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The positive feedback loop between academic self-efficacy, academic initiative, and Grade Point Average: a parallel process latent growth curve model

Sara Madeleine Kristensen[a], Anne G. Danielsen[b], Helga Bjørnøy Urke[a], Torill B. Larsen[a] and Mette Marthinussen Aanes[c]

[a]Department of Health Promotion and Development, University of Bergen, Bergen, Norway; [b]Department of Education, University of Bergen, Bergen, Norway; [c]Department of Leadership and Organizational behaviour, Norwegian Business School, Bergen, Norway

ABSTRACT

This study investigates the associations between students' developmental changes in academic self-efficacy, academic initiative, and grade point average (GPA) during a three-year upper secondary education. The sample consisted of 1453 students aged 16–19 (60.6% girls; baseline mean age = 17.00, *SD* = .91; 56.1% high perceived family wealth; and 74.9% Norwegian-born). To explore how changes in academic self-efficacy, academic initiative, and GPA were related, we investigated a theoretical parallel process latent growth curve model. The results implied that, during upper secondary school, academic self-efficacy declined, while academic initiative and GPA remained stable. We found possible ceiling effects within and between several of the study's constructs. The main finding was support for a positive feedback loop between the developmental trajectories of academic self-efficacy, academic initiative, and GPA. The present study adds new insight that should be taken into consideration when promoting positive educational development during late secondary school.

HIGHLIGHTS

- Academic self-efficacy declines during upper secondary school, while academic initiative and grade point average remains stable.
- Parallel process latent growth curve model analysis.
- Possible ceiling effects within and between several of the study's factors.
- Positive associations between the trajectories of academic self-efficacy, academic initiative, and grade point average.

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CONTACT Sara Madeleine Kristensen Madeleine.Kristensen@uib.no Department of Health Promotion and Development, University of Bergen, 5009 Bergen, Norway

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Introduction

Academic self-efficacy (i.e., beliefs about one's capability to perform academically at a designated level: Bandura, 1997) might influence academic initiative (i.e., an expression of intrinsic motivation and engagement: Larson, 2000) and academic performance. Academic initiative and performances, in turn, can impact self-efficacy beliefs through the four sources of self-efficacy, particularly mastery experience and affective states (Bandura, 1997). These mutual effects are assumed to result in a self-fulfilling prophecy process between performance, self-efficacy, and academic initiative as time progresses (Burns et al., 2020; Talsma et al., 2018; Taylor et al., 2014). Although studies show prospective relationships between academic self-efficacy, academic initiative, and performance, research has largely ignored the association between the growth of the aforementioned factors throughout education. This study aims to fill that knowledge gap. Specifically, a parallel process latent growth curve model is employed to investigate how initial status and development in academic self-efficacy, academic initiative, and academic performance are related in a cohort of students across their upper secondary school education (ages ∼15-19).

Self-determination theory and self-efficacy theory

Initiative (Larson, 2000) consists of the ability to be motivated from within (autonomous motivation) and to focus attention and effort towards a challenging goal (engagement). Because autonomous motivation is characterised by volition, positive feelings, and agency (Ryan & Deci, 2000b), initiative behaviour could be deemed to be autonomously regulated, according to self-determination theory (SDT; Ryan & Deci, 2017). Autonomous self-regulating experiences and behaviours are, for example, setting one's own goals, planning future behaviours, pursuing optimal challenges, persisting in the face of adversity, performing better and more creatively, using mature coping strategies, and experiencing more positive feelings about oneself and one's learning (Hansen et al., 2003; Reeve, 2002).

SDT argues that the basic psychological needs for autonomy, competence, and relatedness are crucial in the experience of motivation (Deci & Ryan, 2002). Internalising schoolwork, for instance, is largely dependent on the satisfaction of the basic needs in an educational setting. The continuum of relative autonomy ranges from the most external form of regulation, in which individuals are devoid of feelings of autonomy, to intrinsic regulation whereby individuals are fully self-determined (see the taxonomy of human motivation: Ryan & Deci, 2000a, p. 61). The greater need satisfaction people experience for a behaviour, the more autonomously regulated the behaviour becomes (Deci et al., 1996). Because initiative is self-endorsed, congruent with oneself, and serves as an expression of an individual's values and beliefs, it could be compared to autonomous self-regulation (Deci & Ryan, 1985, 2002).

Perceived academic self-efficacy refers to beliefs about one's capability to perform behaviours at designated levels in an educational setting (Bandura, 1997). Academic self-efficacy has been related to performance behaviour, such as task choice, effort, persistence, ambitious goal setting, and use of effective learning strategies (Pajares & Usher, 2008; for a review, see Richardson et al., 2012; Schunk & DiBenedetto, 2016).

