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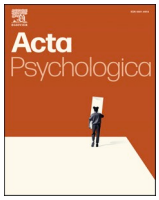

A short-term longitudinal study investigating the role of basic psychological needs and autonomous motivation in explaining students' achievement and dropout from teacher education

Lucas M. Jeno [a,*], Chantal Levesque-Bristol [b], Jorun Nylehn [c], Zeljana Pavlovic [a], Dag Roness [a], Netta Weinstein [d]

[a] Department of Education, University of Bergen, Norway
[b] Center for Instructional Excellence, Purdue University, United States of America
[c] Department of Biological Sciences, University of Bergen, Norway
[d] School of Psychology and Clinical Language Sciences, University of Reading, United Kingdom

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ABSTRACT

This pre-registered short-term longitudinal study investigated the relations between basic psychological need satisfaction and motivational classes and objective measures of achievement and dropout across two semesters. Participants were first-year and fourth-year student teachers (n = 272) in Norway, a demographic known for having high attrition rates. Unexpectedly, we found that autonomous motivation and amotivation were negatively related with achievement, whereas gender (males) and previous high school achievement were positively related with it. Controlled motivation and gender (males) were, conversely, positively related with remaining on the study program. As expected, amotivation was related with dropout. Finally, the effect of autonomous motivation on remaining in education was mediated by basic psychological needs, suggesting that autonomous motivation indirectly reduces dropout through the satisfaction of the basic needs. We discuss the limitations of our study and implications for future research.

1. Introduction

Growing concern for educational quality in schools worldwide includes insufficient graduation rates and subsequent recruitment of qualified teachers (Alatalo et al., 2024; UNESCO, 2013). Traditionally, teacher education programs at universities have admitted students with relatively high academic achievement from upper secondary schools (NOKUT, 2022; Skagen & Elstad, 2023). However, for decades, there has been an alarming trend of declining admission to university colleges and of less qualified student teachers being admitted (NOKUT, 2022), a trend that has increased further after the COVID-19 pandemic.

Specifically in Norway, there is a higher proportion of students leaving their teacher education and fewer students applying for admission to teacher education than in previous years (Bakken, 2022; Statistics Norway, 2024). In Norway, approximately 24% of student teachers drop out of their study program, and only 34% of the student teachers graduate within the stipulated time (Bakken, 2022). The majority of dropouts occur at the start of the program – that is, between the first and second year of study – with men, older students, and low-performing students from upper secondary education having a greater likelihood of dropping out. Furthermore, study and contact time have decreased, because students are forced to spend a lot of time working alongside their studies, which may be further contributing to dropout and poorer performance (Wikan & Bugge, 2014).

Meta-analysis and systematic review (Böhn & Deutscher, 2022) in adjacent areas suggest that changes in interest, wrong career choice, different expectations, and perceived support or guidance from the educational institution predict dropout. Thus, although some fixed factors explain dropout (i.e., gender, age, prior academic achievement), there are some motivational factors (choice, interest, expectancies, support) that might also be predictors of dropout beyond the effect of fixed factors. While factors such as gender and age are more stable, motivational factors may be more malleable. Specifically, for teacher education, motivation is highly important for choosing the study program and for continuation in the program (Elstad et al., 2023). Given the importance of basic psychological need satisfaction for motivation

* Corresponding author.
E-mail address: lucas.jeno@uib.no (L.M. Jeno).

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(Bureau et al., 2021), and the strong effect of motivation on academic adjustment (Howard et al., 2021), this study examines whether basic psychological need satisfaction and motivation act as predictive factors for achievement and have a shielding effect against dropping out of a teacher education program.

To our knowledge, no previous studies have investigated the short-term longitudinal effects of basic psychological needs and motivation on actual achievement and dropout among student teachers in Norway. Most international longitudinal studies investigate the role of motivation on either achievement (e.g., Alamer & Alrabai, 2022; Corpus et al., 2022) or the intention to dropout and achievement (e.g., Corpus et al., 2020; Messerer et al., 2023), without considering the role of basic psychological need satisfaction. Thus, we extend the literature in this field by including the role of basic psychological needs as a potential predictor of achievement and dropout and as a mediator between motivation and achievement and dropout. As such, the primary aim of this study is to longitudinally investigate student teachers' motivation during study periods which are known to have high attrition rates and investigate the impact of motivation on achievement and dropout.

1.1. The correlates of basic psychological needs and motivation in higher education

Our theoretical starting point is informed by Self-Determination Theory (SDT; Ryan & Deci, 2017). SDT is a broad theory of human motivation that emphasizes the role of the impact of social environments on the individual's basic psychological need satisfaction and motivation, and the differential impact of motivation on academic outcomes.

SDT states that satisfaction of basic psychological needs for autonomy (i.e., to feel a sense of agency), competence (i.e., to feel effective), and relatedness (i.e., to feel cared for) are important conditions for students to thrive psychologically and academically. Furthermore, satisfaction of these basic psychological needs mediates the effect of the social context on outcomes (Ryan & Deci, 2017).

SDT differentiates between three classes of motivation (controlled motivation, autonomous motivation, amotivation), depending on the relative degree of self-determination. These three different qualities of motivation have different motivational forces, emotional experiences, involvement levels, and correlates associated with them (Koestner & Losier, 2002). The least self-determined motivation is controlled motivation. Controlled motivation is regulated by either external control (i.e., external regulation) such as compliance, rewards, or avoiding punishment, or internal control (i.e., introjected regulation), such as self-control, ego-involvement, or attaining self-esteem (Ryan & Deci, 2017). Previous studies show that controlled motivation is negatively correlated with optimal learning indicators such as time management, concentration, and attitude (Vansteenkiste et al., 2005), and positively correlated with dropout intentions (Jeno et al., 2018). Conversely, while some studies have linked controlled motivation to negative learning outcomes, others have suggested that it may have some energizing effects, which in turn predict greater achievement (e.g., Botnaru et al., 2021; Jeno et al., 2021).

In contrast to controlled motivation, autonomous motivation reflects more self-determination and is characterized by a high level of personal volition, endorsement, and choice (Ryan & Deci, 2017). Autonomous motivation has been largely correlated with positive outcomes. When autonomously motivated, individuals are regulated by personal importance and value (i.e., identified regulation), congruence in behaviors and actions (i.e., integrated regulation), and interest and enjoyment (i.e., intrinsic motivation) (Ryan & Deci, 2017). Indeed, studies have shown that autonomous motivation is related to academic satisfaction (Breva & Galindo, 2020), perceived knowledge transferability (Levesque-Bristol et al., 2020), adaptive cognitive strategies (Manganelli et al., 2019), and higher achievement (Wang et al., 2022). Furthermore, autonomous motivation has been negatively correlated with dropout intentions (Jeno et al., 2018).

