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Engagement, self-efficacy and self-regulation as predictors of academic success in non-medical healthcare education

Jana Martincová[1*], Iva Staňková[1], Petr Snopek[2,3] and Lucie Zemánková[1]

Abstract

Background The increased demand for skilled healthcare professionals has sparked interest in examining factors affecting the academic success of non-medical healthcare students.

Method This study builds on quantitative study using online questionnaire-based survey focusing on the effect of engagement, self-efficacy and self-regulated learning on academic success. A total of 540 students of non-medical health study programmes participated on the study.

Results The results show a significant positive correlation between engagement and academic success ($r = .50$; $p < .01$), as well as between self-efficacy ($r = .43$; $p < .01$) and self-regulation of learning ($r = .55$; $p < .01$).

Conclusion The study shows that strengthening engagement, self-efficacy, and self-regulation of learning is crucial for improving students' academic performance and their successful career preparation. These findings have important implications for educational strategies aimed at optimizing the teaching and support of healthcare students.

Keywords Achievement, Students, Motivation, Self-control; academic success; self-efficacy, Self-regulation, Engagement

Background

Academic success is a multifaceted concept in educational research, including measures like grades, satisfaction, degree attainment, and career success [1, 2]. It is a significant predictor of successful study completion for students in non-medical healthcare programs and is critical in addressing this workforce gap. Research suggests that junior-year academic performance often predicts future academic outcomes [3, 4], strongly correlating to prior academic achievements [5, 6]. Academic success also depends on competencies acquired in secondary education [7], preparedness [8], and university entry challenges [9]. Poor study habits increase the likelihood of adaptation difficulties and dropout risk [10]. For medical education, success is essential for career readiness and safe patient care, as successful students acquire the necessary knowledge and skills for effective clinical practice [11].

Although structural factors such as funding or infrastructure are often highlighted as reasons for the shortage of health professionals, it is increasingly becoming apparent that factors related to future health professionals' learning achievements and motivation play a key role. Three main determinants—engagement, self-efficacy,

*Correspondence:
Jana Martincová
martincova@utb.cz
[1]Department of Pedagogical Sciences, Faculty of Humanities, Tomas Bata University in Zlín, Czechia, Czech Republic
[2]Department of Health Care Sciences, Faculty of Humanities, Tomas Bata University in Zlín, Czechia, Czech Republic
[3]The Tomas Bata Regional Hospital in Zlín, Czechia, Czech Republic

and self-regulation in learning have been identified as key aspects influencing learning success [12]. These factors increase the likelihood of successful degree completion and promote the development of skills crucial for effective performance in the health professions.

Academic success and engagement

Engagement is widely recognized as a central factor in academic performance, alongside motivation and participation [13]. It encompasses both academic and social dimensions, including class attendance, peer interaction, group work, and teacher-student dialogue—all of which promote meaningful learning and student well-being [2, 3, 14]. In non-medical healthcare programs, student engagement is essential not only for academic achievement but also for clinical competence and patient safety [7]. Active learning strategies, which support deeper cognitive processing, are linked to improved educational outcomes [8]. More engaged students typically invest greater time and energy into their studies, demonstrating stronger commitment and achieving better results [14].

Academic success and self-efficacy

Self-efficacy—the belief in one's ability to perform tasks and achieve goals—has a well-documented influence on academic success [9, 10, 15, 16]. It helps students approach challenges as opportunities rather than threats [17, 18]. In clinical fields, self-efficacy is especially important: nursing students with greater confidence tend to perform better in practical settings [19], while low self-efficacy can lead to avoidance behaviour and reduced professional readiness [20]. Students with higher self-efficacy are more likely to set ambitious goals, manage time effectively, and persist through challenges. This trait is also associated with reduced procrastination and more adaptive coping strategies [21–24].