Bandura (1997) relates self-efficacy to the need for control and suggests that individuals exercise control to obtain benefits (e.g., rewards). Although self-efficacy theory (SET; Bandura, 1997) does not distinguish clearly between intrinsically and extrinsically regulated behaviours (Deci & Ryan, 2000, p. 257), achieving good grades during upper secondary school is a major goal and is valued by most students to either pursue tertiary education or enter the labour market successfully. Because getting good grades is valued by and, to varying degrees, integrated within students, the behaviours that are performed to achieve it can be considered to be identified or integrated depending on relative autonomy (Deci & Ryan, 2002). Identified and integrated regulated behaviours are congruent with one's identity, values, and goals, but are not primarily performed due to the inherent pleasure and joy that they bring about (as is the case for intrinsically regulated actions). There is some external good, benefit, reward, or force that is driving the initiation of identified or integrated action (Ryan et al., 1985).

Bandura (1997) suggested that self-efficacy is informed by four sources of information: mastery experiences, vicarious experiences, verbal persuasion, and physiological/affective states. Mastery experiences concern previous performances in specific settings and are used to determine self-efficacy for the same or similar contexts in the future (e.g., academic performance). In the case of vicarious experiences, people use information available to them to compare themselves to others (e.g., grades compared to their classmates' grades). Verbal persuasion is the feedback individuals receive from their environment (e.g., a teacher telling a student they can do well on an exam). Lastly, physiological and affective states are used as an indicator of how capable a person feels in a specific setting, based on previous similar contexts (e.g., happiness or boredom during schoolwork).

Students who start with high motivational resources and engagement might employ self-regulating learning behaviours that lead to more success, resulting in a cementation of the students' initial levels of motivation and engagement. This is an amplifying effect in the dynamics of motivation and engagement quality over time, central to SDT and SET through basic need satisfaction and self-efficacy sources, respectively. Skinner et al. (2008) found that the emotional components of engagement and the students' self-perceptions of autonomy promoted changes in their behavioural components. In line with these findings and rationales, there are reasons to believe that the initial levels and developmental changes in academic self-efficacy, academic initiative, and academic performance have mutually influential effects as time progresses in education, resulting in a positive feedback loop.

Changes in academic self-efficacy, academic initiative, and academic performance

Several studies and literature reviews, and one meta-analysis, indicate that autonomous motivation and various variables related to motivation typically decline as time progresses throughout education (Ahmed et al., 2013; Caprara et al., 2008; Eccles & Roeser, 2009; Miyamoto et al., 2020; Scherrer & Preckel, 2019; Wigfield et al., 2006). In addition, a negative developmental change in academic performance throughout education has been observed (Ahmed et al., 2013; Gutman et al., 2003; Shim et al., 2008). Relevant to this, Pajares and Valiante (2002) observed that secondary school students had less confidence in their ability to self-regulate learning strategies compared to

elementary school students. Although it has been assumed that academic self-efficacy also declines throughout students' education (e.g., Midgley et al., 1995), findings from one meta-analysis imply that a negative developmental trajectory of academic self-efficacy has not been firmly established (Scherrer & Preckel, 2019).

The developmental associations between academic self-efficacy, academic initiative, and academic performance

Some research supports the notion of a positive feedback loop between academic self-efficacy, academic initiative, and academic performance. First, it has been found that intrinsic motivation and engagement have mutually beneficial and promoting effects with academic achievement over time (see e.g., Lee, 2014; Taylor et al., 2014). Autonomous motivation is related to high effort and task performance (Patall et al., 2008), and students who are autonomously motivated demonstrate high performance levels in education (Wu et al., 2020), strong conceptual learning, and improved memory (Gottfried, 1990). Results from one study also suggested that intrinsic motivation and academic performance have a reciprocal relationship over time (Taylor et al., 2014). Furthermore, several characteristics of engagement are related to academic performance (e.g., Lee, 2014; Vizoso et al., 2018; Wu et al., 2020; Xie et al., 2020) and prior academic performance has been found to influence later engagement (Paloș et al., 2019). Second, a reciprocal relationship between academic self-efficacy and performance has been observed (Burns et al., 2020; Talsma et al., 2018). Third, young people who experience high intrinsic motivation have more favourable academic self-efficacy beliefs (see Gottfried et al., 2001). Lastly, central elements of autonomous motivation such as joy, hope, and pride correlate positively with students' academic self-efficacy and overall achievement (Pekrun et al., 2004).

Aims of the study

This study moves beyond the 'chicken and egg' question of the temporal associations between self-efficacy, autonomous motivation, engagement, and performance in education and investigates a possible positive feedback loop between the developmental trajectories of academic self-efficacy, academic initiative, and GPA in an upper secondary school cohort. We suggest that students who experience increasing self-efficacy and initiative for schoolwork during education express their motivation, engagement, and motivational beliefs through autonomous self-regulated learning behaviours, resulting in a parallel improvement in their grade point average (GPA). Similarly, an improvement of the student's GPA will positively and simultaneously inform their academic self-efficacy and academic initiative through the four sources of self-efficacy and basic need satisfaction, respectively. We specify a parallel process growth curve model (Bollen & Curran, 2006) to examine the theoretical model presented in Figure 1. We hypothesise the following:

H_1. The developmental trajectories of academic self-efficacy, academic initiative, and GPA are negative.