Alongside these two forms of motivation is amotivation, which is characterized by a lack of self-determination. Students that are amotivated act with no intention, value, or control, and feel incompetent (Ryan & Deci, 2017). Research has shown that amotivation is negatively related to student's achievement and knowledge transfer (Wang et al., 2022) and well-being (Breva & Galindo, 2020). In a prospective study among Canadian college students, Vallerand and Bissonnette (1992) found that students who had dropped out had significantly higher amotivation scores compared to persistent students.

1.2. Longitudinal effects of basic psychological needs and motivation

Motivation is sensitive to the learning context (Janke et al., 2022) and can fluctuate within a semester, as well as between semesters (e.g., Busse & Walter, 2013; Robinson et al., 2019). This makes it important to investigate the longitudinal effects of motivation.

Several studies informed by SDT have investigated the longitudinal effects of motivation in higher education. Alamer and Alrabai (2022) investigated how autonomous motivation for learning English predicted achievement across three time points. Using cross-lagged panel modeling, they found, at the within-level, that autonomous motivation predicted achievement at Time 1, but not the other way around, and achievement at Time 2 predicted autonomous motivation at Time 3, but not the other way around. Corpus et al. (2022) found across four timepoints that autonomous regulation remained relatively high across the measurement times, whereas controlled regulation and amotivation remained relatively moderate to low. However, the regulations did not affect students' achievement. Garn and Morin (2021) measured students' motivational regulation every two weeks for seven weeks and found a quadratic model exhibiting high autonomous motivation in the beginning, followed by a decline, before increasing again. Students with higher grade point averages (GPAs) reported higher levels of general motivation regulation at the start of the semester, but GPA was a negative predictor for the increase in autonomous motivation. Messerer et al. (2023) found that, among German freshman students, intrinsic motivation at Time 1, predicted intrinsic motivation for learning at Time 2, and in turn dropout intention at Time 3, but not actual dropout. Corpus et al. (2020) assessed changes in students' motivational trajectories on achievement and retention over four time periods within the first year of college and found that increases in amotivation predicted lower achievement and a lower likelihood of remaining enrolled, whereas identified regulation and intrinsic motivation was associated with higher achievement and the likelihood of remaining enrolled.

We also found several studies that investigated basic need satisfaction using a longitudinal design. Sheldon and Krieger (2007) found among law students, that supporting basic psychological needs positively predicted need satisfaction. Changes in autonomous motivation were explained by changes in autonomy, whereas achievement was uniquely explained by changes in competence. In a recent study across the first four semesters for German undergraduate students, Janke (2022) found that basic need satisfaction in the initial semester predicted both an increase in learning goal orientation over time and amplified the adaptability of this goal orientation. Finally, using latent transition analyses, Gillet et al. (2020) found that a profile characterized by high levels of relatedness and global basic need satisfaction, and average competence displayed the highest levels of students' interest in their studies, educational satisfaction, highest class attendance, and lowest dropout intentions.

1.3. The present study

In sum, there have been several longitudinal studies based on SDT assessing changes in motivation on the effects of higher education students' achievement and/or dropout. However, in evaluating past research, we identified two main research gaps. First, few studies have used objective registry data (data collected at the time of admission or

during/after the semester from the registrar's office) on both achievement and dropout. This may be a cause for concern, given that registry data are less vulnerable to subjective evaluation than self-reported data (Angel & Gronfein, 1988). Second, in teacher education, few studies have investigated the effects of basic psychological needs and motivational qualities on achievement and dropout across semesters. We sought to fill these gaps in a Norwegian educational context. The Norwegian educational system has undergone several reforms and changes in recent decades, but still faces challenges in the recruitment and retention of educators (Caspersen & Smeby, 2023), making it a useful context for testing.

In response to the lack of longitudinal studies on student teachers in the Norwegian higher education system and the use of registry data, we conducted a pre-registered short-term longitudinal study across two semesters, investigating the impact of students' basic psychological needs and motivation qualities on registry data for achievement and dropout. The benefit of pre-registration is that it increases credibility and reproducibility by allowing us to specify our hypotheses and methodological and analytical plan before data collection.

The following hypotheses were put forth. For hypothesis H1a, we expect that autonomous motivation will be a predictor of higher achievement and lower dropout. For hypothesis H1b, we predict that controlled motivation and amotivation will be a predictor of lower achievement and higher dropout. For hypothesis H1c, given that some studies suggest that gender predicts dropout (e.g., Andresen & Lervåg, 2022) and achievement (e.g., Borgonovi et al., 2018), we predict that males will have higher dropout rates than females, whereas females will have higher achievement.

For hypothesis 2, we predict that students in their fourth year will have higher autonomous motivation and lower controlled motivation compared to first-year students. This is mainly hypothesized from a theoretical point of view in which more mature students will have a greater degree of maturity and self-understanding (Vansteenkiste et al., 2018) and that reports suggest that dropout is greater in some years compared to others.

For hypothesis 3, we predict that the effect of motivational qualities on achievement and dropout will vary across individuals. Given that individuals have different starting points for their motivation, and the trajectory may also vary over time, it's important to account for within-person variation for understanding differences in achievement and dropout.

For hypothesis 4, we predict that basic need satisfaction will positively correlate with autonomous motivation, and negatively with controlled motivation and amotivation.

For hypothesis 5, we predict that basic need satisfaction will mediate the effects of motivation on achievement and dropout across time.

2. Methods

2.1. Participants and procedure

Student teachers on a five-year master's program at a large university in Norway participated in the present study. We collected data from first-year, second-year, and fourth-year students ($N = 427$), where the dropout rates are at the highest levels. The planned sample size was based on data availability. The final sample size comprised 272 students (63.7% response rate). The baseline mean age was 21.01 (min = 19, max = 39). In our study sample, 166 (61.02%) were females, whereas 97 (35.6%) were males. Our sample consisted of students from the first year ($n = 110$), second year ($n = 65$), and fourth year ($n = 75$). Included in our sample are also students ($n = 13$) who are from other study years, either third or fifth year. These were coded as N/As for the study year factor given that our primary interest was between first-year, second-year, and fourth-year students.

