



Investigating changes in university students' academic engagement and its relationships with motivation and performance: a quasi-longitudinal study based on latent change score analysis during the COVID-19 pandemic

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Received: 11 September 2025 / Revised: 27 February 2026 / Accepted: 10 March 2026
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Abstract

Academic engagement (AE) has been widely recognized as a key determinant to address key challenges in the academic context as the student persistence and success at university. However, previous studies have mostly measured AE using cross-sectional data, so its development over time is still unexplored. To address this research gap, we involved 209 first-year STEM undergraduates (54% female) from April–May 2019 (t_0) to October–November 2021 (t_1) and investigated: (i) how AE changed from first to third year; (ii) how these changes in AE were affected by initial motivation; and (iii) how they affected students' academic performance. Using the six dimensions of SInAPSi Academic Engagement Scale (SAES) alongside the Relative Autonomy Index (RAI) for motivation and total ECTS credits for performance, latent change score (LCS) models were performed to answer the research questions. In general, we found that a lower initial score was associated with greater changes, thus supporting AE as a dynamic process rather than a trait construct. Results indicated a significant increase in all dimensions except for *engagement with university colleagues dimension*. Moreover, higher autonomous regulations led to higher initial engagement, which remained stable over time. Finally, higher levels of *engagement with colleagues* and *capability to persist* in the first year were associated with better performance in the third year. Findings necessarily reflected effects of instruction disruption during COVID-19 pandemics. The study contributes to the debate about the role of engagement as a multidimensional dynamic construct influenced by social connections, that in turn affect academic achievement.

Keywords Academic engagement · University students · STEM · Latent change score · Academic success

Introduction

In recent decades, research has consistently identified academic engagement (AE) as a key predictor of students' persistence and academic success (Maguire et al., 2017; Mortelmans & Spooren 2017), as well as a factor that decreases academic burnout (Salmela-Aro & Read, 2017). AE has also been recognized as central to addressing challenges commonly experienced at the university level, such as poor academic performance, feelings of alienation, and high drop-out rates (Borja-Gil et al., 2024; Laranjeira & Teixeira, 2025). By adopting a multidimensional perspective, the construct of AE encompasses students' psychological investment, personal involvement, and active participation in the social, academic, and institutional spheres of their educational environment (Esposito et al., 2022; Ben-Eliyahu et al., 2018; Christenson et al., 2012; Fredricks et al., 2004). Recent theoretical models further frame AE as a dynamic process shaped by social relationships, socio-cultural contexts, and institutional practices that foster students' participation and sense of belonging within university life (Brint et al., 2008; Fredricks & McColskey, 2012; Kahu, 2013; Lawson & Lawson, 2013; Snijders et al., 2017). Empirical evidence supports these theoretical perspectives: for example, Ketonen et al. (2016), using a person-centered approach, found that students belonging to an "engaged" profile, which corresponded to higher personal involvement, active participation and task persistence, demonstrated higher academic achievement. Conversely, AE is negatively linked to disaffection, boredom, and intentions to drop out (Gilardi & Guglielmetti, 2011). That is, if students perceive educational institutions as indifferent, coercive, and unfair, or if they relate their attendance to university courses to negative emotions such as boredom, they will become disengaged or disaffected (mccormick et al., 2013; Park et al., 2012; Skinner et al., 2008). Evidence from research at both secondary and higher education levels further underscores the relevance of AE for students' well-being and academic performance. At the high-school level, Fiorilli et al. (2017) examined the associations among academic burnout, AE, and depressive symptoms, showing—consistently with previous findings (Chow et al., 2015)—that burnout and depressive symptomatology were negatively related to students' engagement, whereas higher AE was linked to better academic performance. At the university level, similar patterns emerge. Research indicates that limited contact with teaching staff, low-quality interactions with peers, inadequate instructional practices, and an excessive workload or evaluation pressure can contribute to problematic academic trajectories and diminished engagement (Korhonen & Rautopuro, 2018; Webb & Cotton, 2018).

Starting from such dynamic process perspective, as well as previous studies of our group, we further improved the conceptualization of AE, validating the SInAPSi Academic Engagement Model (Freda et al., 2023). The model features six dimensions: *University value and sense of belonging*, which refers to the recognition of the worth of the university choice, of the relevance of the choice to enroll in the life project, and the perception of a sense of belonging to the context; *Value of University course*, which refers to the recognition of the relevance of the chosen academic course for the professional future; this dimension is connected with the belief that the chosen academic course represents an opportunity, a source of interest and a chance for personal growth; *Perception of the capability to persist in the university choice*, which refers to the awareness of the encountered (or to be encountered) difficulties and of the resources needed to overcome them; in this perspective, this dimension is strictly connected to the intention to drop out; *Engagement with the university professors*, that refers to the feeling of being "seen" as a person by the faculty members; it also refers to the perception of availability and interest of the professors, and

to be respected by them; *Engagement with the university peers*, that refers to the possibility to create good and meaningful relationship with other students; this dimension refers also to the possibility to consider the group of peers at university as a relevant relational net, not only for academic purpose (studying together) but also as support source; *Relationships between University and relational net*, which refers to the balance between academic and private life and the recognition of the need to share with family and friends the enthusiasm for the academic project. In our conceptualization, AE includes the social relationships built within the university context with the academic teaching–learning community (Kahu et al., 2020), the interpersonal interactions and sense of belonging and connection with the university community (Bowden et al., 2017, 2021; Korhonen et al., 2019), the personal meaning given to the field of study (Sá & Tavares, 2018; Sianou-Kyrgiou & Tsiplakides, 2011), the dedication to the chosen course and the compliance with the university rules (Coates, 2007; Vizoso et al., 2018; Zhang, 2022), the value assigned to the academic institution and to attending the specific academic course (Freda et al., 2016), and the perceived difficulties in persisting in the academic project (Azila-Gbettor, 2024). The dynamic view of AE also implies a connection between engagement and the self-regulation strategies that students employ to optimize effort and manage their study time effectively (Dresel et al., 2015; Kahu, 2013; Kahu & Nelson, 2017; Räisänen et al., 2016). For example, in a previous study we showed that the dimensions of our AE model mediate the relationship between academic motivation—conceived as the internal drive that sustains learning and shapes students' progress and outcomes—and university students' academic trajectories, intentions to persist, and performance (Passeggia et al., 2023). Drawing on Self-Determination Theory (SDT; Ryan & Deci, 2017), we found that higher levels of intrinsic and identified motivation were associated with stronger AE, which in turn increased students' likelihood of persisting in their degree programs and achieving higher exam performance. The positive association between engagement and academic achievement is supported by recent systematic reviews (Kocsis & Molnár, 2025) as well as by studies examining broader motivation–performance links where engagement acts as a mediator (Oriol-Granado et al., 2017; Ribeiro et al., 2019).

Despite AE's central role in supporting student persistence throughout the duration of university studies, most existing research has assessed engagement at a single point in time, relying on cross-sectional designs. Only recently has a study employed latent transition analysis to track AE development in 974 students across their first three years of university enrollment (Korhonen et al., 2024). Although valuable, this person-centered approach describes individual differences in average AE levels but does not clarify whether students experience systematic changes in the different dimensions of engagement over time or whether AE at the beginning of a course influences changes at later stages. Additionally, although many studies have established motivation as a predictor of AE, it is still unknown whether students' initial motivation shapes changes in engagement over time. Finally, while prior research has shown that AE predicts academic performance, it remains to be determined whether longitudinal variations in AE also contribute to students' long-term academic outcomes.

Research questions and hypotheses

Drawing on the literature review above, the present study aims to address the highlighted gaps by answering the following research questions:

RQ1: How do changes in AE dimensions from first to third year depend on their initial values?

We expect that initial levels of each AE dimension will significantly predict the magnitude and direction of change in those dimensions from the first to the third year (Hypothesis H1). Previous longitudinal research shows that initial engagement strongly predicts subsequent engagement trajectories. For instance, Eriksen et al. (2024), using latent change score modeling in a large longitudinal sample of secondary students, found that initial levels of behavioral and emotional engagement significantly predicted later changes. Moreover, in their review of 104 longitudinal studies, Salmela-Aro et al. (2021) found that initial engagement levels are among the strongest predictors of later engagement, regardless of dimension. However, given the lack of previous specific studies, we leave open the question about the direction of the relationships between initial values and change in engagement.

RQ2: To what extent does initial motivation affect changes in AE dimensions?

Drawing on previous research studies, we expect that higher initial motivation will positively predict increases in AE dimensions from the first to the third year (Hypothesis H2). For instance, using the SDT framework, Karimi and Sotoodeh (2019) showed that intrinsic motivation acted as a significant predictor of engagement. Similarly, Ruzek and Schenke (2019) in a longitudinal study with about 900 students found that increases in behavioral engagement at a given time consistently predicted subsequent motivation to develop competence and understanding, thus supporting bidirectional influence between motivation and engagement.

RQ3: To what extent do changes in AE affect students' academic performance?