Academic success and self-regulation of learning

Self-regulation includes behavioural, metacognitive, and motivational strategies directed toward achieving learning goals [9, 10, 25, 26]. Rather than being a simple study habit, self-regulation reflects a student's ability to transform their capabilities into learning competencies through self-directed action [27]. Students with strong self-regulation take ownership of their learning and are more likely to act independently of external factors such as teachers or instructional tasks [28, 29]. Those who believe in their potential for success are more inclined to engage in self-regulated learning. As Rashid and Asghar [25] emphasize, self-regulation is a critical skill for 21st-century learners and should be actively developed throughout higher education.

Given the growing importance of student success in addressing healthcare workforce shortages, and in light of the theoretical evidence highlighting engagement, self-efficacy, and self-regulation as core predictors of academic achievement, it is essential to explore how these factors interact in the specific context of non-medical healthcare education. While existing studies have examined these variables individually or in broader educational settings, there is a lack of focused research on how they jointly influence academic success among non-medical healthcare students in the Czech Republic. The aim of the research is to analyse the relationship between academic success and three selected variables (engagement, self-efficacy, self-regulation of learning) in non-medical healthcare students, and to determine the predictive power of these constructs with respect to the level of academic success.

Methods

The study utilised a quantitative, explanatory research design, incorporating both correlational and predictive analyses. Data were collected using a four-part, 80-item questionnaire administered to 540 non-medical healthcare students across all 14 Czech Universities. In line with the theoretical framework and extant empirical evidence, the following hypotheses were formulated: Hypothesis (H1) to be tested by correlational analyses: There is a relationship between student engagement, self-efficacy, self-regulation of learning, and academic success. Hypothesis (H2) to be tested by predictive analyses: Self-regulation of learning, engagement and self-efficacy predict academic success of non-medical healthcare students.

Setting and context of the study

This study was conducted in the Czech Republic, where non-medical healthcare education is regulated by Act No. 96/2004 Coll. and Decree No. 55/2011 Coll., as amended. These legal frameworks define and govern the qualifications for non-medical healthcare professions such as nursing, midwifery, physiotherapy, paramedicine, radiologic assistance, and nutrition therapy. These regulated programs form a key component of the national healthcare education system, aiming to prepare students for clinical roles across a variety of healthcare settings.

In certain countries, including the Czech Republic, the issue of healthcare professional shortages extends beyond insufficient numbers. It also encompasses challenges related to the distribution and retention of professionals within the healthcare system. According to data from the Ministry of Health and the Institute of Health Information and Statistics (IHIS), approximately 30% of general nurses in the Czech Republic are aged 56 or older, with many expected to retire within the next ten years. This trend could potentially leave up to 26,000 full-time positions unfilled [30].

Such shortages pose serious risks to healthcare delivery, increasing the likelihood of stress, burnout, and attrition within the workforce. Workforce sufficiency directly influences the coverage, availability, and quality of healthcare services. In this context, ensuring a sufficient number of trained healthcare professionals is critical to the effective functioning of the healthcare system. Quality education and targeted support for students during their studies can help boost motivation to complete training and transition into clinical practice, thereby strengthening healthcare workforce capacity [12].

Study population

Our research population consisted of students enrolled in non-medical healthcare study programmes at fourteen selected universities in the Czech Republic. Non-medical healthcare students participating in the survey included those training for becoming professionals in nursing, midwifery, physiotherapy, paramedic science, radiology, and nutritional therapy, among several others. According to the Act No. 96/2004 Coll. and Decree No. 55/2011 Coll. their education and subsequent professional responsibilities, do not involve the practice of medicine.

A census-based sampling approach was employed in this study. All fourteen Czech universities offering degree programmes in non-medical healthcare fields were contacted. While participation was voluntary, the study aimed to reach the entire population of students enrolled in these programmes. A total of 540 responses were collected, ensuring broad institutional representation and a sufficient level of sample diversity.