Data collection was performed at three time points, across two academic years. First, in the middle of the spring semester of 2023 (T1), then at the end of the spring semester of 2023 (T2), and finally at the beginning of the autumn semester of 2023 (T3). In Norway, there are two semesters; the academic year begins in the start of the autumn and finish in the end of the spring semester. At these three time points, the same questions were asked concerning the students' basic psychological needs and motivation. At the end of the data collection period, we collected registry data from all students who had consented to participate in the study. Registry data was collected through the university and included grades (achievement) and study credit accumulation (dropout) from the spring semester of 2023, and semester registration (dropout) for autumn 2023.

Aims, sampling plans, hypotheses, and analytical plans are provided in our pre-registration, freely available at the Open Science Framework (OSF) (doi:10.17605/OSF.IO/3AK94). Data were collected through SurveyXact. One deviation from our pre-registration is that, as opposed to the pre-registration where we stated that students not consenting to participate at Time 1 would be removed, we asked students that did not respond at Time 1 to participate at either Time 2 or 3. We did this to increase the total sample size and increase the measurement power at each time point.

Ethical approval to conduct our project (#F2641, March 13th, 2023) was granted by the institutional ethical review board (System for Risk and Compliance), in line with guidelines at the University of Bergen, Norway. We collected registry data only from students who consented to give us access to collect registry data. At each time point, three reminders were sent out. Students who responded at two or more time points were given a gift card (150 NOK = ~14 USD) for their participation.

2.2. Measures

2.2.1. Basic psychological needs

To measure students' basic psychological needs, we employed an adapted three-item (Martela & Ryan, 2023) measure of autonomy ("I am able to do the things that I really want and value in teacher education"), competence ("I can do things well and achieve my goals in teacher education"), and relatedness ("I feel close and connected with other people who are important to me in teacher education"). The students responded on a seven-point Likert scale ranging from 1 (*completely disagree*) through 4 (*neither/nor*) to 7 (*completely agree*). We created a composite variable of these three items to form a variable of psychological needs. Omega reliability was satisfactory for each time point (Table 2). Similar approaches with multidimensional constructs and short questionnaire have been applied within SDT (Rocchi et al., 2023). All the items are available at the OSF link.

2.2.2. Motivation

We used the Self-Determination Index (SDI) (Levesque-Bristol, 2021) to measure three qualities of motivation. The SDI consists of 18 items measuring the different regulations conceptualized within SDT, which were outlined above. The scale can also be used to create classes of motivation depending on their level of self-determination, amotivation, controlled motivation, and autonomous motivation, respectively. In the present study, the students were asked at each time point why they were studying in teacher education. An example of an item for amotivation is "I don't know. I wonder if I should continue". An example of an item for controlled motivation (external regulation) is "because I feel I have to". An example of an item for autonomous motivation (identified regulation) is "because it allows me to develop skills that are important to me". We created composite variables of amotivation, controlled motivation (external regulation and introjected regulation), and autonomous motivation (identified regulation, integrated regulation, and intrinsic motivation). The students responded on a seven-point Likert scale ranging from 1 (*completely disagree*) through 4 (*neither/nor*) to 7 (*completely agree*). Omega reliability was satisfactory for each time point for each motivational class (Table 2). All the items are available through

the OSF link.

2.2.3. Achievement

The registry data of student achievement collected was in the form of letter grades achieved during the spring semester, which can be either summative (high-stake) or formative (e.g., portfolio) depending on the course. If the students had more than one exam that semester, an average was created. In Norway, achievement range from A (the highest) to F (fail). In this study, only passing achievement were collected from the registry data, meaning A to E. The achievements were transformed into numerical values ranging from 5 (the highest) to 1 (the lowest).

2.2.4. Dropout

Two registry data measurements were collected as proxies for dropout. First, we collected how many study credits (ECTS) the students completed during the spring semester. The normal amount for progression is 30 ECTS, and anything less is considered a failure to complete that semester. We dichotomized this measure with $\leq$29 being considered a failure, and $\geq$ 30 being considered a pass. Finally, we collected a dichotomous measure of student registration in the following semester. If the students were not registered for the autumn semester, this was an indication that the students had dropped out of the current (autumn) semester.

2.2.5. Control variables

The following control variables were collected from the registry office, which were recorded when the students were accepted on to the program: gender, age, and high-school GPA. Students reported their gender and age at the start of the teacher education program. Their high-school GPA was registered when the students applied for the university. The scores range from 1 (*lowest grade*) to 6 (*highest grade*).

2.3. Analytical strategy

All preliminary and primary analyses were performed using the open and freely available statistical software R, version 4.3.2 (R Core Team, 2018). All R-scripts reported in our study are openly available on GitHub. To analyze our primary hypotheses, we employed linear mixed-effect modeling using the "nlme" package (Pinheiro et al., 2023), generalized linear models (R Core Team, 2018) and the "lavaan" package (Rosseel, 2012) for path analysis. To evaluate global fit measures for the path-model, we used conventional cut-off criteria (Hu & Bentler, 1999), with satisfactory values above 0.90 for comparative fit index (CFI) and Tucker-Lewis index (TLI), and values below 0.08 for root mean square error of approximation (RMSEA) and standardized mean square residual (SRMR). Furthermore, a non-significant chi-square (χ^2) is recommended (Schermelleh-Engel et al., 2003), however, chi-square is sensitive to samples and sample size (Kline, 2011), and caution is advised for this goodness-of-fit index.

3. Results

3.1. Missing data

272 students responded at any of the three time points. Of the total sample size of 272 respondents, the number of complete cases across all three time points is 83, whereas 188 cases are incomplete. We present the overview of the missing data for each motivational variable at each time point in Table 1. Given that our rate of missing data is greater than 5%, we did not proceed to impute missing values. All missing data were handled through full information maximum likelihood (FIML) strategy.

3.2. Preliminary analysis

We provide basic descriptive statistics for our main motivational variables for each time point in Table 2. All variables show signs of normality with acceptable values of skewness ($<$ 3) and kurtosis ($<$ 3). Furthermore, all variables have satisfactory reliability measures (Omega) with values $>$0.70. Finally, the mean scores suggest that basic need satisfaction and autonomous motivation decrease slightly at the end of the spring semester (between Time 1 and Time 2), and then increase again at the start of the autumn semester (Time 3). However, for amotivation and controlled motivation, we see the opposite with mean scores increasing at the end of the spring semester and then decreasing at the start of the autumn semester.