We expect that increases in AE dimensions from first to third year will positively predict students' academic performance (Hypothesis H3). This hypothesis is supported by previous longitudinal studies. For instance, van Herpen et al. (2025) in a study with 613 undergraduate students found that increases in engagement and study effort mediated the relationship between student–teacher/peer relationships and later performance. Moreover, engagement was a significant longitudinal predictor of academic performance. At secondary school level, Saracostti et al. (2025) in a 3-year study with 284 students found that behavioral and cognitive engagement predicted later performance in language and mathematics.

Methods

Sample and procedure

For the present study, we drew on a convenience sample of Italian university students enrolled in the Science–Technology–Engineering–Mathematics (STEM) school of the authors' institution, specifically within the degree programs in Biology,

Biotechnology, Chemistry, Computer Science, Mathematics, and Physics. We focused on STEM programs because they have consistently been identified as high-risk contexts for student attrition (ANVUR, 2018; Eurostat, 2020; OECD, 2023). Research on university dropout in Italy and across Europe points to a range of contributing factors that are not unique to STEM fields, including family and parental background (Aina, 2013; Ghignoni, 2017), inadequate pre-university academic preparation (Belloc et al., 2010), structural and organizational characteristics of university programs (Gitto et al., 2016), and broader national higher-education policies (Di Pietro & Cutillo, 2008). However, STEM degrees also present domain-specific challenges that tend to amplify dropout risk. In particular, many students struggle with the first-year introductory courses such as calculus, general physics, and general chemistry, contributing to early disengagement and reduced persistence (Passeggia et al., 2023; Seymour & Hewitt, 1997).

Data were collected at two points in time: end of the first year of enrolment (t_0 , April and May 2019), and beginning of the third year (t_1 , October and November 2021), which is the last year of the Bachelor's degree. The reason for choosing as t_0 the second semester of the first year is that students were able to experience the university context for some time before measuring their AE. The reason for choosing the last year of the degree course as t_1 is that during this year the students have almost finished their course so it is reasonable to expect that they have sufficiently experienced the university context so that changes in AE would be reasonably expected. We note that while administration of the survey at the end of the third year would have been optimal, we chose the beginning of the third year because students usually focus in that semester on their final examinations to conclude their course.

Data collection at t_0 was carried out as follows: two of the authors first asked the courses' coordinators for permission to submit the first survey (see below) during in-person lecture. Once obtained, the permission to access the lecture rooms, the researchers contacted the instructors and agreed on a schedule for the survey administration. Once in the lecture room, the researchers explained to the students the aims of the study and asked them to sign a written consent form to participate in the study. Students not willing to participate were allowed to leave the room. The administration time was on average 30 min. Due to the quasi-longitudinal nature of the study, the students were also asked to explicitly express their will to report their institutional mail, their university course, and identification number for subsequent contacts and data retrieval.

At time t_1 , due to the COVID-19 restrictions (which consisted of moving the teaching activities and examinations for all courses, including the STEM ones, fully online between March 2020 and January 2022) that still affected at the time the universities, the researchers contacted the students via Microsoft Teams for the administration of the second survey (see below). They also retrieved the performance records from the university database of those students that had expressed their will to participate in the study and given their university identification number. All data were anonymized for the subsequent analysis. A total of $N_1=565$ students (female students = 52.4%; age range: 18–20 years old: 89.7%; 21–23 years old: 8.5%; > 23 years old: 0.8%) agreed to participate in the study at t_0 and reported their university identification number. Such initial dataset was sequentially reduced to individuals who agreed to participate again at t_1 arriving at a total of $N_2=209$ students (female students = 53.8%) for the present study. The retention rate for this study was thus 37%. There were no gender differences between students who answered at both t_0 and t_1 and students who participated

only at t_0 ($\chi^2=0.191$; $df=1$; $p=0.662$). However, about 40% of the students who answered only at t_0 had changed university or dropped out at t_1 .

Measures

The AE was measured at both t_0 and t_1 through the SInAPSi Academic Engagement Scale (SAES; Freda et al., 2023), a 29-item instrument which features six subscales corresponding to the six dimensions described in the background section. The instrument uses a 5-point Likert scale (from 1—completely disagree to 5—completely agree). The scores for the *Perception of the capability to persist in the university choice* dimension were reversed to facilitate interpretation of results.

The confirmative factorial analysis (CFA) confirmed the 6-factor structure of the SAES scale at both t_0 ($\chi^2/df=1.725$; Incremental Fit Index [IFI]=0.906; Tucker-Lewis Index [TLI]=0.888; Comparative Fit Index [CFI]=0.906; Root Mean Square Error of Approximation [RMSEA]=0.059, Confidence Intervals [CI]=[0.050–0.068]) and t_1 ($\chi^2/df=1.782$; IFI=0.936; TLI=0.921; CFI=0.935; RMSEA=0.061, CI=[0.052–0.070]). Four items (1, 5, 18, 28) with regression weights lower than 0.5 were eliminated in the subsequent analyses. The four items were from different factors, so we decided to carry out the analyses on the remaining 25 items. The SAES showed an adequate through good internal consistency at both time t_0 and t_1 , as McDonald's ω ranged from 0.67 to 0.86 and from 0.76 to 0.91, respectively.

Once the factorial structure was confirmed, we also tested the longitudinal invariance of our measurement model for AE across the two time points through invariance of the measurement weights and structural covariances (Byrne, 2008). Data showed a satisfactory longitudinal measurement invariance of the 6-factor structure of SAES both when constraining measurement weight, $\chi^2=14.942$, $df=19$, $p=0.726$, $\Delta CFI=0.001$, $\Delta NFI=0.003$, $\Delta TLI=-0.005$; $\Delta RMSEA=0.001$ and structural covariances, $\chi^2=36.060$, $df=40$, $p=0.648$, $\Delta CFI=0.007$, $\Delta NFI=0.007$, $\Delta TLI=-0.008$, $\Delta RMSEA=0.002$.

The Academic Motivation Scale (AMS; Alivernini & Lucidi, 2008) was used to measure students' motivation at both t_0 and t_1 . The AMS features five subscales, each corresponding to a different motivational regulation style. The five subscales reflect different levels of autonomy in a continuum that goes from the least autonomous style to the most autonomous one: amotivation, external, introjected, identified, and intrinsic motivation. Each type of motivation is composed of four items, for each motivation type, on a 7-point Likert scale (from 1—does not correspond at all to 7—corresponds exactly), for a total of 20 items. The measure also allows us to compute a total index, namely the Relative Autonomy Index (RAI; Grolnick & Ryan, 1989), which is a continuous quantity that synthesizes information from four dimensions of motivation, from less autonomous to more autonomous regulation. The reason for using the RAI is to simplify the calculations of the statistical models used (see below). To calculate the index, we used the following formula (Howard et al., 2020):

$$RAI = 2 \times \overline{\text{external}} - 1 \times \overline{\text{introjected}} + 1 \times \overline{\text{identified}} + 2 \times \overline{\text{intrinsic}}$$

where $\overline{\text{external}}$, $\overline{\text{introjected}}$, $\overline{\text{identified}}$, $\overline{\text{intrinsic}}$ represent the mean values of the corresponding AMS subscales. Note that in the RAI amotivation is not included given the aim of capturing the continuum of self-determination.

The CFA of the 5-factor structure AMS at t_0 also showed a good FIT ($\chi^2/df=2.008$; IFI=0.916; TLI=0.898; CFI=0.915; RMSEA=0.070). McDonald's Omega for the four AMS dimensions that we used for calculating the RAI ranged between 0.75 and 0.90, so the AMS shows a good internal consistency.

The number of credits acquired, according to the European Transfer Credits System (ECTS), was retrieved from administrative records using students' university identification number and used as a proxy for academic performance. The maximum number of ECTS at the end of the third year is 180.

Data analysis

To answer RQ1 and investigate the development of AE between t_0 and t_1 , we used a latent change score (LCS) model approach (McArdle, 2009; McArdle & Nesselrode, 1994). This particularly versatile class of models is useful because it allows us to model the change of a given construct as an unobserved, latent variable, thus reducing measurement error, and because it can be used with a relatively low number of time points (a minimum of 2, although more are desirable). Moreover, LCS models capture intra-individual change rather than just describing changes in group averages and allow testing of hypotheses about directionality and causality of change (Kievit et al., 2018). Another advantage of these models over traditional longitudinal methods based on direct comparisons between measures at two time points (e.g., pre-post mean differences) is that they do not necessarily assume that the intervals are equivalent in the two measures, as the change itself becomes a latent variable that depends on the measures at the baseline and at the end point (Kievit et al., 2018). Finally, with LCS models, it is possible to relate changes to other variables of interest. LCS models in longitudinal studies are increasingly used in educational research at secondary school level (Eriksen et al., 2024; Garrecht et al., 2024), but no study has yet used them to investigate engagement development at university level.