H_2. Initial statuses of academic self-efficacy, academic initiative, and GPA are positively associated.

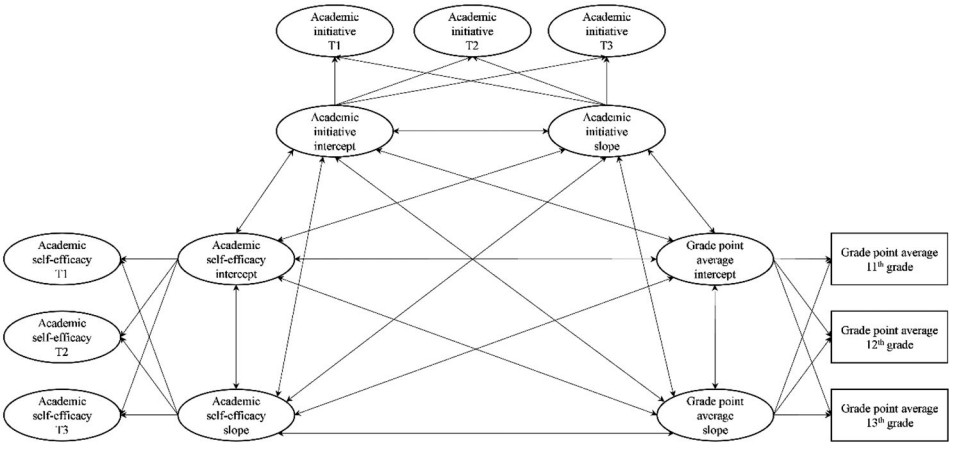

Figure 1. Model of academic self-efficacy, academic initiative, and Grade Point Average.

H_3. Initial statuses of academic self-efficacy, academic initiative, and GPA are positively associated with the corresponding developmental trajectories and changes in the other factors.

H_4. The developmental trajectories of academic self-efficacy, academic initiative, and GPA are positively associated.

Method

This article was based on data from the COMPLETE project (Larsen et al., 2018), a study that lasted from 2016 to 2019. COMPLETE is a randomised controlled trial study developed to improve the psychosocial learning environment and subsequently increase the completion rate in upper secondary school. In the study, there were two intervention groups (six + five schools) and one control group (five schools). All students enrolled in the first grade of upper secondary school in August 2016, in the aforementioned schools, were invited to participate in the project. The study sample was students aged 16–19 who attended a general education programme.

Procedure

In Norway, the grade levels of primary and secondary school consist of 13 grades, from age 6 to age 19. Upper secondary school (grade 11 to grade 13) is right-based, voluntary, and free of cost. Approximately 98% of adolescents choose to begin an upper secondary school education and 79.6% complete the education within five to six years (SSB, 2021). We followed a cohort of students attending a general education programme from their first to their last year of upper secondary school. Data was collected in March 2017 (grade11/T1), March 2018 (grade12/T2), and March 2019 (grade13/T3). The data collection took place close to the end of each school year and the student's grades were collected from register data at the end of each school year. The data was collected by researchers in the project on school grounds using tablets.

Students who were not present during the data collection were contacted via SMS to participate.

Participants

The total sample consisted of 1453 participants, of whom 60.6 per cent (n = 881) were girls and 39.4 per cent (n = 572) were boys. At T1, the students were aged 16 (65.7%), 17 (27.8%), 18 (3.1%), 19 (1.1%), and 20 – 25 (2.3%). A median split of the students' perceived family wealth on baseline indicated that 56.1 per cent (n = 815) perceived their family as being in a high socioeconomic position (well off or very well off), while 24.8 per cent (n = 360) perceived their family as being in a low socioeconomic position (not well off or not well off at all), and 19.1 per cent (n = 278) did not answer the question. The majority of the participants were Norwegian-born (n = 1088; 74.9%), while 6.1 per cent (n = 89) were born in another country and 19 per cent (n = 276) did not answer this question.

Measures

Academic initiative

Academic initiative was measured by a brief, Norwegian version of the Youth Experience Survey (YES 2.0) (Hansen et al., 2003; Hansen & Larson, 2005). The adaptation of the scale included five indicators that particularly addressed important qualities of initiative (Danielsen et al., 2010). The items were altered to refer specifically to the school context. An example indicator is 'I find out how I can reach my goals in schoolwork'. The participants rated the statements on a scale from 1 = 'never' to 4 = 'almost always'. Previous studies that have employed the brief, Norwegian-adapted scale have reported Cronbach's alpha above .84 in adolescent samples (Danielsen et al., 2010; 2011).

