21 (0.41)	1.44	0.08	95	44.4
Control variable						
Grade level (mean centred)		0.05 (2.24)	-0.01	-1.36	245	
5					58	23.7
6					64	26.1
7					59	24.1
8					64	26.1

Table 2. Correlations between the self-efficacy variables (N = 186–225). All correlations were statistically significant at $p < .001$.

Self-efficacy variables Time points (T)	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. T1	1	.69	.68	.73	.69	.54	.56	.54	.48
2. T2		1	.71	.64	.66	.53	.54	.46	.49
3. T3			1	.70	.60	.58	.59	.59	.57
4. T4				1	.74	.63	.68	.59	.66
5. T5					1	.65	.65	.53	.53
6. T6						1	.67	.69	.61
7. T7							1	.78	.70
8. T8								1	.74
9. T9									1

Change in the pupils' academic self-efficacy during the study period

The results of the final two-piece latent growth curve model for pupils' academic self-efficacy are shown in Table 3. The factor mean of slope 1 (control week) was very low and statistically non-significant; on average, the pupils' self-efficacy did not change during the control week. However, the positive mean of slope 2 denoting linear change during the intervention week was statistically significant, as was the variance of slope 2. On average, the pupils' academic self-efficacy increased during the intervention week, but there was also variation between the pupils in the rate of linear increase: the increase in academic self-efficacy was faster for some pupils than for others.

Table 3. Unstandardised parameter estimates of the two-piece latent growth curve model for students' academic self-efficacy (N = 186–225).

Two-piece latent growth curve model for academic self-efficacy	Growth parameter estimates				
	Mean	Variance	Factor covariances		
			Level with Slope 1	Level with Slope 2	Slope 1 with Slope 2
Level	2.84***	0.24***	-0.01	-0.01*	0.00
Linear Slope 1 (control week)	-0.00	0.00			
Linear Slope 2 (intervention week)	0.04***	0.00**			
Range of R^2 for academic self-efficacy variables	0.60–0.77***				

Note. *p < .05, **p < .01, ***p < .001.

The negative factor correlation between the initial level and the rate of change in self-efficacy during the intervention week indicates that pupils with a higher initial level of self-efficacy showed a slower increase in self-efficacy during the intervention week than those with a lower initial level of self-efficacy (Table 3). The increase was faster for pupils with a lower initial level of self-efficacy. Thus, the differences in academic self-efficacy across pupils decreased during the intervention week.

Self-rated L1 and mathematics grades predicting variation across the pupils' academic self-efficacy

Appendix 1 shows the relationships of the L1 and math grades assessed by the pupils at baseline with level of and change in the pupils' academic self-efficacy after controlling for gender and grade level. Both skills predicted the initial level of the pupils' self-efficacy. The initial level of self-efficacy was higher among pupils who rated their L1 and/or math skills as excellent at the beginning of the study than those who rated their skills as either low or good (Appendix 1, Figures 2 and 3, respectively). According to the R^2 values, self-rated skills accounted for approximately 30% of the variation across pupils in the initial level of academic self-efficacy (Table 4).