A typical LCS model aims at describing the average change Δ in the score of a measured construct (e.g., engagement) or of a dimension of such construct between two points in time, t_1 and t_0 , and the extent to which individuals differ in such change. In LCS models, we first let the latent post-scores regress on the pre-scores, with regression coefficient fixed to 1 and residual variance allowed to freely vary. The residual variance represents the aspects of the post-scores that cannot be explained by the pre-scores. Then, we introduce a new latent variable that describes the change between t_0 and t_1 , which is entirely defined by the unique aspects of the post-scores not explained by the pre-scores. In other words, the latent change variable summarizes all the changes from t_0 to t_1 . Finally, the latent change variable is allowed to vary in specifically how each learner changes from the pre-scores. To this aim, the latent change variable is allowed to regress on the pre-scores with a regression coefficient β representing the strength of the association between the change in the score and the initial score.

This basic univariate LCS model is represented in Fig. 1 (Howardson et al., 2017).

The model in Fig. 1 can be generalized to cases in which the pre-scores and post-scores are measured through a series of indicators, so that they can also be expressed as latent variables, as in the usual measurement models in confirmatory factor analysis (Fig. 2).

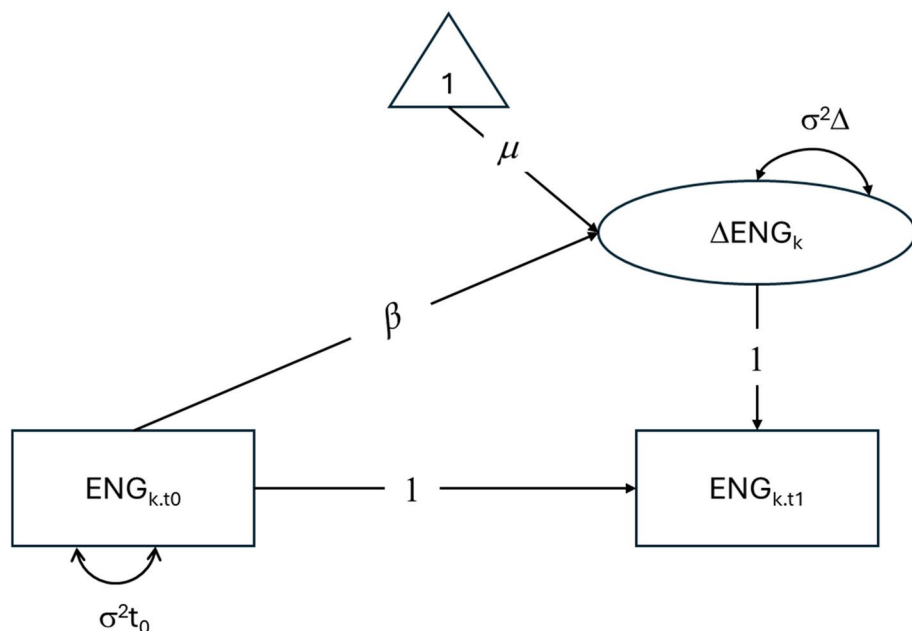


Fig. 1 Graphical representation of the basic univariate LCS model. ENG_{k,t_0} and ENG_{k,t_1} indicate the k -th dimension of engagement measured at time t_0 and t_1 , respectively. ΔENG_k indicates the latent change for the k -th dimension. $\sigma^2 \Delta$ represents the variance explained by the model, μ the average change in the dimension between t_0 and t_1 , $\sigma^2 t_0$ the variance of pre-scores

The model in Fig. 2 was then implemented in this study using AMOS v. 29 (see Fig. 3).

Then, as in typical CFA, we assessed the goodness of fit of the LCS model through usual indices (CMIN/DF, IFI, TLI, CFI, and RMSEA). The free parameters of the LCS models were estimated by the maximum likelihood method, under the assumption of multivariate normality, which is the most common approach. Means of the latent change variables were calculated through imputation using regression.

To answer RQ2, the LCS models for each of the engagement factors used in RQ1 were modified by adding motivation as an observed predictor of the two latent variables of the model in Fig. 1.

To answer RQ3, the LCS models tested in RQ1 for each of the factors of AE were further modified by adding the number of ECTS in the third year as an observed variable predicted by the two latent variables of the model in Fig. 1.

All the models were applied to the sample of 209 students that responded to the survey at both time points. The power analysis was performed with the powerLCS function (Zhang & Liu, 2018) of the R package WebPower. The adequacy of the sample size for a two-wave LCS model was assessed via Monte Carlo simulation (1000 replications). The simulation parameters assumed moderate measurement error (estimated reliability $\sim .67$) and stable variance across time points.

Sensitivity analysis revealed that the study possesses excellent statistical power ($>.95$) to detect medium-to-small latent change effects ($d=0.30$). Furthermore, the sample guarantees adequate power (power=0.84) to detect small effects down to a minimum threshold of $d=0.25$.

Therefore, the sample was adequate to test the study hypotheses.

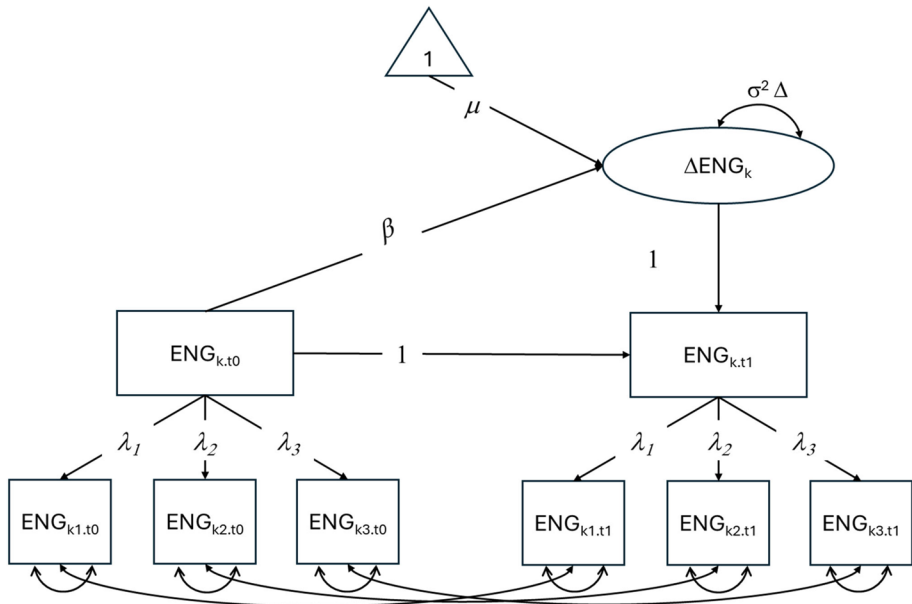


Fig. 2 Graphical representation of the univariate LCS model in Fig. 1 with three indicators. Regression weights λ_i , $i=1,2,3$ are also represented. Variances of observed indicators and correlations between residual errors are also reported as double headed curved arrows

Results

Univariate LCS models of AE dimensions

We report in Table 1 the descriptive statistics for the average latent change scores for the six AE factors calculated from factorial scores using linear regression, the correlations between latent change factorial scores obtained from the LCS models, and the standardized regression weights of the initial value at time t_0 on the latent change score variable. In the Supplemental Material, we report further details of the LCS models for each of the 6 AE factors. The analysis shows that models have a good fit, meaning that at least some part of the variance of the change in the scores can be predicted by initial scores. Moreover, all means are significant, namely individuals, on average, increase or decrease significantly between the two time points. Five out of six AE dimensions showed a positive change, while only for one dimension, “*Engagement with the university peers*” the change is negative. We also report the standard deviation around the mean of the latent change variables. A high spread indicates that not all individuals experienced similar changes in the dimensions of AE. For instance, Δ *Relationship between university and relational net* had a SD of 0.88, meaning that for about 67% of the sample the perceived change in the relationship between university and relational net will range from a slightly negative change of 0.62 to a substantially more positive change of +1.14.

Table 1 also shows that all the regression weights between each AE dimension at the initial time and its variation are negative and significant. This implies that lower initial scores of AE correspond to greater variations, while higher scores correspond to smaller

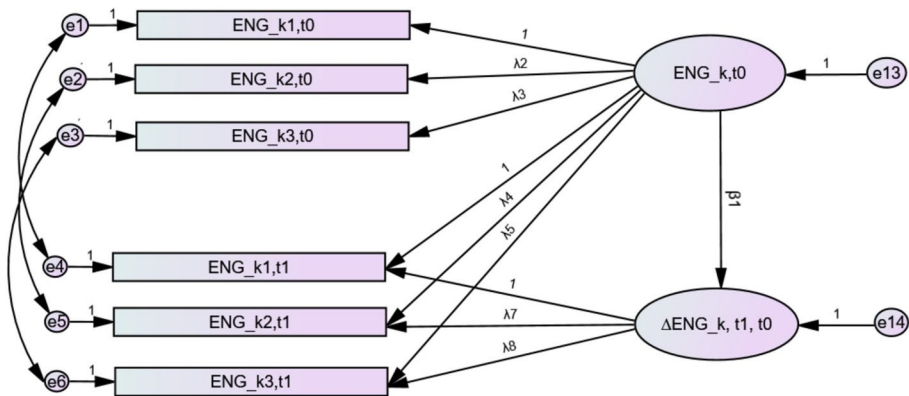


Fig. 3 Graphical representation of the univariate LCS model in Fig. 2 implemented in IBM AMOS v.29 for this study. Note that the latent variable representing post-scores has been deleted given that it perfectly regressed on pre-scores and latent change and indicators at time t_1 let regress on both pre-score and latent change. To allow the model in Fig. 3 to be specified, we imposed that the factor loadings between t_0 and t_1 are equal, namely $\lambda_2 = \lambda_4 = \lambda_7$ and $\lambda_3 = \lambda_5 = \lambda_8$, and we let error terms in the observed indicators to be correlated

variations. In other words, students who on average had lower AE scores in their first year, and persisted in their university choice, reported in their third year a higher AE score difference between initial and third year scores, compared to those who reported on average higher AE scores in their first year; in fact, these students' AE scores remained stable.