Academic self-efficacy

The students' perceived capability to master and perform schoolwork was measured using the academic self-efficacy scale from Patterns of Adaptive Learning Scales (PALS; Midgley et al., 2000). Since the Norwegian translation of 'classwork' is more similar to the notion of doing work related to school in general, the wording of classwork is replaced with schoolwork (i.e., lessons done in class or work assigned at school or to do at home). The instrument consists of five items that were assessed on a Likert-scale ranging from 1 'Not at all confident' to 5 'Very confident'. An indicator example is 'I'm certain I can figure out how to do the most difficult schoolwork'. Previous research indicates a reliable Cronbach's alpha above .78 for the academic self-efficacy subscale of PALS (Midgley et al., 2000).

Grade Point Average (GPA)

To collect information about the student's GPA, their final grades for each subject of each year were obtained from register data at the school level and a mean was

calculated based on these grades. All general education programme students in upper secondary school in Norway take mandatory, multidisciplinary subjects such as Norwegian, English, geography, physical education, mathematics, natural science, and social studies. General education students within different fields of study also take subjects related to their specialisations (e.g., 'media and communication' or 'mathematics and natural sciences'). The grades obtained from the registry data are based on both mandatory and specialisation-specific subjects. In Norway, grades range from 1, which is a failing grade, to the highest grade of 6.

Control variables

Gender. Men were coded as 0 and women as 1.

Socioeconomic position. We created a dummy variable based on the participants' perceived family wealth (Iversen & Holsen, 2008), wherein low socioeconomic position was coded as 0 and high socioeconomic position was coded as 1.

Immigrant background. The participants reported whether they were born in Norway (coded as 0) or not (coded as 1).

Intervention condition. To exclude the possible effects of the interventions on our model, we included two dummy variables based on intervention conditions, wherein students were either in the intervention condition (coded as 1) or not (coded as 0).

Statistical analyses

Data analysis

All preliminary screenings and analyses were performed using IBM SPSS Statistics for Windows Version 25, while the lavaan package in R (version 0.6-9; Rosseel, 2012) was used to perform structural equation modelling (SEM) in our primary analysis, with maximum likelihood estimation. The same standards for interpreting the model fit were applied to each structural equation model: 1) the root mean square error of approximation (RMSEA) should ideally be below .05, but below .08 is acceptable (Browne & Cudeck, 1993); 2) the comparative fit index (CFI) should ideally be close to or above .95, but a CFI above .90 is acceptable; and 3) a standardised root mean square residual (SRMR) below .08 is considered a good fit (Hu & Bentler, 1999). Chi-square was considered and reported but was not a decisive indicator of goodness-of-fit as it tends to be sensitive to sample size (Bearden et al., 1982).

Preliminary analyses consisted of omega reliability tests, bivariate correlations of the study's variables, intraclass correlation (ICC) analyses, and tests of longitudinal measurement invariance. Considerations of correlational effect sizes were based on Cohen (1988), wherein $r > .10$ is small, $r > .30$ is moderate, and $r > .50$ is large. To investigate if the association between academic self-efficacy, academic initiative, and GPA should be examined using multilevel analyses, the ICC of the constructs were investigated at the level of intervention condition and school membership. Next, to examine if the participants perceived the questions similarly across time and that development

Table 1. Response rates.

	T1	T2	T3
Number of invited students	1508	1478	1478
Number of respondents	1184	949	1016
Response rate	78.5%	64.2%	68.7%
Full response rate	75.6%	61.9%	63.1%
Partial response rate	2.9%	2.3%	5.6%

Note. Full response rate = respondents who replied to both scales, partial response rate = respondents who replied to only one scale.

could be attributed to actual growth in the constructs, we investigated longitudinal measurement invariance of the two latent variables in the study. The longitudinal measurement invariance test was performed by specifying increasingly stricter parameter constraints on the academic self-efficacy and academic initiative scales through four levels. First, we tested for configural invariance, followed by the metric, the scalar, and the strict models (Chen, 2007; Wickrama et al., 2016). We used the effects-coding approach whereby the sum of the indicator intercepts and the set of factor loadings for each construct were constrained to 0.0 and 1.0, respectively (Little et al., 2006). If the goodness-of-fit did not deteriorate significantly between models (ΔCFI $<$ .01; ΔRMSEA $<$ .015; ΔSRMR $<$ .03: Chen, 2007), the model with the highest level of invariance was accepted and the constraints were kept in place for further modelling.