Descriptive statistics for both dropout indicators showed that 14 participants (5.3%) in our sample were not registered, whereas 35 participants (14.1%) had less than 30 ECTS from the spring semester. Across study years, the distribution was as follows for non-registered students: in first year $n = 8$, second year $n = 4$, and fourth year $n = 0$. Two ($n = 2$) non-registered students came from an unspecified study year. For study credits, the distribution was as follows for those with less than 30 ECTS: in first year $n = 19$, second year $n = 12$, and fourth year $n = 4$.

3.3. Confirmatory hypotheses testing

3.3.1. Achievement

To test Hypotheses 1a, 1b,1c, and 3, where we investigate the role of autonomous motivation (H1a), controlled motivation (H1b), gender differences (H1c), and individual variability (H3) on achievement, we conducted a range of mixed-effects model building from a simple model to a more complex model (Ryoo, 2011). However, after testing a null model (intercept only), we found that the intraclass correlation (ICC) was 0.97, indicating that 97% of the variance in achievement could be attributed to a student (Hausknecht et al., 2008). This suggests that only 3% of the variance is left unexplained after taking the between-level variables into account. We thus conducted a multiple regression analysis with cluster robust standard errors to account for some of the within-level effects (using students as a grouping factor). We dummy-coded gender, with males as the reference variable (female = 0, males = 1), and mean-centered amotivation, controlled motivation, and autonomous motivation for ease of interpretation (Raudenbush & Bryk, 2002). We also controlled for mean-centered students' high-school achievement. The model's performance as a whole was satisfactory,

Table 1
Overview of missing data.

Variable	Time 1		Time 2		Time 3	
	Compl.	Incompl.	Compl.	Incompl.	Compl.	Incompl.
Basic need satisfaction	142 (52.2)	130 (47.8)	153 (56.2)	119 (43.8)	209 (76.8)	63 (23.2)
Amotivation	138 (50.7)	134 (49.3)	150 (55.1)	122 (44.9)	208 (76.5)	64 (23.5)
Controlled motivation	138 (50.7)	134 (49.3)	150 (55.1)	122 (44.9)	208 (76.5)	64 (23.5)
Autonomous motivation	138 (50.7)	134 (49.3)	150 (55.1)	122 (44.9)	208 (76.5)	64 (23.5)

Note: Compl = Complete, Incompl = Incomplete. Percentages are shown in parenthesis.

Table 2
Descriptive statistics of the main motivational variables.

	n	*M*	SD	Min	Max	Range	Skew.	Kurt.	se	ω
1. Basic needs_T1	142	4.95	1.07	2.00	7.00	5.00	−0.39	−0.24	0.09	0.73
2. Amotivation_T1	138	2.26	1.36	1.00	6.00	5.00	0.96	−0.20	0.12	0.83
3. Controlled motivation_T1	138	2.40	1.12	1.00	5.67	4.67	0.83	−0.07	0.09	0.89
4. Autonomous motivation_T1	138	4.97	1.07	1.78	7.00	5.22	−0.57	0.15	0.09	0.92
5. Basic needs_T2	153	4.75	1.18	1.00	7.00	6.00	−0.75	0.33	0.10	0.77
6. Amotivation_T2	150	2.49	1.53	1.00	6.00	5.00	0.84	−0.48	0.12	0.84
7. Controlled motivation_T2	150	2.71	1.19	1.00	6.50	5.50	0.60	−0.45	0.10	0.91
8. Autonomous motivation_T2	150	4.82	1.08	1.67	7.00	5.33	−0.42	−0.18	0.09	0.92
9. Basic needs_T3	209	4.91	1.12	1.00	7.00	6.00	−0.86	1.19	0.08	0.77
10. Amotivation_T3	208	2.36	1.51	1.00	7.00	6.00	1.03	0.04	0.10	0.88
11. Controlled motivation_T3	208	2.57	1.26	1.00	5.67	4.67	0.60	−0.68	0.09	0.92
12. Autonomous motivation_T3	208	4.86	1.08	1.67	7.00	5.33	−0.58	−0.02	0.07	0.93

loglik −549.43 (df = 7), AIC = 1112.86, and BIC = 1141.75. The model's intercept when amotivation, controlled motivation, autonomous motivation, and high school achievement are at mean, and for females, is 3.42 (95% CI [3.33, 3.51], $t(452) = 72.1$, $p < .001$). The results within this model showed that both amotivation (β = −0.10, 95% [−0.16, −0.04], $t(452) = -3.39$, $p < .001$) and autonomous motivation (β = −0.15, 95% [−0.22, −0.08], $t(452) = -4.15$, $p < .001$) were negatively related to students' achievement. The effect of controlled motivation was not significant (β = 0.02, 95% [−0.465 0.087], $t(452) = 0.62$, $p = .53$). The effect of both gender (males) (β = 0.21, 95% [0.04, 0.37], $t(452) = 2.49$, $p = .013$) and high school achievement (β = 0.72, 95% [0.58, 0.87], $t(452) = 9.60$, $p < .001$) were positive predictors of students' achievement.

We conducted a post hoc power analysis using Monte Carlo simulations with 5000 iterations to test the statistical power of our regression model for achievement. The simulation yielded power > 0.80, for most predictors, indicating that the sample size was sufficient to detect the observed effects with a high level of confidence (95% CI).

3.3.2. Dropout

To test Hypotheses 1a, 1b, 1c, and 3, where we investigate the role of autonomous motivation (H1a), controlled motivation (H1b), gender differences (H1c), and individual variability (H3) on dropout, we conducted logistic regression analyses. We tested two identical models (i.e., amotivation, controlled motivation, autonomous motivation, and gender) in predicting students' study credit accumulation (≥ 30 ECTS, which indicates passing that semester, and ≤ 29 ECTS, which indicates failure) and registration (either registered or not registered). In both models, our null model (intercept only model) suggested high ICC (>95%). Thus, we continued with standard logistic regression analysis without considering within-person variation. See Table 4 for results of the logistic regressions.

To test if our model predicted study credit accumulation, we fitted logistic regression using maximum likelihood. The explanatory power (pseudo R-squared) of the model was low, McFadden = 0.01, Cox & Snell = 0.01, Nagelkerke = 0.02. None of our predictors had significant coefficients.