A total of 486 female and 54 male participants took part in the research study. The significant gender imbalance observed in the study population can be attributed to the fact that non-medical healthcare programmes in the Czech Republic are predominantly pursued by women. This trend is also reflected in the workforce composition. According to the Czech Statistical Office, only 4% of general nurses in the Czech Republic are male [31]. The mean age of the respondents was 23 years (Age_{mean}=23,06; $Age_{Std.Error}$=4,29). The sample primarily consisted of students enrolled in full-time study programmes, ensuring a high level of engagement with the academic environment. This composition aligns with the demographic profile of the target population, enhancing the study's validity and relevance within the given educational context.

Data collection

The data were collected in 2022 as part of a structured and ethically approved research process. Data collection was conducted through an online survey, which was distributed in collaboration with the respective universities. A total of 540 students completed the survey, yielding a response rate of 73%. The average completion time was approximately 20 min. Data collection was conducted anonymously and in full compliance with applicable ethical and legal standards, particularly the General Data Protection Regulation (GDPR). All participants were informed about the purpose of the study and provided informed consent for the processing of their responses. All data were anonymised and used exclusively for research purposes.

Research tool

For the purpose of this research, a questionnaire was developed containing a total of 80 items divided into four parts. Respondents rated all statements on a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire had a response rate of 73%. Students answered all 80 Likert-type items. Completing the questionnaire took students approximately 20 min. The data were collected in the year 2022 as part of a structured research process.

The first part of the questionnaire focuses on student engagement. This variable is captured by items 1–9 of the UWES-9 S questionnaire (Utrecht Work Engagement Scale for Students 9-item version), authored by Schaufeli et al. [32]. This questionnaire is based on the original version of the UWES-S (Utrecht Work Engagement Scale for Students) questionnaire. The UWES-9 S is a 9-item scale grouped into three subscales (vigour, dedication, absorption) of three items each [32]. Cronbach's alpha was calculated for our measurement as $\alpha = 0.79$.

The second part of the questionnaire focuses on students' self-efficacy, for which we chose the Self-Efficacy Formative Questionnaire (items 10–22) developed by Gaumer Erickson and Noonan [33]. Two main components of self-efficacy are measured using this questionnaire. On the one hand, these are believing in one's abilities and, on the other hand, focusing on one's efforts, progress, and learning and taking steps to increase one's confidence. The questionnaire consists of 13 items which are divided into two subscales. The first consists of eight items assessing an individual's belief in their own abilities. The second subscale consists of five items that assess an individual's belief that abilities grow with effort [33]. Cronbach's alpha was calculated for our measurement as $\alpha = 0.82$.

The third part of the questionnaire was designed to measure students' self-regulation of learning. This is the DAUS1 (DAUS1 is the Czech acronym for Questionnaire of Self-Regulation of Student Learning, items 23–62), which was developed by Hrbáčková et al. [34]. It is a revised version of the original DAUS questionnaire by the same authors. In analysing the level of self-regulation, the questionnaire focuses on factors such as motivational orientation (external vs. intrinsic sources of motivation),

Table 1 Descriptive statistics

Variable	Arithmetic mean (M)	Standard deviation (SD)
Engagement (E)	3.252	1.182
Self-efficacy (SE)	2.422	1.048
Self-regulation of learning (SR)	2.723	1.207
Study success (SS)	2.626	1.220

self-confidence (beliefs about task management and one's own abilities), metacognitive strategies (the ability to self-control, plan, and self-monitor), and the meaningfulness of study (current attitude towards studying and perceived meaningfulness of learning), which are assessed through its 40 items [34]. Cronbach's alpha was calculated for our measurement as $\alpha = 0.89$.

Some of these items were adapted from existing validated instruments, while others were newly developed based on York's theoretical framework [35]. The revised version of the questionnaire was subsequently pilot-tested on a smaller sample of students to ensure clarity of the items and to verify their reliability. Cronbach's alpha was calculated for our measurement as $\alpha = 0.71$.