To determine the developmental trajectory of academic self-efficacy, academic initiative, and GPA, we incorporated an intercept and a slope factor in a model with the three observed GPA variables and in the invariant measurement models of academic self-efficacy and academic initiative. The intercept and slope factors refer to the variables' initial status and change, respectively. Since the study's variables consisted of three measurement waves (T1, T2, and T3/grades 11, 12, and 13), we assumed linear growth for each variable. The slope factor loadings in the linear growth models were specified as T1/grade 11 = 0, T2/grade 12 = 1, and T3/grade 13 = 2. First, we investigated model fit and results of the unconditional latent growth curve models of each variable separately. Next, we investigated the associations between initial level and development of academic self-efficacy, academic initiative, and GPA in a conditional parallel process latent growth curve model. In this model, we included gender, socioeconomic position, immigrant background, and intervention conditions as time-invariant control variables.

Missing data

We investigated construct-level missingness at each time point through a consideration of response rates (Newman, 2014). See Table 1 for the number of respondents and response rates across three measurement waves (and Appendix A for additional information). It should be noted that although we did not have response rates lower than 30% at any measurement times, which would indicate high person-level missingness, we conducted several follow-up sensitivity analyses of our hypothesised model to investigate the potential impact of person-level missingness in our study. The model results and standard errors were similar across groups with different missingness (i.e., complete data, intermittent missing, and all participants). Because one school dropped out of the study, we examined the model with school as a cluster variable as a robustness test. The cluster model was similar to the original model in estimates

Table 2. Descriptive statistics, omega reliability, and correlations of academic self-efficacy, academic initiative, and Grade Point Average.

	N	ω	*M (SD)*	1	2	3	4	5	6	7	8	9
1. ASE_{T1}	1151	.91	4.00 (.79)	–								
2. ASE_{T2}	923	.92	3.97 (.83)	.62**	–							
3. ASE_{T3}	947	.89	3.70 (1.00)	.35**	.43**	–						
4. AI_{T1}	1148	.87	2.58 (.69)	.41**	.31**	.17**	–					
5. AI_{T2}	917	.88	2.57 (.70)	.28**	.39**	.09*	.58**	–				
6. AI_{T3}	942	.90	2.65 (.74)	.28**	.34**	.26**	.44**	.53**	–			
7. GPA_{T1}	1243	–	4.25 (.78)	.41**	.41**	.20**	.31**	.30**	.26**	–		
8. GPA_{T2}	949	–	4.28 (.77)	.37**	.45**	.25**	.30**	.38**	.33**	.81**	–	
9. GPA_{T3}	980	–	4.32 (.82)	.31**	.30**	.28**	.26**	.26**	.37**	.69**	.82**	–

Note. ASE = academic self-efficacy, AI = academic initiative, GPA = grade point average.
**$p < .01$. *$p < .05$. $N = 641 – 1151$ within ASE correlations; $N = 632 – 1148$ within AI correlations; $N = 665 – 1243$ within GPA correlations; $N = 634 – 1140$ between ASE and AI correlations; $N = 649 – 1150$ between ASE and GPA correlations; $N = 647 – 1147$ between AI and GPA correlations.

and standard errors and a chi-square difference test was not significant ($p > .05$). We used full information maximum likelihood (FIML) to handle potential construct-level missingness.

Results

Descriptive statistics

Descriptive statistics and bivariate correlations for the study variables are presented in Table 2. Omega estimates indicated high internal reliability of the latent construct of academic self-efficacy ($\omega > .89$) and academic initiative ($\omega > .87$) on all measurement occasions. There were positive and significant correlations within and between academic self-efficacy, academic initiative, and GPA across all time points. The school-level ICC of academic self-efficacy, academic initiative, and GPA at each measurement wave was $r < .166$, indicating that the schools were not necessarily more similar than dissimilar with regard to the study's measurements. Likewise, the ICC within the intervention conditions of academic self-efficacy and academic initiative were small ($r < .127$). We concluded that multilevel analyses based on either school level or intervention conditions were not necessary.

Longitudinal measurement invariance

The configural models of academic self-efficacy and academic initiative produced satisfactory model fit and the longitudinal measurement invariance details are presented in Appendix B. Academic initiative achieved strict invariance, while academic self-efficacy achieved partial strict invariance. The invariance constraints were kept in place for further growth curve modelling.

Changes in academic self-efficacy, academic initiative, and Grade Point Average

The latent growth curve models of academic self-efficacy ($\chi^2 = 875.789$, $df = 91$, $p < .001$, RMSEA = .078, 90% CI [.073, .082], CFI = .927, SRMR = .045), academic initiative ($\chi^2 = 376.465$, $df = 99$, $p < .001$, RMSEA = .044, 90% CI [.040, .049], CFI = .968, SRMR =

Table 3. Latent growth curve estimates of academic self-efficacy, academic initiative, and Grade Point Average.