To test if our model predicted semester registration, we fitted logistic regression using maximum likelihood. The explanatory power (pseudo R-squared) of the model was substantial, McFadden = 0.25, Cox & Snell = 0.10, Nagelkerke = 0.29. Within this model, the results showed that amotivation was a significant and negative predictor of semester registration, whereas controlled motivation and gender (males) were positive and significant predictors. Autonomous motivation was a non-significant predictor. Furthermore, the results show that if the students' amotivation increased by one unit, the odds ratio for being registered decreased by 0.41. In contrast, if students' controlled motivation increased by one unit, the odds ratio for being registered increased by 1.51. Finally, the odds ratio for being registered if you were a male compared to a female was 4.36 times higher.

We conducted a post hoc power analysis using Monte Carlo simulations with 5000 iterations to test the statistical power of our regression model for semester registration. The simulation yielded power > 0.80 for most predictors, indicating that the sample size was sufficient to detect the observed effects with a high level of confidence (95% CI).

3.3.3. Autonomous motivation

To test Hypothesis 2 (whether students in their fourth year will have higher autonomous motivation and lower controlled motivation compared to first-year students), we fitted a mixed-effects model using autonomous motivation as a dependent variable and study year and time points as predictors (fixed effects). The results are presented in Table 5. We started with the simplest model (null model) and then increased the complexity. However, the best-fitting model was the random intercept model in which we included students as random effects. We added an interaction term between study year and time points, however, this model was not significantly better than the model without interaction effect, $p = .098$. We also tested if we could add study year as a random intercept, however, this model was not significantly better than the previous model, $p = .467$. We thus retained our random intercept model.

Table 4
Logistic regression models of dropout.

	B	*SE*	Wald's Z	*P*	Deviance (DF)	Odds ratio	CI for odds ratio
Study credits					329.29 (462)		
Amotivation	−0.14	0.11	−1.25	0.20		0.86	0.69, 1.08
Controlled motivation	−0.07	0.12	−0.62	0.53		0.92	0.73, 1.18
Autonomous motivation	−0.17	0.15	−1.09	0.27		0.83	0.60, 1.14
Gender (males)	−0.46	0.29	−1.56	0.11		0.62	0.35, 1.13
Semester registration					150.76 (480)		
Amotivation	−0.88	0.16	−5.50	0.000**		0.41	0.29, 0.55
Controlled motivation	0.41	0.20	2.06	0.03*		1.51	1.03, 2.29
Autonomous motivation	0.09	0.22	0.41	0.68		1.09	0.70, 1.69
Gender (males)	1.47	0.59	2.48	0.01*		4.36	1.50, 16.20

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

Table 5
Mixed effects model of students' autonomous motivation.

	Null model	Random intercept model	Random intercept/ interaction model	Random intercept and random slope
(Intercept)	4.902*** (0.061)	**5.227*** (0.106)**	5.247*** (0.128)*	5.226*** (0.101)
Study year (second year)		**−0.076 (0.153)**	−0.028** (0.195)	−0.073 (0.141)
Study year (fourth year)		**−0.683*** (0.143)**	−0.754*** (0.181)	−0.680*** (0.151)
Timepoints (time 2)		**−0.093 (0.073)**	−0.075 (0.127)	−0.089 (0.073)
Timepoints (time 3)		**−0.113 (0.071)**	−0.155 (0.119)	−0.112 (0.071)
Study year (second year) × Timepoints (time 2)			0.032 (0.189)	
Study year (fourth year) × Timepoints (time 2)			−0.045 (0.168)	
Study year (second year) × Timepoints (time 3)			−0.167 (0.184)	
Study year (fourth year) × Timepoints (time 3)			0.202 (0.163)	
SD (intercept subject)	0.896	**0.836**	0.840	0.767
R2 Marg.	0.000	**0.092**	0.099	0.090
R2 Cond.	0.729	**0.727**	0.738	0.730
AIC	1271.7	**1182.8**	1190.9	1188.3
ICC	0.7	**0.7**	0.7	0.7

Note: Standard errors within parentheses.
Highlighted in bold is the final model we retained. Subject is each individual student.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

The results showed that the intercept for the random intercept model is 5.227 across students at study year (first year) and Time-point (Time 1). The fixed effect of Time-point (both Time 2 and Time 3) was non-significant, $p > .05$. The fixed effect of study year (second year) is non-significant, whereas the effect of the fourth year (study year) is significant ($\beta = -0.64$, 95% CI [−0.90, −0.38], $t = -4.78(239)$, $p < .001$). The variance around students' intercept is 0.84, whereas the variance around students' slope is 0.29. The model's explanatory power is substantial with a conditional R^2 of 73%. See Fig. 1 for a visualization of the effect of study year on students' autonomous motivation.

To test Hypothesis 4, regarding whether psychological need satisfaction correlates positively with autonomous motivation, and negatively with controlled motivation and amotivation, we conducted a correlational analysis using individual students as a grouping factor. Results are presented in Table 6. In line with our predictions, we found that both between-person and within-person correlations are in the expected directions. That is, basic need satisfaction correlated negatively with amotivation, and positively with autonomous motivation. Controlled motivation was unrelated to basic need satisfaction and autonomous motivation at the between-person level. At the within-person level, controlled motivation was negatively related to basic need satisfaction and unrelated with autonomous motivation.

To test our final hypothesis (H5), examining whether basic need satisfaction mediates the effects of motivation on achievement and dropout across time, we employed a path-analytical model. We specified three models that consisted of amotivation, controlled motivation, and autonomous motivation as exogenous predictors and basic need satisfaction as mediator. This model was tested three times using achievement, semester registration (dropout), and study credits (dropout) as endogenous outcomes, respectively. Across all three models, we achieved measurement equivalency after testing for configural- and scalar invariance. In all three models, we removed controlled motivation due to no significant relation to all or parts of the measurement points on the latent variable (i.e., controlled motivation). For the dropout models (i.e., registration and study credit), we used the diagonally weighted least square (WLSMV) estimator to account for the dichotomous endogenous outcome variables, which is the least biased and most accurate estimator for dichotomous outcomes (Li, 2016). Goodness-of-fit indices are presented in Table 7.

Results for achievement showed that only autonomous motivation was related to basic need satisfaction ($\beta = 0.98$, $p < .001$), while amotivation was unrelated ($\beta = 0.03$, $p = .77$). However, the relation between basic need satisfaction and achievement was non-significant ($\beta = -0.12$, $p = .08$). The indirect effect between autonomous motivation and achievement, through basic need satisfaction, was also non-significant ($\beta = -0.12$, $p = .09$). Finally, the model accounted for 1.6% of the variance in achievement ($R^2 = 0.016$), and 93% of the variance in basic need satisfaction ($R^2 = 0.933$).