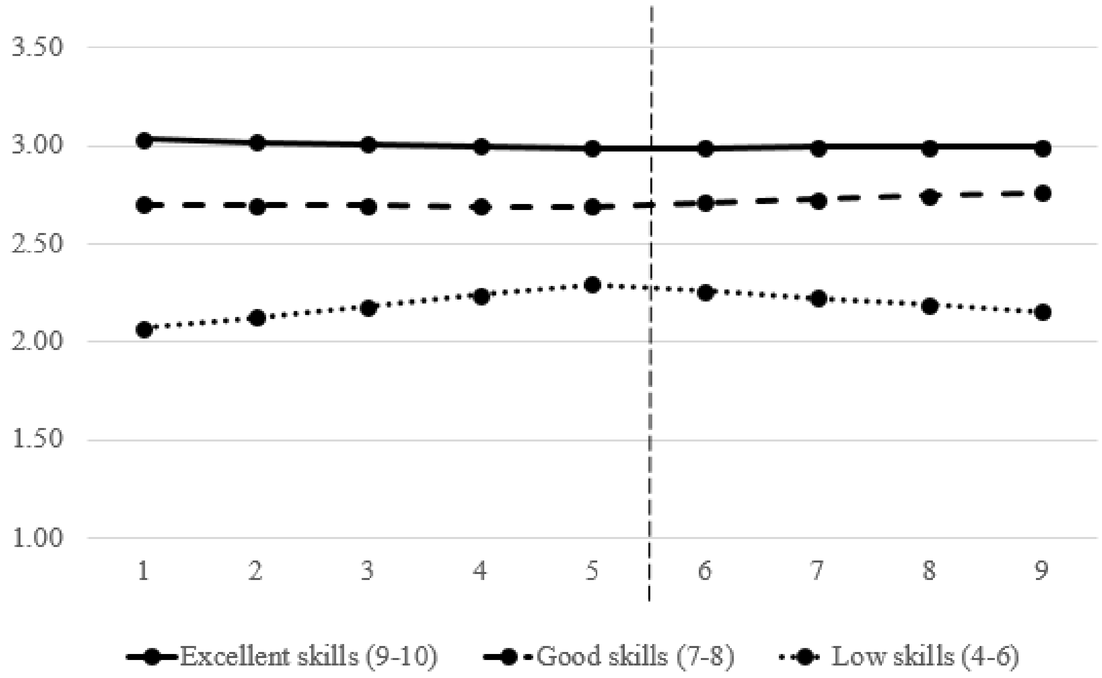

Figure 2.

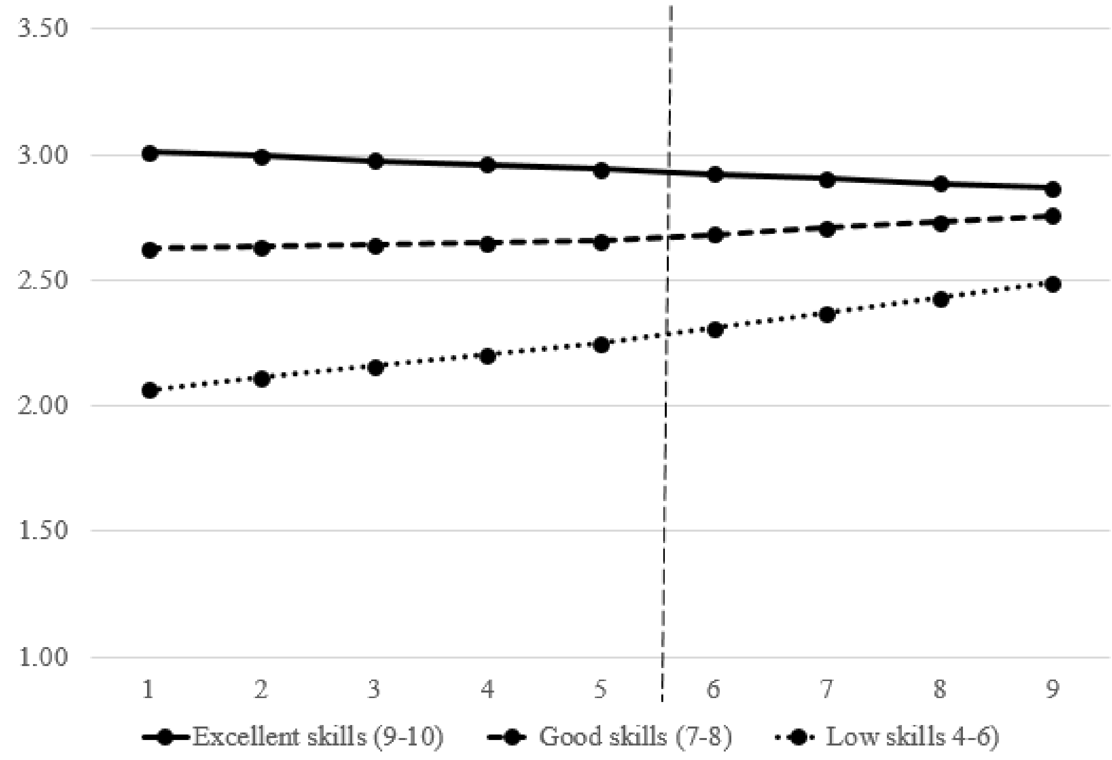

Figure 3.

All the associations of self-rated skills with rate of change during the control week (Slope 1) were very small and statistically non-significant (see Appendix 1). Only 8–10% of the variation across pupils was accounted for by self-rated skills. Thus, neither self-rated L1 nor math grades predicted the rate of change in academic self-efficacy during the control week.

During the intervention week, only the math grades reported at the beginning of the study positively predicted variation across the pupils in rate of change in self-efficacy (see slope 2 in Appendix 1 and Figure 3). According to the R^2 values, math skills accounted for 21% of the variation. During the intervention week, the increase in self-efficacy was faster among the pupils who reported having either low or good math skills at the beginning of the study in comparison to those who rated their skills as excellent.