	Unstandardised		Standardised	
	Estimate	SE	Estimate	SE
Academic self-efficacy				
Latent means (μ)				
Intercept	3.994***	0.023	5.545***	0.242
Slope	–0.090***	0.016	–0.286***	0.060
Variance (σ^2)				
Intercept	0.519***	0.045	1.000	0.000
Slope	0.099***	0.023	1.000	0.000
Covariance (σ)				
Intercept – Slope	–0.128***	0.028	–0.566***	0.061
Academic initiative				
Latent means (μ)				
Intercept	2.564***	0.019	4.675***	0.237
Slope	0.023	0.012	0.122	0.068
Variance (σ^2)				
Intercept	0.301***	0.030	1.000	0.000
Slope	0.035*	0.015	1.000	0.000
Covariance (σ)				
Intercept – Slope	–0.041**	0.018	–0.399***	0.097
Grade point average				
Latent means (μ)				
Intercept	4.223***	0.021	5.921***	0.170
Slope	0.010	0.010	0.048	0.048
Variance (σ^2)				
Intercept	0.509***	0.029	1.000	0.000
Slope	0.041***	0.012	1.000	0.000
Covariance (σ)				
Intercept – Slope	–0.003	0.014	–0.023	0.096

Note. ***$p < .001$. **$p < .01$.

.043) and GPA ($\chi^2 = 3.057$, $df = 1$, $p < .080$, RMSEA = .038, 90% CI [.000, .089], CFI = .999, SRMR = .008) produced satisfactory model fit. Table 3 presents the results of the separate unconditional latent growth curve models of the study's variables. The significant and negative slope factor mean of academic self-efficacy indicates a decline in the construct from T1 to T3 (–0.090 units over three years). The slope factor means of academic initiative and GPA did not reach significance, which implies that students' grades and initiative for schoolwork remained stable during upper secondary school. The significant slope factor variance in academic self-efficacy, academic initiative, and GPA indicates that some students increased and decreased at significantly different paces compared to the average developmental trajectories. The significant and negative covariance between the intercept and slope of academic self-efficacy and academic initiative implies that students with high initial levels experienced more rapidly declining levels and slower increasing levels, respectively, compared to others. This effect was not found in GPA.

Parallel process latent growth curve model of academic self-efficacy, academic initiative, and Grade Point Average

The standardised results of the conditional multivariate growth curve model of initial level and development in academic self-efficacy, academic initiative, and GPA are presented in Figure 2 (see Appendix C for more details). The model produced acceptable

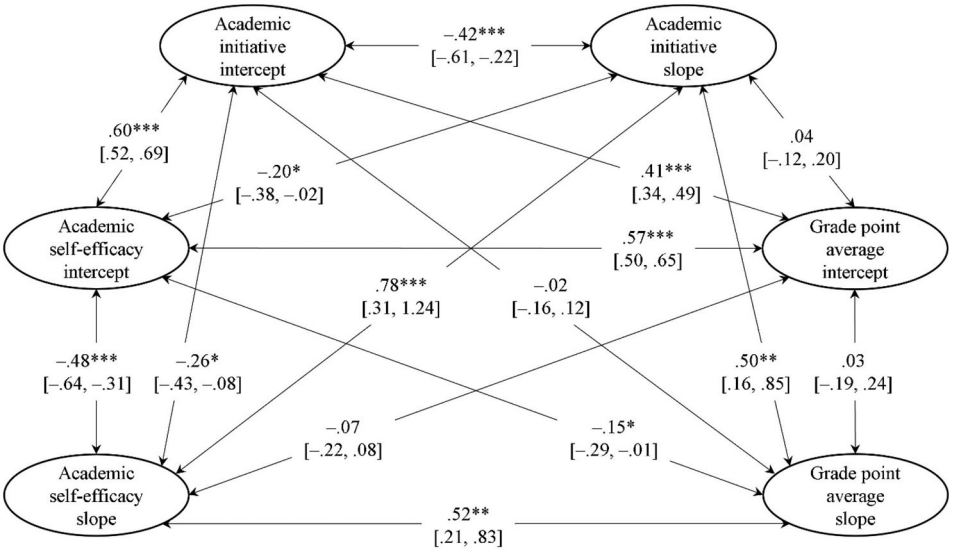

Figure 2. Simplified representation of the parallel process latent growth curve model of academic self-efficacy, academic initiative, and Grade Point Average.
Note. Standardised estimates are presented with 95% confidence intervals in brackets. *** $p < .001$, ** $p < .01$, * $p < .05$.

fit: $\chi^2 = 1804.272$, $df = 631$, $p < .001$, RMSEA = .040, 90% CI [.038, .042], CFI = .942, SRMR = .048.

The results indicated that the initial statuses of academic self-efficacy, academic initiative, and GPA were all positively, significantly, and strongly related to each other. This implies, first, that students with a high initial status of academic self-efficacy had an increased likelihood of reporting high initial academic initiative at the same time point, and of achieving better grades in general during the first year of upper secondary school, compared to students with a lower initial level of academic self-efficacy, academic initiative, or GPA. Second, students with a higher initial level of academic initiative were also more likely to achieve a higher first-year GPA compared to students with a lower initial academic initiative.