Effects of motivation on changes of the AE dimensions

All modified LCS models by adding the RAI as observed variable show adequate fit (see Supplemental material for full details). Table 2 reports the results of the LCS analyses for each of the six AE factors. Initial motivation has a significant direct effect on all engagement dimensions only at time t_0 except for the “Relationship between university and relational net” dimension. Given that in all LCS models the score at t_0 significantly affects the change in the score, the relationship between initial motivation and change variable is influenced by the score at t_0 for all dimensions, except for the “*Relationship between university and relational net*” dimension. Note that indirect effects of the initial motivation on the change in the score are significant at $p < 0.05$ and negative for the remaining five AE dimensions, namely the higher the initial score in motivation, the more stable the level of the engagement dimension.

Effects of changes of the AE dimensions on performance

All modified LCS models by adding the number of ECTS as observed variable show adequate fit (see Supplemental material for full details). While the relationships between initial score of the AE dimensions and their corresponding change are all significant as in the previous univariate LCS models, the number of ECTS is significantly affected by the initial value of only two AE dimensions, namely “*Perception of the capability to persist in the university choice*” and “*Engagement with the university professors.*” In the first

Table 1 Descriptive statistics and regression weights β for the univariate LCS models in Fig. 1 of the six dimensions of engagement

Engagement factor	1	2	3	4	5	6
1. Δ University value and sense of belonging	1					
2. Δ Value of the university course	0.699**	1				
3. Δ Perception of the capability to persist in the university choice	-0.353**	-0.355**	1			
4. Δ Engagement with the university professors	0.315**	0.394**	-0.154*	1		
5. Δ Engagement with the university peers	0.231**	0.189**	-0.037	0.116	1	
6. Δ Relationship between university and relational net	0.284**	0.229**	-0.126	0.137*	0.095	1
Mean	0.114***	0.076***	0.046***	0.13***	-0.114***	0.26***
SD	0.69	0.77	0.76	0.86	0.82	0.88
St. err	0.008	0.011	0.010	0.02	0.014	0.02
Kurtosis	0.943	0.434	1.337	2.195	0.014	0.475
Asymmetry	0.569	0.428	-0.077	0.65	-0.344	-0.060
β	-0.540*	-0.477**	-0.421*	-0.460*	-0.295*	-0.394*
[CI 95% lower]	-0.646	-0.659	-0.579	-0.582	-0.379	-0.502
[CI 95% upper]	-0.424	-0.336	-0.126	-0.194	-0.167	-0.197

* $p < 0.05$; ** $p < 0.01$

Table 2 Regression weights with confidence intervals for the LCS models of the six dimensions of engagement modified by adding the observed variable RAI as predictor, and modified by adding the observed variable ECTS as outcome variable

Engagement factor	β	Lower	Upper
<i>University value and sense of belonging</i>			
$t_0 \Delta$	-0.499**	-0.682	-0.355
RAI t_0	0.525**	0.390	0.631
RAI Δ	0.044 ns	-0.121	0.158
<i>Value of the university course</i>			
$t_0 \Delta$	-0.647*	-0.779	-0.474
RAI t_0	0.661**	0.575	0.760
RAI Δ	0.161 ns	-0.021	0.290
<i>Perception of the capability to persist in the university choice</i>			
$t_0 \Delta$	-0.358*	-0.595	-0.065
RAI t_0	0.554**	0.423	0.693
RAI Δ	-0.166 ns	-0.389	0.027
<i>Engagement with the university professors</i>			
$t_0 \Delta$	-0.432*	-0.573	-0.172
RAI t_0	0.284*	0.134	0.403
RAI Δ	-0.026 ns	-0.188	0.087
<i>Engagement with the university peers</i>			
$t_0 \Delta$	-0.305*	-0.406	-0.160
RAI t_0	0.221*	0.066	0.311
RAI Δ	0.063 ns	-0.061	0.224
<i>Relationship between university and relational net</i>			
$t_0 \Delta$	-0.396*	-0.513	-0.208
RAI t_0	0.076 ns	-0.047	0.222
RAI Δ	0.037 ns	-0.119	0.132
<i>University value and sense of belonging</i>			
$t_0 \Delta$	-0.476*	-0.659	-0.336
t_0 ECTS	0.092 ns	-0.064	0.234
Δ ECTS	0.083 ns	-0.067	0.224
<i>Value of the university course</i>			
$t_0 \Delta$	-0.540*	-0.646	-0.423
t_0 ECTS	0.078 ns	-0.095	0.241
Δ ECTS	0.066 ns	-0.102	0.221
<i>Perception of the capability to persist in the university choice</i>			
$t_0 \Delta$	-0.474*	-0.622	-0.259
t_0 ECTS	0.241*	0.043	0.377
Δ ECTS	0.161 ns	0.037	-0.365
<i>Engagement with the university professors</i>			
$t_0 \Delta$	-0.464*	-0.585	-0.254
t_0 ECTS	0.201*	0.048	0.345
Δ ECTS	0.062 ns	-0.097	0.278
<i>Engagement with the university peers</i>			
$t_0 \Delta$	-0.294*	-0.379	-0.167
t_0 ECTS	0.057 ns	-0.076	0.190

Table 2 (continued)

Engagement factor	β	Lower	Upper
Δ ECTS	0.189*	0.063	0.319
<i>Relationship between university and relational net</i>			
$t_0 \Delta$	-0.396*	-0.503	-0.196
t_0 ECTS	-0.015 ns	-0.118	0.117
Δ ECTS	0.035 ns	-0.094	0.187

* $p < 0.05$; ** $p < 0.01$

case, $\beta = 0.241$, $CI = [0.043; 0.377]$, $p < 0.05$; thus, the higher the intention to persist measured at the first university year, the higher are the ECTS gained at the third year. In the second case, $\beta = 0.201$, $CI = [0.048; 0.345]$, $p < 0.05$, the better the perceived relationship with instructors at the first university year, the higher are the ECTS gained at the third year. Concerning the latent change variables, the number of ECTS is significantly affected only by the change in the “*Engagement with the university peers*” dimension, $\beta = 0.189$, $CI = [0.063; 0.319]$, $p < 0.05$, namely as the perception of meaningful peer relationships improves, the higher are the ECTS gained at the third year.

Discussion

In this paper, we analyzed through a latent change score approach how AE of university students evolves from the first year of enrolment to the third and final year of the university course. We also investigated how such variational relationships are affected by initial motivation and influence final academic performance. Therefore, our study addresses not only the typical limitations of previous studies that used single-time measurement of engagement but also contributes to the field from the methodological point of view, having applied a quasi-longitudinal analysis strategy that can provide a valid alternative to traditional pre-post approaches based on the analysis of raw scores and cross-sectional research, which do not account for the metrics differences.

In this section, we discuss the main results obtained according to the research questions of the study.

RQ1: How do changes in AE dimensions from first to third year depend on their initial values?

Our findings showed that students who began the degree program with relatively low levels of AE tended to exhibit greater changes—whether positive or negative—by the third year, whereas students who started with already high scores showed little variation in either direction. This pattern indicates that those students entering the study program with less developed forms of AE and that persist in their academic choice may be more responsive to the learning environment and more susceptible to contextual influences over time. While these findings confirm Hypothesis H1, the consistently negative direction of the relationship between initial AE values in each dimension and subsequent change represents a novel contribution of this study to the literature in the field. Specifically, while the present study cannot uncover the reciprocal relationship between persistence and engagement

development dynamics for students with lower initial AE, our results suggest that such a relationship can possibly unfold also reasons for which students decide to drop out at a certain point of their study course, while students with higher initial AE levels appeared to maintain more stable trajectories, possibly due to ceiling effects or because their engagement levels were already well aligned with the program's demands and supports. Overall, within the multidimensional perspective adopted in this study, our results suggest that AE in university contexts operates as a dynamic process, rather than being a fixed or uniformly progressing trait of student (Lawson & Lawson, 2013). This means that AE appears to evolve in ways that depend substantially on how students started their academic trajectory, determined by the interplay between individual starting psychological status and the academic and encountered contextual conditions, for instance if teachers and peers create a supportive environment (Pham et al., 2022). Our results also suggest that AE is affected by relational factors and that institutional practices enacted by universities may differentially shape the trajectories of students with diverse initial AE profiles (Skinner et al., 2008).