Discussion and Conclusions

This pilot study aimed to explore Finnish school pupils' academic self-efficacy and its changes during a two-week time period, divided into a control week, including subject-specific curriculum, and an intervention week, during which a multidisciplinary learning module was implemented. The objective was to determine whether there were any differences in academic self-efficacy within and between the two weeks. Moreover, the relationship between the pupils' self-reported L1 and mathematics grades and the level of and change in self-efficacy across both weeks was explored.

The preliminary results of this study show that even when the teaching and learning method changed considerably, the pupils' self-efficacy did not decrease. On average, it increased during the intervention week. The increase was faster for pupils with a lower initial level of academic self-efficacy than those with a higher initial level. The results showed a correlation between the initial level of the pupils' self-efficacy and their self-reported grades; it was highest among pupils who rated their skills as excellent and lowest amount those who rated their skills as poor. L1 grades did not predict changes in self-efficacy during either week. However, pupils' self-reported math grades predicted an increase in self-efficacy during the intervention week. It increased more rapidly among pupils with low or good math skills than those who reported their skills as excellent; thus, the differences between different math skills groups began to diminish during the intervention week.

Our preliminary results suggest that pupils are not at risk of reduced self-efficacy when studying based on an integrated curriculum approach that emphasises their active participation, collaborative problem solving in small groups (Doll et al. 2010; Drake and Burns 2004) and hands-on work using the framework of inquiry-based learning (Furtak et al. 2012). One explanation might be that because the integrated curriculum approach is a different learning situation that includes intensive collaboration and teamwork between pupils, it may have enabled the mastery and vicarious experiences that helped them maintain or enhance self-efficacy (Usher and Pajares 2008; Byars-Winston et al. 2017).

As expected, both skills (L1 and math) predicted the initial level of academic self-efficacy. This result is in line with previous research; high self-efficacy has been found to contribute to academic achievement (Honicke and Broadbent 2016). However, it was interesting that the pupils' self-reported math grades predicted an increase in self-efficacy during the intervention week. This raises the question: Why did the self-reported math grades predict a favourable change in the pupils' academic self-efficacy, whereas the L1 grades did not? One explanation might be that, in the multidisciplinary learning module, the role of math was integrated with problem solving and approached with cross-curricular applications (Jansen et al. 2015). In contrast, the literacy and interaction (L1) skills needed during the intervention week might not have differed as much from the control week's subject-specific curriculum. Furthermore, mathematical assignments were executed in teams as a part of the collaborative project. Therefore, during the multidisciplinary learning module, pupils with low self-reported math grades may have benefitted from a different study context and peer support; thus, they were able to experience moments of succeeding in mathematical tasks. Previous research suggests that engaging in small group activities and encouraging peer support in the classroom can enhance pupils' learning (Freeman et al. 2014) and self-efficacy (Zimmerman 2000).

The results of our pilot study emphasise the importance of scaffolding pupils to face challenging tasks and use their preliminary knowledge without being afraid of failing, and of structuring the pedagogy of multidisciplinary learning and inquiry-based learning to allow pupils to gain enactive mastery experiences. Enabling mastery experiences has been shown to be an essential source of self-efficacy (Bandura 1997; Britner and Pajares 2006). Although these results are encouraging, it should be noted that, in some cases, introducing new methods and materials can diminish self-efficacy if pupil support is insufficient (see Usher and Pajares 2008; Jansen et al. 2015).

Additionally, when implementing new pedagogies, supporting teachers in their work might be essential for successful experiments and for promoting pedagogies that support learning for all (Hauge and Wang 2019). In this study, the intervention week was implemented in collaboration with a university. Thus, the teachers may have received considerable support in the planning, implementation and assessment of integrated curriculum instruction (Bautista et al. 2016; Braskén et al. 2020; Peltomaa and Paterson 2020) and in scaffolding the pupils, which might explain the tendency of self-efficacy (Liu et al. 2014).