The small, significant, and negative correlation between the intercept factor of academic self-efficacy and the slope factor of academic initiative indicates that students who experienced a high initial level of academic self-efficacy were more likely to experience a slower increasing level of academic initiative during upper secondary school, compared to students with a low initial level of academic self-efficacy. The same association was found between initial status of academic self-efficacy and the slope factor of GPA, which implies that higher initial academic self-efficacy was related to a slower improvement in GPA during upper secondary school, compared to others. We found a small, significant, and negative relationship between the intercept factor of academic initiative and the slope factor of academic self-efficacy, which means that students who experienced a high initial level of academic initiative had a more rapidly declining level of academic self-efficacy during upper secondary school, compared to others.

The associations between the developmental trajectories of academic self-efficacy, academic initiative, and GPA were all moderate or large, significant, and positive. This means several things. First, individuals who experienced a slower decreasing trajectory of academic self-efficacy during upper secondary school also experienced more rapidly increasing positive changes in academic initiative and GPA during the same time frame, compared to students with a more rapidly declining level of academic self-efficacy. Second, students with more rapid positive developmental changes in academic initiative during upper secondary school experienced a more rapid positive change in their academic performances during the same time frame, compared to students with a more slowly increasing level of academic initiative.

Discussion

The goal of our study was twofold. The first aim was to examine how academic self-efficacy, academic initiative, and GPA changed during three years of upper secondary school. The second aim was to investigate the associations between the developmental trajectories of academic self-efficacy, academic initiative, and GPA. The results indicated that academic self-efficacy decreased during upper secondary school, while academic initiative and GPA remained stable. The initial statuses of the constructs were positively associated. There were negative relationships between the initial status of academic self-efficacy and the development of self-efficacy, academic initiative, and GPA and between the initial status of academic initiative and the development of academic self-efficacy. Lastly, the developmental trajectories of academic self-efficacy, academic initiative, and GPA were strongly and positively associated.

Changes in academic self-efficacy, academic initiative and Grade Point Average

In partial support of hypothesis 1, we found that, to varying degrees, students experienced significantly declining levels of academic self-efficacy throughout upper secondary school. The negative trajectory of academic self-efficacy may be related to the student's perception of the increasing pressures in the environment, such as parental and teacher expectations, competition with peers, and examinations. Research indicates a shift in Western societies towards a greater emphasis on educational attainment, resulting in an increased number of stressors in education (Högberg, 2021). Increasing pressure, demands and stress for schoolwork can negatively impact self-efficacy in school (Kristensen et al., 2023), possibly through the negative affective and physiological states accompanying the stressful schoolwork (Bandura, 1997). Because our results do not coincide with previous research on the development of academic self-efficacy (Scherrer & Preckel, 2019), more research on the subject is needed – particularly in late secondary school, where the developmental change in academic self-efficacy is still largely unexplored.

Neither in support nor contrary to parts of hypothesis 1, we discovered that students had stable GPAs and academic initiative throughout upper secondary school. Students choose their study programme when they enter upper secondary school, and also specific subjects within that programme. They might experience a genuine

interest in and enjoyment of their schoolwork, which are core indicators of being autonomously motivated (Ryan & Deci, 2017); thus sustaining a stable level of academic initiative. Further, the students may have, before upper secondary school, experienced an internalisation of values that are ingrained in the educational system, such as good grades, promoting academic performance and autonomous self-regulation (Deci & Ryan, 2000). A stable academic initiative and GPA might indicate that the student's school environment is autonomous, with positive teacher-student relationships, and well-structured classrooms, satisfying the basic psychological needs for autonomy, competence, and relatedness (Gnambs & Hanfstingl, 2016).

The developmental dynamics of academic self-efficacy, academic initiative, and Grade Point Average

Supporting hypothesis 2, we found positive associations between initial statuses of academic self-efficacy, academic initiative, and GPA. This suggests that students who, during their first year of upper secondary school, reported a high level of academic self-efficacy, were likely to experience high academic initiative and to perform well academically simultaneously, and vice versa.

Despite finding positive relations between the constructs' initial statuses, some of the results were in direct contradiction to hypothesis 3. We anticipated positive associations between initial status and growth within and between the constructs. However, we found that a high initial academic self-efficacy was related to a more rapid decline in academic self-efficacy and slower increasing levels of academic initiative and GPA. Further, a high initial academic initiative was associated with a faster decline in academic self-efficacy. These associations are somewhat contradictory to the theoretical assumptions of SDT (Deci & Ryan, 1985, 2002) and SET (Bandura, 1986, 1997), hypothesising an amplifying effect in the dynamics of intrinsic motivation, engagement, and self-efficacy over time. The theories argue that people will experience a form of self-fulfilling prophecy with increasing intrinsic motivation, engagement, and self-efficacy through a positive feedback loop between the person and their environment. For instance, Skinner et al. (2008) found an amplifying effect in the dynamics of motivation and engagement quality over time. Similarly, Kristensen et al. (2023) showed that positive changes in academic self-efficacy are likely followed by similar positive increases in the same construct on a following time point. The contradictory outcome we observed for academic self-efficacy and academic initiative might simply be explained by ceiling effects, whereby students with high initial levels were unable to experience an equally rapid increase in academic initiative or a slower decline in academic self-efficacy as students who originally had lower levels in their first year of upper secondary school.