When looking in more detail at the results of the univariate LCS models, our analysis shows that, for our sample, all the AE dimensions, except *Engagement with the university peers*, have an average significant increase between first and third year. The increase in the first two value-related dimensions corroborates existing research, suggesting the relevance of perceiving that the degree program meets initial expectations and is aligned with their personal and professional goals in order to increase commitment and resilience in the university path (Galve-Gonzalez et al., 2025; Xia et al., 2023). Moreover, this result is in agreement with previous studies that suggest a relationship between the value given to the specific attended course and the reputation of the institution itself in which this course is taught (Alan et al., 2018; Bowden et al., 2021). The increase in the *Relationship between university and relational net* dimension also confirms previous studies according to which persistence in university course is positively affected by a successful interaction between academic context and personal life (Kahu, 2013). The positive change in the *Engagement with the university professors* dimension may be linked to the perception of an increased support by instructors throughout the courses, especially during the pandemic. Particularly, this result may be due to a bidirectional link between the relationships with the instructors and the commitment to the institution in which such relationships develop (Snijders et al., 2020; Zeps et al., 2014). This may be due for instance to an improved perception of the self within the institution, a relationship that is mediated by the sense of belonging in the community of the university course (Kahu & Nelson, 2017) or to an improved confidence in adequately interacting with others in an educational context that is recognized as relevant for the self (Shernoff et al., 2016). Alternatively, such improved perception may also be caused, for instance, by moving from large classes at the first year to smaller classes at the third year, which may foster a better interaction with the instructors. Finally, the increase in the *Perception of the capability to persist in the university choice* may be due to the fact that students who participated in the study at time t_1 were still enrolled in their course so that they were more likely to be aware of the encountered difficulties, i.e., they became more resilient (Galve-Gonzalez et al., 2025), especially after the pandemic, or they had developed other suitable mechanisms to cope with such difficulties thus reducing the intention to drop out (Ajjawi et al., 2020). The only dimension that shows a decrease in the students' scores is the *Engagement with the university peers*. Such decrease may be linked to the relational difficulties experienced as a consequence of the disruption of teaching activities due to the pandemic, thus directly interfering with the fulfilment of students' need for relatedness with peers (Janke et al., 2022). Alternatively, such decrease may be also due to attending classes in a post-pandemic context with new peers as the courses become less

populated and more specialized, thus reducing the perception of support from peers in the forms as, e.g., tutoring, feedback or supplemental instruction sessions (Gasiewski et al., 2012; Kassab et al., 2024). Another possible interpretation is that although relationships with peers are important during the early university years, they give way to institutional and more adult relationships that increase students' sense of belonging to the institution (Miller et al., 2018).

RQ2: To what extent does initial motivation affect changes in engagement?

While previous studies have analyzed the relationship between motivation and AE with a cross-sectional design (e.g., Chiu, 2021), this study is the first to analyze the effect of initial motivation on the variations in the AE dimensions over a long time period. All the LCS models for the six AE dimensions were significant, which means that initial motivation scores affect initial scores in the AE dimensions, which in turn influenced subsequent AE changes. However, for all AE dimensions, the effect of initial motivation on AE changes was not significant, suggesting a short-time bidirectional relationship between motivation and AE dimensions limited to time t_0 . Thus, Hypothesis H2 was not confirmed. Namely, differently from what we expected from previous studies, the more autonomous was the style of motivational regulation at t_0 , the higher the initial value of all engagement dimensions, but the more stable was the score in the AE dimensions. Differently, lower scores in the initial motivation led to lower initial values of engagement but to greater changes in engagement. This result may be interpreted taking into account that less autonomous motivational regulations include identified and introjected regulations, which refer to the behavior enacted in light of its utility for future plans or to avoid bad feelings about one's own performance. While these kinds of regulations do not necessarily lead to high levels of engagement, they may support persistence in the university course for extrinsic motivations, as utility value of the university course, which in turn may also lead to an increased level of engagement (Marôco et al., 2020; Morelli et al., 2021). Therefore, our study aligns with recent trends according to which initial motivational states can shape future academic trajectories through indirect pathways that lead students to acknowledge, for instance, the utility value of university and of the relationships with peers and instructors in the academic context (Liu, 2024). Conversely, our results also indicate that enrolling in a study program that is not a student's first choice may increase the risk of low engagement and potential dropout (Korhonen & Rautopuro et al., 2018).

RQ3: To what extent do changes in engagement affect students' academic performance?

When including the performance as a dependent observed variable, all the LCS models remain significant; thus, the initial score of engagement still affected subsequent changes. However, the effects of the initial scores of AE and of their changes on academic performance at the third year were not consistent for all dimensions. Thus, Hypothesis H3 was only partially confirmed. This result confirms results from previous studies according to which only some engagement dimensions were correlated with students' achievement (Laranjeira & Teixeira, 2025). For instance, we found that when initial values were high or low in the *Perception of the capability to persist in the university choice* dimension they, respectively, positively or negatively influenced the performance at the third year. This finding expands on the previous ones by demonstrating the long-term negative effect of the

desire to drop out on academic performance and confirms the results obtained in the Italian context by Alivernini et al., (2008), who found that the intention to drop out at the beginning of the semester influenced the number of credits obtained at the end of the semester. Our analysis also showed that students who manifest an increase in the score of perceived engagement with peers are more likely to have a better performance at the third year. This result emphasizes the importance of the sense of belonging to the university community extending to a longitudinal perspective the relevance of social relationships in students' academic trajectory (Korhonen et al., 2019). A possible reason is that STEM courses, especially in the second and third year, often rely on group work, which has been shown to support the need for relatedness (Garn et al., 2019).

Limitations

While our study addresses the gap in the literature related to how engagement changes over three years of university courses, it has limitations that should be taken into account. First, while from the longitudinal perspective the response rate was adequate, it should be noted that the results reflected only the specific group of students who responded to the survey twice. Hence, students who answered at time t_0 and dropped out before the third year were underrepresented at the end of the study—a factor that should be taken into account when interpreting the results. Second, given the potential bias between STEM students, who typically have different academic preparation according to the chosen course, future research should use advanced statistical techniques, such as propensity score matching, to determine whether attending a specific STEM course leads to a significantly greater level of academic engagement and whether it remains after accounting for potential biases due to the chosen course. Third, the sample included students at a single Italian university, which may limit the generalizability of the results to other cultural and geographical contexts. Moreover, the study did not take into account the cultural differences that concern, for instance, the dimensions related to the social and institutional university which may not be equally relevant across countries (Carayon & Gilles, 2005). Future studies may replicate this study in different countries and with a more diverse sample in terms of areas of study and demographic characteristics. Finally, this study did not collect any information on students' future study intentions.

Conclusions

In this longitudinal work, we studied the variations over three years of six academic engagement dimensions for a sample of university students who persisted in the chosen course.

First, findings showed that out of the three working hypotheses, one (H1) was confirmed, one (H2) was not confirmed and one was partially confirmed (H3). However, in all models, the initial level of engagement affects subsequent variations; specifically, those students who at the beginning of their studies reported high values for academic engagement remained stable during the three-year period, while those who started with lower values in the third year increased their engagement. Future research is needed to explore the reasons underlying the latter relationships.

Second, the decrease in engagement dimension of the relationship with peers calls for implementing more active teaching strategies that may stimulate a sense of belonging within students, so that no student could feel alone when attending lectures that are merely a passive transmission of contents. To support networks and other social aspects of students' lives within the institution may contribute to building such a sense of belonging. Correspondingly, to build a safe classroom environment where students can express their doubts, ask their questions and receive meaningful feedback may increase the perception of the engagement with instructors, whose changes are predictors of student achievement. Institutions can build upon such results by focusing.

As next step, future studies can also investigate if changes in engagement dimensions can be coupled, namely if the increase in one dimension may lead to increase in another dimension.

In conclusion, this longitudinal study lends validity to the six-dimensional construct of engagement because it can be a useful means to dynamically understand the complexity of students' experiences from the first to the third year, taking into account not only motivational factors but also a range of other factors, both within and outside the university, which may affect the academic trajectory and performance.

Appendix. SAES instrument

SlInAPSi Academic Engagement Scale (SAES)

On a scale of 1 (not at all) to 5 (totally), indicate how true each statement is true for you.

For some of the following statements relating to university life, you should also consider your experience of virtual classrooms in your answers if you have followed distance learning courses and workshops on online platforms during the recent covid-19 emergency.