For semester registration, only autonomous motivation was related to basic need satisfaction ($\beta = 0.89$, $p < .001$), whereas amotivation remained non-significant ($\beta = -0.05$, $p = .69$). Basic need satisfaction was a significant predictor of semester registration ($\beta = 0.38$, $p < .05$). We also found that the effect between autonomous motivation on semester registration was fully mediated by basic need satisfaction ($\beta = 0.34$, $p < .01$). The model accounted for 14.9% of the variance in semester registration ($R^2 = 0.149$), and 85% of the variance in basic need satisfaction ($R^2 = 0.855$).

For study credits, autonomous motivation was a significant predictor of basic need satisfaction ($\beta = 0.92$, $p < .001$), whereas amotivation was not significant ($\beta = -0.008$, $p = .95$). Basic need satisfaction was a non-significant predictor of study credits ($\beta = 0.01$, $p = .95$). No significant indirect effects were found (p's > 0.05). The model explained 86% of the variance in basic need satisfaction (R^2=. 865) and less than 1% for study credits ($R^2 = 0.000$).

4. Discussion

The main aim of this pre-registered study was to gain a better understanding of the impact of student teachers' basic psychological needs and motivational classes across two semesters on students' achievement and dropout of teacher education during study periods, which are known to have high attrition rates. Furthermore, we were interested in variability across individuals, gender, and study year on achievement and dropout. Interestingly, the results of our present study found some support for our hypotheses, whilst other results contradicted our expectations.

4.1. The effect of motivational classes and basic need satisfaction on achievement and dropout

Our results showed some mixed results regarding students' achievement. In contrast to our hypotheses, autonomous motivation was negatively related to achievement. Amotivation was also negatively related to achievement, although this was more in line with expectations, as well as previous findings (Wang et al., 2022). The strongest predictor for achievement was students' high school achievement, which is consistent with previous research (Hailikari et al., 2008). Controlled

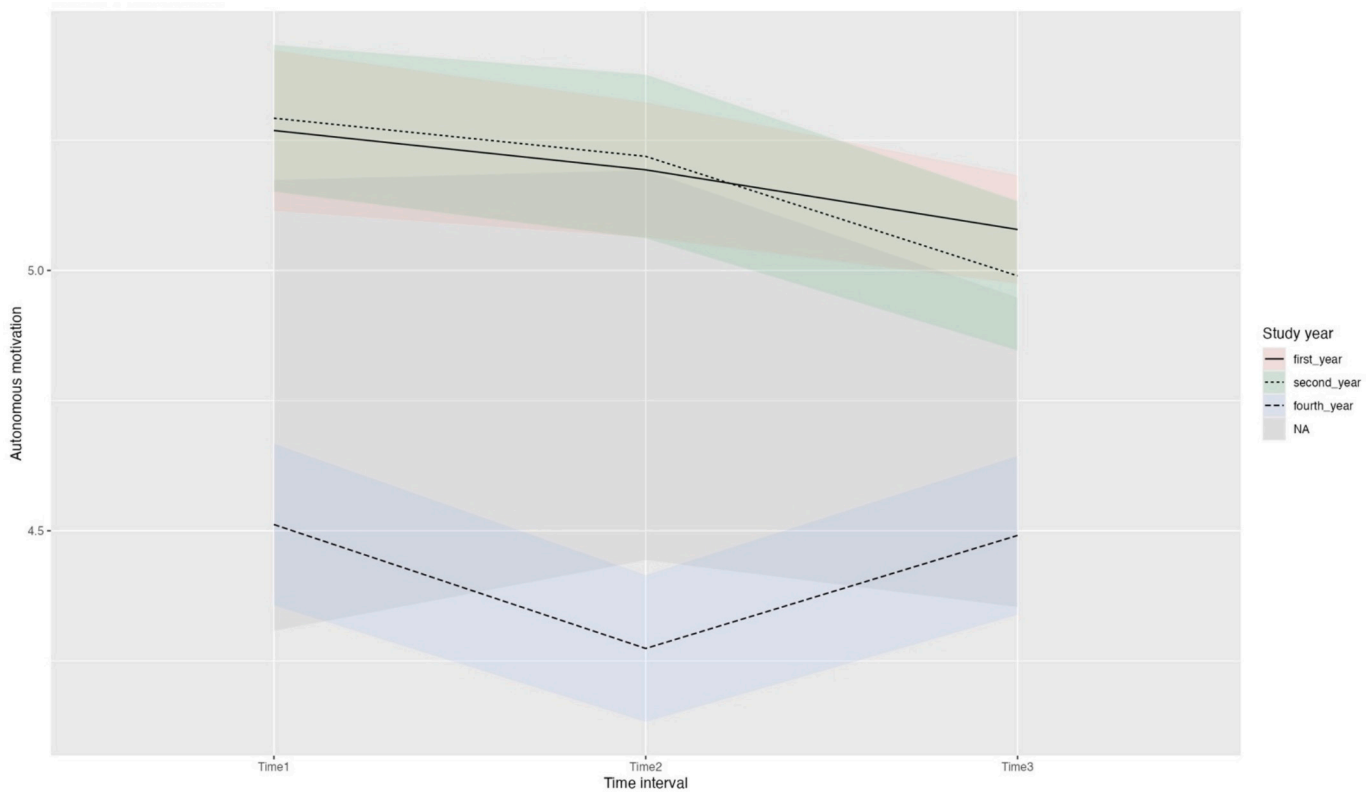

Fig. 1. Autonomous motivation across semesters as a function of study year.
Note: Fixed effects results from the Linear Mixed effects modeling for autonomous motivation across three timepoints as a function of three study year levels. NAs = 13 participants who were not sampled from either first, second, or fourth year and were thus removed.

Table 6
Correlational matrix of the main motivational variables.

Variable	Mean (SD)	ICC	1	2	3	4
1. Basic need satisfaction	4.87 (1.13)	0.58	–	−0.19***	−0.13**	0.22***
2. Amotivation	2.37 (1.48)	0.74	−0.43***	–	0.18***	−0.33***
3. Controlled motivation	2.56 (1.20)	0.57	−0.10	0.25***	–	0.01
4. Autonomous motivation	4.88 (1.08)	0.74	0.59***	−0.51***	−0.10	–

Note: Means and standard deviations (SD) are at the between-person level. ICC=Intraclass correlations.
Between-person correlations are below the diagonal, whereas within-person correlations are above the diagonal.
** indicates $p < .01$, *** indicates $p < .001$.