We found strong evidence in support of hypothesis 4, which assumed that the trajectories of academic self-efficacy, academic initiative, and GPA would be positively associated. Aligning with SDT (Ryan & Deci, 2017) and SET (Bandura, 1997), changes in academic self-efficacy, academic initiative, and GPA during upper secondary school probably constitute a positive and reinforcing feedback loop, sharing parallel growth and mutual influence. One study has found similar associations between

developmental trajectories of motivation and engagement (Noels et al., 2019). Research implies that positive developmental trajectories of intrinsic motivation, engagement, and self-efficacy in a school setting are promoted through basic need satisfaction (Zhen et al., 2020) and the four sources of self-efficacy (Peura et al., 2021). For students to experience a positive feedback loop between academic initiative, academic self-efficacy, and academic performance, we encourage systematic work in the schools to continuously promote school belonging (Neel & Fuligni, 2013) and reduce school-related stress (Kristensen et al., 2023) and emotional burnout (Wang et al., 2015).

Implications

Some implications for research, educational practices, and student's academic functioning can be derived from this study. First, our findings advance the knowledge of the structural similarity (i.e., measurement invariance) of academic self-efficacy and academic initiative across two years. The restrictive level of measurement invariance strengthens the study's assumption of the generalisability of the developmental changes in the constructs of academic initiative and self-efficacy across time. Our findings might be useful for longitudinal research, particularly in upper secondary school or higher education, as curriculum and subjects can vary greatly across time beyond the primary and lower secondary educational level. In addition, establishing strict longitudinal measurement invariance in the short measurement scale of academic initiative can benefit researchers who are interested in measuring a concept that is comparable to autonomous motivation and engagement for schoolwork.

Second, because academic self-efficacy decreased during upper secondary school, students might benefit from educational practices designed to promote self-efficacy in the school setting during this period. For instance, teacher autonomy support positively impacts students' academic self-efficacy, engagement, and subjective well-being (Gutiérrez & Tomás, 2019). Furthermore, academic self-efficacy is promoted in school climates that satisfy the student's sense of belonging with supportive interpersonal relationships (Zysberg & Schwabsky, 2021). Because autonomy-supportive and positive psychosocial learning environments also increase autonomous motivation and academic performance (Ryan & Deci, 2017), teachers in upper secondary schools should strive to adapt their teaching style to be autonomy-supportive (see Ahmadi et al., 2022 for an overview of motivational behaviours). Lastly, students experiencing rapidly declining academic self-efficacy might benefit from behavioural treatment targeting the cognitive and emotional components of anxiety (Bresó et al., 2011).

Limitations and future directions

Although the study sample is not nationally representative, the demographics (gender, immigrant background, socioeconomic position) of the participants are similar to the general Norwegian adolescent population. Moreover, the mix of school sizes and urbanity in our study is representative of upper secondary schools in Norway. Overall, the demographics in our study reflect the Norwegian upper secondary school

population to a great extent. We suggest that future studies expand on the present study to samples that are representative of relevant populations. Longitudinal research on academic motivation and performance trajectories and their associations can provide information valuable to intervention strategies targeting different age groups and diverse student samples.

One limitation of this study might be the lack of environmental and contextual measures that might be predictive of the study's factors. For example, teachers and peers influence students' development of academic self-efficacy (Schunk & Pajares, 2002). Thus, investigating how teacher and student classroom dynamics (Furrer et al., 2014; Skinner et al., 2008) impact the developmental trajectories of autonomous motivation and academic performance can further our understanding of changes relevant to educational adjustment during adolescence.

Lastly, to further advance our knowledge of the developmental associations between academic self-efficacy, academic initiative, and academic performance during upper secondary school, researchers might expand on this study and examine the reciprocity between the factors. This can provide valuable information regarding the temporality between the factors and their predictive relationships across specific time points—perhaps throughout particularly demanding contexts such as exams or school transitions (Eccles & Roeser, 2011; Wigfield et al., 1991).

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ORCID

Sara Madeleine Kristensen http://orcid.org/0000-0003-4239-4696
Anne G. Danielsen http://orcid.org/0000-0002-3530-7454
Helga Bjørnøy Urke http://orcid.org/0000-0001-9187-2776
Torill B. Larsen http://orcid.org/0000-0003-3457-9922
Mette Marthinussen Aanes http://orcid.org/0000-0002-7757-3603

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