Statement	Not at all	Very little	Somewhat	A lot	Totally
1. I'd be better off doing other things than going to university					
2. Attending university is a great opportunity for me					
3. I have good relationships with my fellow students					
4. I have created meaningful friendships with some of my fellow students					
5. The teachers clarify what they expect from us students					
6. Teachers are usually available to discuss my work					
7. My teachers respect me as a person					
8. My teachers are interested in my opinions and what I say					
9. The course of study I am attending will help me to achieve my professional goals					
10. The course of study I am attending is an opportunity for me					
11. The course of study I am attending interests me					
12. I like the course of study I am attending					
13. I take university education seriously					

Statement	Not at all	Very little	Somewhat	A lot	Totally
14. I believe that university is good for me					
15. I discuss my university career with my family					
16. I talk about my professional projects with my friends					
17. I talk about my professional projects with my family					
18. University study is part of my life project					
19. The university is very important in my life					
20. I would leave university immediately if I had an alternative					
21. I like meeting friends at university					
22. I feel part of a group of friends at university					
23. Despite the difficulties I sometimes encounter in university life, I think it is worth continuing my studies					
24. Sometimes I think about leaving university					
25. In my opinion, university education is not worth all the time, money and effort it requires of me					
26. I am convinced that my decision to enroll in this university was the right one for me					
27. I'm sure the degree course I'm attending is the right place for me					
28. Studying with other students helps me					
29. I find my studies very relevant to my professional projects					
SCORING (mean for each factor)					
1. Perception of the capability to persist in the academic choice	1, 20, 24, 25				
2. University value and sense of belonging	2, 13, 14, 18, 19, 23				
3. Value of the university course	9, 10, 11, 12, 26, 27, 29				
4. Relationship between University and relational net	15, 16, 17				
5. Relationship with University peers	3, 4, 21, 22, 28				
6. Relationship with University professors	5, 6, 7, 8				

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10212-026-01094-1>.

Funding Open access funding provided by Università degli Studi di Napoli Federico II within the CRUI-CARE Agreement. This study was funded by the fund PLS 2017–2019.

Data availability The data reported in this manuscript will be made available upon reasonable request.

Declarations

Ethics approval The research presented in this study was conducted in accordance with the Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects and the ICMJE guidelines on Protection of Research Participants.

Consent for publication We are aware that, if accepted for publication, a certification of authorship form will be required that all co-authors sign.

Competing interests The authors declare no competing interests.

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References

- Alivernini, F., & Lucidi, F. (2008). The academic motivation scale (AMS): Factorial structure, invariance and validity in the Italian context. *Testing Psychometrics Methodology in Applied Psychology*, 15(4), 211–220. <https://doi.org/10.4473/TPM.15.4.3>
- Aina, C. (2013). Parental background and university dropout in Italy. *Higher Education*, 65(4), 437–456. <https://doi.org/10.1007/s10734-012-9554-z>
- Ajjawi, R., Dracup, M., Zacharias, N., Bennett, S., & Boud, D. (2020). Persisting students' explanations of and emotional responses to academic failure. *Higher Education Research & Development*, 39(2), 185–199. <https://doi.org/10.1080/07294360.2019.1664999>
- Alan, A. K., Kabadayi, E. T., & Cavdar, N. (2018). Beyond obvious behaviour patterns in universities: Student engagement with university. *Research Journal of Business and Management*, 5(3), 222–230.
- Alivernini, F., Lucidi, F., & Manganelli, S. (2008). The assessment of academic motivation: A mixed methods study. *International Journal of Multiple Research Approaches*, 2, 71–82. <https://doi.org/10.5172/mra.455.2.1.71>
- ANVUR. (2018). *Rapporto biennale sullo stato del sistema universitario e della ricerca*. <https://www.anvur.it/wp-content/uploads/2018/11/ANVUR-Completo-con-Link.pdf>. Accessed Mar 2025.
- Azila-Gbette, A. (2024). Predicting intellectual engagement from academic resilience: Mediating moderating role of academic diligence and learning support. *Journal of Applied Research in Higher Education*, 16(5), 1596–1613. <https://doi.org/10.1108/JARHE-01-2023-0008>
- Belloc, F., Maruotti, A., & Petrella, L. (2010). University drop-out: An Italian experience. *Higher Education*, 60(2), 127–138.
- Ben-Eliyahu, A., Moore, D., Dorph, R., Schunn, C. D. (2018) Investigating the multidimensionality of engagement: Affective, behavioral, and cognitive engagement across science activities and contexts. *Contemporary Educational Psychology*, 53, <https://doi.org/10.1016/j.cedpsych.2018.01.002>.
- Borja-Gil, J., Castellanos Verdugo, M., & Oviedo-García, M. Á. (2024). Engagement and commitment in higher education: Looking at the role of identification and perception of performance. *European Journal of Education*, 59, Article e12642. <https://doi.org/10.1111/ejed.12642>
- Bowden, J. L. H., Conduit, J., Hollebeek, L. D., Luoma-Aho, V., & Solem, B. A. (2017). Engagement valence duality and spillover effects in online brand communities. *Journal of Service Theory and Practice*, 27(4), 877–897.
- Bowden, J.L.-H., Tickle, L., & Naumann, K. (2021). The four pillars of tertiary student engagement and success: A holistic measurement approach. *Studies in Higher Education*, 46(6), 1207–1224. <https://doi.org/10.1080/03075079.2019.1672647>
- Brint, S., Cantwell, A. M., & Hanneman, R. A. (2008). The two cultures of undergraduate academic engagement. *Research in Higher Education*, 49, 383–402. <https://doi.org/10.1007/s11162-008-9090-y>
- Byrne, B. M. (2008). Testing for multigroup equivalence of a measuring instrument: A walk through the process. *Psicothema*, 20(4), 872–882.
- Carayon, S., & Gilles, P. Y. (2005). Développement du questionnaire d'adaptation des étudiants à l'université (QAEU). *L'orientation Scolaire Et Professionnelle*, 34(2), 165–189. <https://doi.org/10.4000/osp.463>

- Chiu, T. K. F. (2021). Applying the self-determination theory (SDT) to explain student engagement in online learning during the COVID-19 pandemic. *Journal of Research on Technology in Education*, 54(sup1), S14–S30. <https://doi.org/10.1080/15391523.2021.1891998>
- Chow, C. M., Tan, C. C., & Buhmester, D. (2015). Interdependence of depressive symptoms, school involvement, and academic performance between adolescent friends: A dyadic analysis. *British Journal of Educational Psychology*, 85(3), 316–331. <https://doi.org/10.1111/bjep.12075>
- Christenson, S. L., Reschly, A. L., & Wylie, C. (2012). Handbook of research on student engagement. Springer. <https://doi.org/10.1007/978-1-4614-2018-7>
- Coates, H. (2007). A model of online and general campus-based student engagement. *Assessment & Evaluation in Higher Education*, 32(2), 121–141. <https://doi.org/10.1080/02602930600801878>
- Di Pietro, G., & Cutillo, A. (2008). Degree flexibility and university Drop-Out: The Italian experience. *Economics of Education Review*, 27(5), 546–555.
- Dresel, M., Schmitz, B., Schober, B., Spiel, C., Ziegler, A., Engelschalk, T., & Steuer, G. (2015). Competencies for successful self-regulated learning in higher education: Structural model and indications drawn from expert interviews. *Studies in Higher Education*, 40(3), 454–470. <https://doi.org/10.1080/03075079.2015.1004236>
- Eriksen, E. V., Vestad, L., Bru, E., & Caravita, S. C. S. (2024). Social competencies, classroom relationships, and academic engagement: A latent change score modeling approach among lower secondary school students. *Social Psychology of Education: An International Journal*, 27(2), 435–459. <https://doi.org/10.1007/s11218-023-09841-8>
- Esposito, G., Marôco, J., Passeggia, R., Pepicelli, G., & Freda, M. F. (2022). The Italian validation of the university student engagement inventory. *European Journal of Higher Education*, 12(1), 35–55. <https://doi.org/10.1080/21568235.2021.1875018>
- Eurostat. (2020). *Tertiary education statistics*. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Tertiary_education_statistics&oldid=8752. Accessed Mar 2025.
- Fiorilli, C., De Stasio, S., Pepe, A., & Salmela-Aro, K. (2017). School burnout, depressive symptoms and engagement: Their combined effect on student achievement. *International Journal of Educational Research*, 84. <https://doi.org/10.1016/j.ijer.2017.04.001>
- Freda, M. F., González-Monteaudo, J., & Esposito, G. (2016). *Working with underachieving students in higher education: fostering inclusion through narration and reflexivity*. <https://doi.org/10.4324/9781315659121>
- Freda, M. F., Raffaele, D. L. P., Esposito, G., Ragozini, G., & Testa, I. (2023). A new measure for the assessment of the university engagement: The SInAPSi academic engagement scale (SAES). *Current Psychology*, 9674–9690. <https://doi.org/10.1007/s12144-021-02189-2>
- Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, 74(1), 59–109. <https://doi.org/10.3102/00346543074001059>
- Fredricks, J. A., & McColskey, W. (2012). The measurement of student engagement: A comparative analysis of various methods and student self-report instruments. In *Handbook of research on student engagement* (pp. 763–782). Boston, MA: Springer US. https://doi.org/10.1007/978-1-4614-2018-7_37
- Galve-González, C., Castro-Lopez, A., Cervero, A., & Bernardo, A. B. (2025). Overcoming barriers: The role of resilience as a mediating factor in academic engagement. *Studies in Higher Education*. <https://doi.org/10.1080/03075079.2025.2463004>
- Garn, A. C., Morin, A. J. S., & Lonsdale, C. (2019). Basic psychological need satisfaction toward learning: A longitudinal test of mediation using bifactor exploratory structural equation modeling. *Journal of Educational Psychology*, 111(2), 354–372. <https://doi.org/10.1037/edu0000283>
- Garrecht, C., Steegh, A., & Schiering, D. (2024). “We are sorry to inform you...”—The effects of early elimination on science competition participants’ career aspirations. *Journal of Research in Science Teaching*, 61(4), 841–872. <https://doi.org/10.1002/tea.21901>
- Gasiewski, J. A., Eagan, M. K., Garcia, G. A., Hurtado, S., & Chang, M. J. (2012). From gatekeeping to engagement: A multicontextual, mixed method study of student academic engagement in introductory STEM courses. *Research in Higher Education*, 53(2), 229–261. <https://doi.org/10.1007/s11162-011-9247-y>
- Ghignoni, E. (2017). Family background and university dropouts during the crisis: The case of Italy. *Higher Education*, 73, 127–151. <https://doi.org/10.1007/s10734-016-0004-1>
- Gilardi, S., & Guglielmetti, C. (2011). University life of non-Traditional students: Engagement styles and impact on attrition. *The Journal of Higher Education*, 82, 33–53. <https://doi.org/10.1353/jhe.2011.0005>