Table 7
Path analytical models.

Model	χ^2	*df*	CFI	TLI	RMSEA [CI]	SRMR
Achievement	67.56***	26	0.94	0.91	0.077 [0.05, 0.10]	0.046
Semester registration	38.22	26	0.94	0.90	0.076 [0.00, 0.12]	0.059
Study credits	33.59	26	0.96	0.93	0.06 [0.00, 0.13]	0.05

Note: *** indicate $p < .001$.

motivation remained a non-significant predictor of students' achievement. This is not a surprising finding, which is what might be expected based on the order of regulations specified within SDT (Ryan & Deci, 2017). The results from our path analysis also found similar results, that is, we found no significant effect of basic need satisfaction on achievement, nor the indirect effect of autonomous motivation on achievement, through basic need satisfaction, as we initially hypothesized.

However, a result that deserves some explanation is the unexpected negative relation between autonomous motivation and achievement. In addition to being unexpected, it is inconsistent with some previous research (e.g., Guiffrida et al., 2013; Wang et al., 2022). There could be several explanations for this. These unexpected findings might be due to how the students are assessed, which pushes the students towards more rote approaches and less towards conceptual understanding that is associated with autonomous motivation (e.g., Kusurkar et al., 2023). But it could also be due to differential motivations for different subjects. That is, the students' motivation for becoming a teacher might conflict with the students' different motivational regulations for different subjects. For instance, you could be highly autonomous for working in the profession (as a teacher), but not necessarily for performing some of the academic requirements the course requires (paper submissions, seminar classes), or even between subjects (motivation for pedagogy courses versus subject-specific courses such as math). Given that grades were averaged across all subjects during that particular semester we collected the data, the different motivational regulations might have canceled each other out. This argument is similar to the "specificity-hypothesis" which suggests that students may exhibit differential intrinsic motivation and identified regulation (i.e., autonomous motivation) between subjects (Chanal et al., 2025). This might be a plausible explanation, given that our results show that autonomous motivation for becoming a teacher seems more central for persistence (i.e., dropout), whereas autonomous motivation for subjects is more related to grades, as found

in previous studies (e.g., Howard et al., 2021). Thus, although the general finding is unexpected, the results might be due to the fact that some of the motivations for specific subjects are canceled out when averaged across. Future studies would need to test if this is the case.

Yet another explanation is that there could also be some methodological reasons. The measurement of autonomous motivation and the collection of student achievement occurred in a short time frame, this could have been a contributing factor to our negative findings. Additionally, high attrition rates between measurement time points could have affected the results as well (Caruana et al., 2015). A longitudinal design over a longer period could have yielded different results, as found in other cases (Wang et al., 2019).

Our study echoes previous studies showing the detrimental effect of amotivation on student achievement (e.g., Breva & Galindo, 2020; Leroy & Bressoux, 2016). Lack of feelings of efficacy and intentionality, which are characteristics of amotivation, might impact students' study strategies, class attendance, and help-seeking behaviors (Ryan & Deci, 2017), which might explain the negative effect of amotivation on achievement in our study.

For dropout, our regression models were only able to predict dropout when measured as semester registration, and not as study credits. As expected, amotivation was negatively related to dropout (being registered), which is in line with previous literature (e.g., Vallerand et al., 1997; Vallerand & Bissonnette, 1992). However, surprisingly, controlled motivation was positively related to semester registration. An explanation for this finding could be how Norwegian teacher education is structured, which requires students to complete their degree as they will be left with no credit if they leave early. This functionally forces the students to complete their teacher education or to drop out, leaving them without any degree that could be applied to other study areas (Skagen & Elstad, 2023). This might also have financial implications for the students, as they would face a reduction in their student loans.

Thus, when considering how the study program is set up, controlled motivation seems to be a motivational force for the students to complete their program, yet it might have other unintended negative consequences. The results from our path analyses found that basic need satisfaction was positively related to being registered for the semester. Furthermore, autonomous motivation was also indirectly related to semester registration, mediated by basic psychological needs. This finding suggests that students who are autonomously motivated are more likely to be registered, but only to the extent that their basic psychological needs are satisfied. The mediating effect of basic need satisfaction has also been found in other studies (e.g., Hope et al., 2019; Niemiec et al., 2009).

4.2. Variability in individuals and groups on achievement and dropout

In contrast to our hypothesis tests, we found no support for variability across individuals. The models we tested showed low intra-individual variability, indicated by very high ICC-levels. One explanation could be that the individuals in our sample are more similar than dissimilar across time. It could be interpreted that individuals in our sample, across different years of study, experience similar situations which are captured by our measures.

In contrast to our hypothesis, males had higher achievement relative to females and were more likely to be registered for the following semester compared to females. This was surprising given that previous research consistently finds that females outperform males, and that males are more likely to dropout (Bakken, 2022). One explanation could be that, given our sample had a higher percentage of females, the finding that fewer women were semester registered could simply reflect the skewed gender distribution. Interestingly, there are large gender differences in admission into teacher education programs as well, meaning that students who drop out are more likely to be females. Our results could therefore be explained by the general dropout rates of the program.

The gender differences might also be a result of societal changes, especially regarding future careers in schools. There has been a worldwide trend that fewer males seek a career in the teaching profession (Jóhannesson et al., 2024; McGrath & Bergen, 2017). This has led to campaigns for recruiting more males into teacher education, and males are sometimes favored in recruitment and promotions in schools (Cushman, 2007; Francis, 2008). Males are also sought after for role models and seen as beneficial for both boys and girls by many students and their parents (McGrath & Sinclair, 2013). These positive expectancies have been seen to give some male teachers a “head start” in their career (Jóhannesson et al., 2024). Although these studies concern the career as a teacher, similar expectancies might exist among teacher students. The students will likely be exposed to ongoing trends in schools during their practicum. Future studies would need to replicate our results regarding gender differences or investigate the factors that contribute to these gender differences.