Our pilot study has limitations, which should be acknowledged when attempting to generalise its findings. The first three limitations relate to the study design. Our study was conducted in a real-world school setting using a quasi-experimental interrupted time series design (Shadish et al. 2002; for a review, see Handley et al. 2018) with five measurement points before the introduction of the intervention and four measurement points during it. This enabled us to evaluate the short-term intervention effect of the multidisciplinary learning module while accounting for the pre-intervention level and trend in the pupils' academic self-efficacy during the 'normal' subject-specific school week. With this design, some of the potential threats to internal validity typical of quasi-experimental designs could be overcome (testing/maturation effect) or assessed (regression towards the mean) (Shadish et al. 2002; for a review, see Handley et al. 2018). However, the intervention only lasted four days, which may not be long enough to offer deep insight into the impacts on pupils' academic self-efficacy. Moreover, the design did not include a control group. A carefully chosen control group would have allowed us to make more firm conclusions about the causal effects of the intervention on the pupils' academic self-efficacy, for example, by enabling us to assess the potential differences in the characteristics of the study periods, the participating school, and the pupils. Finally, we adjusted for students' gender and grade level, but we could not consider any effects related to their socio-economic (SES) backgrounds. Although the SES differences in students' academic performance and subsequent educational attainment are small Finland compared to many other countries (Chmielewski 2019; Lehti 2020), the SES has been shown to have an effect on them also here (OECD 2019). To consider these limitations, future studies should examine whether a similar, but longer-term, intervention with a follow-up assessment and a control group would have lasting effects on pupils' academic self-efficacy and skills. Moreover, a larger variety of background characteristics of students should be considered.

Fourthly, academic self-efficacy is a task- and domain-specific phenomenon (Schunk and Pajares 2005); thus, it could have been impacted by various aspects of the multidisciplinary learning module: the pedagogical methods, teamwork, teachers' roles, and the subjects' roles (as compared to the subject-specific school week). In our study, the pupils were accustomed to subject-specific learning. The multidisciplinary learning module introduced a number of new factors, such as intensive teamwork, collegial collaboration among the school and the university and different learning materials, making it difficult to assess which of these factors impacted the pupils' self-efficacy. In future research, these aspects should be further explored, even though they are all organic elements of an integrated curriculum (see Drake and Burns 2004).

Fifthly, if a pupil perceived his/her academic self-efficacy to be at the top of the given response scale (1–4) during the control week, he/she could not increase his/her score during the intervention week, even if he/she felt that his/her academic self-efficacy increased. Therefore, for the pupils who evaluated their self-efficacy as excellent from the beginning of the study, we could only detect a possible reduction in perceived self-efficacy during the remainder of the study. In future research, this gap could be reduced, for example, by using qualitative interviews or open questions in the questionnaire. Furthermore, executing a proficiency test for math and L1 skills could be beneficial for obtaining more information about the changes in the pupils' self-efficacy in relation to these skills.

In closing, this study encourages educators to plan and implement multidisciplinary learning modules for pupils with different skill levels, with the understanding that the integrated curriculum approach demands an active learning approach (e.g., inquiry-based learning) and scaffolding.

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Appendix 1

Table A1. Standardised estimates for the associations of the levels and slopes of academic self-efficacy with gender, grade level and self-rated skills ($N = 214$).

	Academic self-efficacy	
	L1 grade as predictor	Math grade as predictor
Goodness-of-fit indexes		
$\chi^2(60)$	129.25***	124.21***
CFI/TLI	0.93/0.92	0.94/0.93
RMSEA	0.07	0.07
SRMR	0.08	0.08
Intercept	Estimate	Estimate
Gender (0 = boy, 1 = girl)	0.09*	0.17*
Grade level (5–8, mean centred)	-0.01	0.03
L1 grade		
Low skills (4–6)	-0.47***	-
Good skills (7–8)	-0.34***	-
Excellent skills (9–10)	ref.	-
Math grade		
Low skills (4–6)	-	-0.51**
Good skills (7–8)	-	-0.39***
Excellent skills (9–10)	-	ref.
Slope 1	Estimate	Estimate
Gender (0 = boy, 1 = girl)	-0.03	-0.04
Grade level (5–8, mean centred)	-0.03	-0.06
L1 grade		
Low skills (4–6)	0.30	-
Good skills (7–8)	0.09	-
Excellent skills (9–10)	ref.	-
Math grade		
Low skills (4–6)	-	0.30
Good skills (7–8)	-	0.23
Excellent skills (9–10)	-	ref.
Slope 2	Estimate	Estimate
Gender (0 = boy, 1 = girl)	0.35*	0.34**
Grade level (5–8, mean centred)	0.16*	0.05
L1 grade		
Low skills (4–6)	-0.11	-
Good skills (7–8)	0.02	-
Excellent skills (9-10)	ref.	-
Math grade		
Low skills (4–6)	-	0.25×
Good skills (7–8)	-	0.26**
Excellent skills (9–10)	-	ref.
R^2		
Level	0.28***	0.32***
Slope 1	0.08	0.10
Slope 2	0.15*	0.21**

Note. ×$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$; ref. = reference category; - not included in the analysis.