- Gitto, L., Minervini, F.L., Monaco, L. (2016). University dropout rates in Italy. In: *Youth and the Crisis*. Routledge
- Grolnick, W. S., & Ryan, R. M. (1989). Parent styles associated with children's self-regulation and competence in school. *Journal of Educational Psychology*, 81(2), 143.
- Howard, J. L., Gagné, M., den Van Broeck, A., Guay, F., Chatzisarantis, N., Ntoumanis, N., & Pelletier, L. G. (2020). A review and empirical comparison of motivation scoring methods: An application to self-determination theory. *Motivation and Emotion*, 44(4), 534–548. <https://doi.org/10.1007/s11031-020-09831-9>
- Howardson, G. N., Karim, M. N., & Horn, R. G. (2017). The latent change score model: A more flexible approach to modeling time in self-regulated learning. *Journal of Business and Psychology*, 32(3), 317–334. <https://doi.org/10.1007/s10869-016-9475-4>
- Janke, S., Messerer, L. A., & Daumiller, M. (2022). Motivational development in times of campus closure: Longitudinal trends in undergraduate students' need satisfaction and intrinsic learning motivation. *British Journal of Educational Psychology*, e12522, 1582–1596.
- Kahu, E. R. (2013). Framing student engagement in higher education. *Studies in Higher Education*, 38(5), 758–773. <https://doi.org/10.1080/03075079.2011.598505>
- Kahu, E. R., & Nelson, K. (2017). Student engagement in the educational interface: Understanding the mechanisms of student success. *Higher Education Research and Development*, 37(1), 58–71. <https://doi.org/10.1080/07294360.2017.1344197>
- Kahu, E. R., Picton, C., & Nelson, K. (2020). Pathways to engagement: A longitudinal study of the first-year student experience in the educational interface. *Higher Education*, 79, 657–673. <https://doi.org/10.1007/s10734-019-00429-w>
- Karimi, S., & Sotoodeh, B. (2019). The mediating role of intrinsic motivation in the relationship between basic psychological needs satisfaction and academic engagement in agriculture students. *Teaching in Higher Education*, 25, 959–975. <https://doi.org/10.1080/13562517.2019.1623775>
- Kassab, S. E., Rathan, R., Taylor, D. C. M., & Hamdy, H. (2024). The impact of the educational environment on student engagement and academic performance in health professions education. *BMC Medical Education*, 24, 1–10. <https://doi.org/10.1186/s12909-024-06270-9>
- Ketonen, E. E., Haarala-Muhonen, A., Hirsto, L., Hänninen, J. J., Wähälä, K., & Lonka, K. (2016). Am I in the right place? Academic engagement and study success during the first years at university. *Learning and Individual Differences*, 51, 141–148. <https://doi.org/10.1016/j.lindif.2016.08.017>
- Kievit, R. A., Brandmaier, A. M., Ziegler, G., van Harmelen, A. L., de Mooij, S. M. M., Moutoussis, M., Goodyer, I. M., Bullmore, E., Jones, P. B., Fonagy, P., NSPN Consortium, Lindenberger, U., & Dolan, R. J. (2018). Developmental cognitive neuroscience using latent change score models: A tutorial and applications. *Developmental Cognitive Neuroscience*, 33, 99–117. <https://doi.org/10.1016/j.dcn.2017.11.007>
- Kocsis, A., & Molnár, G. (2025). Factors influencing academic performance and dropout rates in higher education. *Oxford Review of Education*, 51(3), 414–432. <https://doi.org/10.1080/03054985.2024.2316616>
- Korhonen, V., Ketonen, E., Toom, A. (2024) Student engagement and its development in university education: A three-year follow-up study. *Learning and Individual Differences*, 113, <https://doi.org/10.1016/j.lindif.2024.102465>.
- Korhonen, V., Mattsson, M., Inkinen, M., & Toom, A. (2019). Understanding the multidimensional nature of student engagement during the first year of higher education. *Frontiers in Psychology*, 10, Article 1056. <https://doi.org/10.3389/fpsyg.2019.01056>
- Korhonen, V., & Rautopuro, J. (2018). Identifying problematic study progression and “at-risk” students in higher education in Finland. *Scandinavian Journal of Educational Research*, 63(7), 1056–1069. <https://doi.org/10.1080/00313831.2018.1476407>
- Laranjeira, M., & Teixeira, M. O. (2025). Relationships between engagement, achievement and well-being: Validation of the engagement in higher education scale. *Studies in Higher Education*, 50(4), 756–770. <https://doi.org/10.1080/03075079.2024.2354903>
- Lawson, M. A., & Lawson, H. A. (2013). New conceptual frameworks for student engagement research, policy, and practice. *Review of Educational Research*, 83(3), 432–479. <https://doi.org/10.3102/0034654313480891>
- Liu, X. (2024). Effect of teacher-student relationship on academic engagement: The mediating roles of perceived social support and academic pressure. *Frontiers in Psychology*, 15, 1–8. <https://doi.org/10.3389/fpsyg.2024.1331>
- Maguire, R., Egan, A., Hyland, P., & Maguire, P. (2017). Engaging students emotionally: The role of emotional intelligence in predicting cognitive and affective engagement in higher education. *Higher Education Research and Development*, 36(2), 343–357. <https://doi.org/10.1080/07294360.2016.1185396>