4.3. The effect of study year and basic need satisfaction on motivational classes

The results of our study show, in contrast to our hypothesis, that students in the fourth year had lower autonomous motivation across time. This was surprising given that our initial reasoning was that fourth-year students, compared to first-year students, would have internalized the value of studying and becoming a teacher. However, a plausible explanation could be that as students progressed, their workload and expectations increased, leading to less value and enjoyment concerning their study motivation. For example, in a recent study that shows that fourth-year students in teacher education have decreased autonomous motivation following periods of intense practicum and high workloads (Jeno et al., 2025). Furthermore, given the dynamics of teacher education in Norway and general income situation for students in higher education (e.g., Wikan & Bugge, 2014), the decrease in students' autonomous motivation could be a function of less intention to become a teacher in general, and the perception of being under a high level of pressures. Although our initial reasoning came from a developmental perspective (i.e., maturation increases internalization), this inconsistency in the literature requires more research to understand the development of autonomous motivation through students' educational pathway.

Our correlational analysis supported our hypothesis that basic needs correlate positively with autonomous motivation, and negatively with amotivation and controlled motivation. This general pattern was found at the between-person and within-person level. These results indicate that persons who experience basic psychological need satisfaction at the individual level are more likely to have higher autonomous motivation. This is consistent with the assumptions of SDT which suggest that individual experience of need satisfaction is necessary for developing more autonomous forms of motivation (Ryan & Deci, 2017).

4.4. Limitations

There are several limitations worth considering when interpreting our results. First, measuring dropout through study credit accumulation and semester registration the following semester could be challenged. In Norway, dropout is measured five years after students are supposed to have graduated (Andresen & Lervåg, 2022; Hovdhaugen & Aamodt, 2005). This is useful for accounting for sickness, parental leave, and breaks in studying. Yet, the issue of dropout is complex given that student dropout can be understood from different levels. For instance, program dropout, institutional dropout, and sector dropout (e.g., Tinto, 1993), have different consequences for the university program, higher education institution, and individual students, respectively. In this study, we measured program dropout, and although we cannot infer that our results imply program dropout, per se, our study design speaks to the importance of assessing dropout within a profession struggling with

recruitment. In contrast to dropout intentions, registry data provides objective data on students registered for a specific semester. Furthermore, our dropout rates for semester registration (5.3%) and study credit production (14.1%) are not too dissimilar compared to national numbers which are 25% and 16% for bachelor and master students, respectively, and 20% for younger students (Andresen & Lervåg, 2022). Nevertheless, future studies could complement our design with an assessment five years after the predicted graduation date to investigate if the percentage of dropouts across a longer period varies.

Relatedly, our study design only covered a short period of time, meaning we only investigated motivational trajectories during the transition from one semester to another, in which attrition is known to be high. Future studies could examine long-term trajectories over the entire teacher program to investigate how motivation varies within a semester and across the entire program.

Finally, given the relatively small sample size in our study due to data availability, we created composite constructs of motivational classes and basic needs. This is a limitation of our study. There have been methodological discussions concerning measuring classes vs. regulations (Howard et al., 2020), with studies suggesting that regulations predict outcomes differentially. Future studies could test alternative models using the separate factors as predictors. Our small sample size and the number of students who provided responses at all three time points could be one explanation as to why some of our models failed to converge. Relatedly, our study was variable-centered. Future studies could employ person-centered analyses to uncover trajectories of classes/profiles to uncover more nuanced results between the different regulations and their effect on achievement and dropout.

4.5. Future directions and implications

Despite these limitations, there are some useful implications of our study. Methodologically, our models seem to be less successful in predicting achievement, and more successful in predicting dropout, specifically semester registration. Future studies should further investigate when basic need satisfaction and motivational classes are and are not predictive of achievement, or the boundary conditions of achievement in terms of basic need satisfaction and motivational classes, i.e. it may be that competence is an important construct for predicting achievement, while relatedness is less important. Similarly, it may be that integrated regulation – which is closely tied into identity or self-concept – is more important for achievement than intrinsic motivation. Future studies are needed to disentangle these effects with larger sample sizes. Related to this, future studies could distinguish between motivation for studying and motivation for pursuing a career in teacher education. These motivations could have different trajectories as they may tap into a contextual and global aspect of motivation, respectively. Furthermore, understanding the effects of controlled motivation for dropout and achievement, and the factors contributing to this seem important as a future research avenue. Despite our findings showing that controlled motivation seems to shield against dropout, the phenomenological experiences associated with this form of motivation may not be positive and even come at a negative cost for mental health. Thus, our interpretation of this finding has some caveats attached to it. Given that we found little support for individual differences, future studies could include measures of personality traits (Big Five or Causality orientations), which could be predictive of both achievement (Mammadov, 2021) and dropout (Liu et al., 2025).

Based on our results, we recommend that teacher education programs focus on supporting students' basic needs. This may be especially important when implementing initiatives to reduce dropout rates (i.e., increase the level of semester registration) and supporting learning (i.e., increase achievement). Relatedly, implementing initiatives to address students with high amotivation or low autonomous motivation seems to be an important step towards increasing achievement and reducing dropouts. Supporting basic needs and creating the conditions for autonomous motivation could be accomplished through providing choice or rationales (supporting autonomy), providing optimal challenges and feedback (supporting competence), or expressing affection or asking about student progress and/welfare (supporting relatedness) (Ahmadi et al., 2023). Supporting the basic needs and facilitating autonomous motivation could create the conditions in which students could experience a sense of need satisfaction that could serve as a protective factor against unwanted drop-out. Similarly, given the positive effect of controlled motivation on semester registration, the higher education system should adapt the system so that the motivational force for studying is not compliance or compulsion, but rather personal value and importance. This could be achieved through fewer high-stakes exams, more flexibility in program exchanges, and non-control-based study loan requirements.

5. Conclusions

Our study investigates the longitudinal associations between basic needs, motivational classes, and registry data on achievement and dropout, an area underexplored in Norwegian higher education. Taken together, we find support for our assumptions that the degree of self-determined motivation seems to play a pivotal role in dropout and achievement among student teachers. Our study also uncovers important nuances in terms of individual differences and contextual influences on students´motivation which influences their achievement and dropout levels.

CRediT authorship contribution statement

Lucas M. Jeno: Writing – original draft, Project administration, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Chantal Levesque-Bristol:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Jorun Nylehn:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Zeljana Pavlovic:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Dag Roness:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Netta Weinstein:** Writing – review & editing, Supervision, Methodology, Conceptualization.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. All study participants consented to participating in this study.

Declaration of Generative AI and AI-assisted technologies in the writing process

AI has been used solely for assistance in code improvement for R-programming.

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Declaration of competing interest

The authors declare no conflicts of interest.

Data availability

Data will be made available on request.

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