- Marôco, J., Assunção, H., Harju-Luukkainen, H., Lin, S.-W., Sit, P. S., Cheung, K.-C., Maloa, B., Stepanovic Ilic, I., Smith, T., & Campos, J. (2020). Predictors of academic efficacy and dropout intention in university students: Can engagement suppress burnout? *PLoS ONE*. <https://doi.org/10.1371/journal.pone.0239816>
- McArdle, J. J. (2009). Latent variable modeling of differences and changes with longitudinal data. *Annual Review of Psychology*, 60, 577–605. <https://doi.org/10.1146/annurev.psych.60.110707.163612>
- McArdle, J. J., & Nesselroade, J. R. (1994). Using multivariate data to structure developmental change. In S. H. Cohen & H. W. Reese (Eds.), *Life-span developmental psychology: Methodological contributions* (pp. 223–267). Lawrence Erlbaum Associates Inc.
- mccormick, ac, kinzie, j, & gonyea, rm. (2013). Student engagement: Bridging research and practice to improve the quality of undergraduate education. *Higher Education: Handbook of Theory and Research* (pp. 47–92). Springer. https://doi.org/10.1007/978-94-007-5836-0_2
- Miller, A. L., Williams, L. M., & Silberstein, S. M. (2018). Found my place: The importance of faculty relationships for seniors' sense of belonging. *Higher Education Research & Development*, 38(3), 594–608. <https://doi.org/10.1080/07294360.2018.1551333>
- Morelli, M., Chirumbolo, A., Baiocco, R., & Cattelino, E. (2021). Academic failure: Individual, organizational, and social factors. *Psicología Educativa*, 27(2), 167–175. <https://doi.org/10.5093/psed2021a8>
- Mortelmans, D., & Spooren, P., (2017). Who succeeds at university and how much time does it take? In E. Kyndt (Ed.), *Higher education transitions: Theory and research* (pp. 172–188). Routledge.
- OECD. (2023). *Education at a Glance 2023: OECD Indicators*. OECD Publishing. <https://doi.org/10.1787/e13bef63-en>
- Oriol-Granado, X., Mendoza-Lira, M., Covarrubias-Aplaza, C. G., & Molina-López, V. M. (2017). Positive emotions, autonomy support and academic performance of university students: The mediating role of academic engagement and self-efficacy. *Revista De Psicodidáctica (English Ed.)*, 22(1), 45–53. <https://doi.org/10.1387/revpsicodidact.14280>
- Park, S., Holloway, S. D., Arendtsz, A., Bempechat, J., & Li, J. (2012). What makes students engaged in learning? A time-use study of within- and between-individual predictors of emotional engagement in low-performing high schools. *Journal of Youth and Adolescence*, 41(3), 390–401. <https://doi.org/10.1007/s10964-011-9738-3>
- Passeggia, R., Testa, I., Esposito, G., Picione, R. D. L., Ragozini, G., & Freda, M. F. (2023). Examining the relation between first-year university students' intention to drop-out and academic engagement: The role of motivation, subjective well-being and retrospective judgements of school experience. *Innovative Higher Education*, 48(5), 837–859. <https://doi.org/10.1007/s10755-023-09674-5>
- Pham, Y. K., Murray, C., & Gau, J. (2022). The inventory of teacher-student relationships: Factor structure and associations with school engagement among high-risk youth. *Psychology in the Schools*, 59(2), 413–429. <https://doi.org/10.1002/pits.22617>
- Räisänen, M., Postareff, L., & Lindblom-Ylänne, S. (2016). University students' self- and co-regulation of learning and processes of understanding: A person-oriented approach. *Learning and Individual Differences*, 47, 281–288. <https://doi.org/10.1016/j.lindif.2016.01.006>
- Ribeiro, L., Rosário, P., Núñez, J. C., Gaeta, M., & Fuentes, S. (2019). First-year students background and academic achievement: The mediating role of student engagement. *Frontiers in Psychology*, 10, Article 2669. <https://doi.org/10.3389/fpsyg.2019.02669>
- Ruzek, E. A., & Schenke, K. (2019). The tenuous link between classroom perceptions and motivation: A within-person longitudinal study. *Journal of Educational Psychology*, 111(5), 903–917. <https://doi.org/10.1037/edu0000323>
- Ryan, R. M., & Deci, E. L. (2017). Self-determination theory: Basic psychological needs in motivation, development, and wellness. *The Guilford Press*. <https://doi.org/10.1521/978.14625/28806>
- Sá, C., & Tavares, O. (2018). How student choice consistency affects the success of applications in Portuguese higher education. *Studies in Higher Education*, 43(12), 2148–2160. <https://doi.org/10.1080/03075079.2017.1313219>
- Salmela-Aro, K., & Read, S. (2017). Study engagement and burnout profiles among Finnish higher education students. *Burnout Research*, 7, 21–28.
- Salmela-Aro, K., Tang, X., Symonds, J., & Upadaya, K. (2021). Student engagement in adolescence: A scoping review of longitudinal studies 2010–2020. *Journal of Research on Adolescence*, 31, 256–272. <https://doi.org/10.1111/jora.12619>
- Saracostti, M., Miranda, E., Guzmán, P., Schnettler, B., Concha-Salgado, A., de Toro, X., Lara, L., & Suazo, I. (2025). Exploring school engagement and academic outcomes over time: The role of contextual factors in Chile. *Psychology in the Schools*, 62, 3257–3272. <https://doi.org/10.1002/pits.23538>
- Seymour, E., & Hewitt, N. (1997). *Talking about leaving: Why undergraduates leave the sciences*. Westview Press.

- Shernoff, D. J., Kelly, S., Tonks, S. M., Anderson, B., Cavanagh, R. F., Sinha, S., & Abdi, B. (2016). Student engagement as a function of environmental complexity in high school classrooms. *Learning and Instruction*, 43, 52–60. <https://doi.org/10.1016/j.learninstruc.2015.12.003>
- Sianou-Kyrgiou, E., & Tsiplakides, I. (2011). Similar performance, but different choices: Social class and higher education choice in Greece. *Studies in Higher Education*, 36(1), 89–102. <https://doi.org/10.1080/03075070903469606>
- Skinner, E. A., Marchand, G., Furrer, C., & Kindermann, T. (2008). Engagement and disaffection in the classroom: Part of a larger motivational dynamic. *Journal of Educational Psychology*, 100(4), 765–781. <https://doi.org/10.1037/a0012840>.
- Snijders, I., Rikers, R. M. J. P., Wijnia, L., & Loyens, S. M. M. (2017). Relationship quality time: The validation of a relationship quality scale in higher education. *Higher Education Research & Development*, 37(2), 404–417. <https://doi.org/10.1080/07294360.2017.1355892>
- Snijders, I., Wijnia, L., Rikers, R. M. J. P., & Loyens, S. M. M. (2020). Building bridges in higher education: Student-faculty relationship quality, student engagement, and student loyalty. *International Journal of Educational Research*, 100, Article 101538. <https://doi.org/10.1016/j.ijer.2020.101538>
- van Herpen, S. G., Hilverda, F., & Vollmann, M. (2025). A longitudinal study on the impact of student-teacher and student-peer relationships on academic performance: the mediating effects of study effort and engagement. *European Journal of Higher Education*, 15(4), 599–618. <https://doi.org/10.1080/21568235.2024.2414760>
- Vizoso, C., Rodríguez, C., & Arias-Gundín, O. (2018). Coping, academic engagement and performance in university students. *Higher Education Research & Development*, 37(7), 1515–1529. <https://doi.org/10.1080/07294360.2018.1504006>
- Webb, O. J., & Cotton, D. R. E. (2018). Early withdrawal from higher education: A focus on academic experiences. *Teaching in Higher Education*, 23(7), 835–852. <https://doi.org/10.1080/13562517.2018.1437130>
- Xia, J., Wu, H., Cheng, H., & Jiang, Z. (2023). The impact of student engagement on satisfaction with medical education in China: A supplementary perspective. *Advances in Health Sciences Education*, 28(4), 1265–1288. <https://doi.org/10.1007/s10459-023-10219-w>
- Zepke, N., Leach, L., & Butler, P. (2014). Student engagement: Students' and teachers' perceptions. *Higher Education Research & Development*, 33(2), 386–398. <https://doi.org/10.1080/07294360.2013.832160>
- Zhang, Z. (2022). Promoting student engagement with feedback: Insights from collaborative pedagogy and teacher feedback. *Assessment & Evaluation in Higher Education*, 47(4), 540–555. <https://doi.org/10.1080/02602938.2021.1933900>
- Zhang, Z., & Liu, H. (2018). Sample size and measurement occasion planning for latent change score models through Monte Carlo simulation. In E. Ferrer, S. M. Boker, & K. J. Grimm (Eds.), *Advances in longitudinal models for multivariate psychology: A festschrift for Jack McArdle* (pp. 189–211). Routledge.

Current themes of research

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Most relevant publications:

- Passeggia, R., Testa, I., Palazzo, L., & Esposito, G. (2025). Challenges of the transition to university: identifying psychological and academic profiles of STEM university students. *Journal of Applied Research in Higher Education*, 1–14.
- Passeggia, R., & Esposito, G. (2026). The effect of academic engagement and psychological distress on the intention to drop out during the COVID-19 pandemic: a structural equation modeling approach. *Current Psychology*, 45(5), 504.

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Freda, M. F., Raffaele, D. L. P., Esposito, G., Ragozini, G., & Testa, I. (2023). A new measure for the assessment of the university engagement: The SInAPSi academic engagement scale (SAES). *Current Psychology*, 42(12), 9674-9690.

Passeggia, R., & Esposito, G. (2026). The effect of academic engagement and psychological distress on the intention to drop out during the COVID-19 pandemic: a structural equation modeling approach. *Current Psychology*, 45(5), 504.

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Esposito, G., Marôco, J., Passeggia, R., Pepicelli, G., & Freda, M. F. (2022). The Italian validation of the university student engagement inventory. *European Journal of Higher Education*, 12(1), 35-55.

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Freda, M. F., Raffaele, D. L. P., Esposito, G., Ragozini, G., & Testa, I. (2023). A new measure for the assessment of the university engagement: The SInAPSi academic engagement scale (SAES). *Current Psychology*, 42(12), 9674-9690.

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Most relevant publications:

- Passeggia, R., Giovanna, E., Palazzo, L., & Testa, I. (2026). Exploring STEM identity profiles among undergraduate STEM students and their relationships with gender, discipline, persistence and engagement: a latent profile analysis. *International Journal of STEM Education*.
- Cioffi, A., Galano, S., Passeggia, R., & Testa, I. (2024). Validation of two test anxiety scales for physics undergraduate courses through confirmatory factor analysis and Rasch analysis. *Physical Review Physics Education Research*, 20(1), 010126.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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