Data analysis

Data were analysed using IBM SPSS Statistic 28.0. Descriptive statistics was used to determine the level of self-regulation of learning, self-efficacy, engagement and academic success of students. Subsequently, Pearson's correlation coefficient was calculated to determine the relationship between the variables. Regression analysis, specifically ENTER followed by the STEPWISE method, was used. The results of the STEPWISE analysis are presented in the paper. The normality of the data was verified. The data came from a normal distribution.

Results

According to Table 1, the mean score for the engagement variable among students is M_E=3.252. The lower the mean value, the higher the engagement of the respondents. Respondents show slightly lower levels of engagement.

The students' self-efficacy is, on average, M_{SE}=2.422. Here also, the lower the mean value achieved by the students, the higher their self-efficacy. The respondents show such an average value that they are oriented towards higher self-efficacy.

Table 1 shows that the mean of students' self-regulation of learning takes the value of M_{SR}=2.723 (SD = 1.207). This is a slightly above-average rating of students' self-regulation of learning. It is true that the lower the measured value, the higher the learning self-regulation ability.

Table 2 Correlation between engagement, self-efficacy, self-regulation of learning, study success and GPA

Variable	1	2	3	4	5
Engagement	–				
Self-efficacy	r(540) = 0.35, p <.01	–			
Self-regulation	r(540) = 0.61, p <.01	r(540) = 0.57, p <.01	–		
Study success	r(540) = 0.50, p <.01	r(540) = 0.43, p <.01	r(540) = 0.55, p <.01	–	
GPA	r(540) = 0.09, p =.05	r(540) = 0.13, p <.01	r(540) = 0.21, p <.01	r(540) = 0.04, p =.32	–

We measured academic success using two instruments. The first instrument is the grade point average. A review of studies on academic success found that approximately 55% of the selected articles from over twenty peer-reviewed journals reported GPA as the most commonly used indicator of academic success [35]. The grade point average of our research sample is M = 1.86.[1] However, a number of studies show that it is not an effective tool for measuring academic success [36–38]. Therefore, the questionnaire was supplemented with statements that explored respondents' subjective perceptions of their own academic success. On average, students scored M_{SS}=2.626 (SD = 1.220). Students claimed that they experience academic success in university (Mss = 3.535; SD = 1.015) and that academic success is important to them (Mss = 3.889; SD = 1.157) (Table 1).

Table 2 provides evidence that hypothesis (H1) on the relationship between engagement, self-efficacy, self-regulation of learning and academic success was confirmed. There is a moderate level of correlation for the variables studied. The correlations ranged from r =.35 to r =.61. The correlations between the variables of engagement, self-efficacy, self-regulation of learning, academic success and grade point average were assessed as very weak. The correlations ranged from r =.04 to r =.21. The calculated correlation between academic success and grade point average was statistically insignificant (p >.05; r =.04). The result shows that GPA has little impact on academic success in non-medical health programmes, indicating that grades alone do not reflect students' readiness for clinical practice. This suggests that other factors, such as practical skills, engagement, and self-efficacy, are more important for their success. It is therefore appropriate to consider a more comprehensive approach to assessing their competencies.

[1] For the research sample, the grade point average is determined as the arithmetic mean of the pass rates of the completed courses. The pass rates (A, B, C, D and E) have a numerical value of A = 1; B = 1.5; C = 2; D = 2.5; E = 3; F = exam failure. Exam failure is not applied in the calculation of the average classification of students.

Table 3 Prediction of study success

Model Summary[d]									
Model	*R*	*R* Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.548[a]	0.300	0.299	6.515	0.300	230.8	1	538	< 0.001
2	.586[b]	0.343	0.341	6.318	0.043	35.25	1	537	< 0.001
3	.602[c]	0.362	0.359	6.231	0.019	16.10	1	536	< 0.001

a. Model 1: Predictors: (Constant), self-regulation of learning

b. Model 2: Predictors: (Constant), self-regulation of learning, engagement

c. Model 3: Predictors: (Constant), self-regulation of learning, engagement, self-efficacy

d. Dependent Variable: Study success

Table 4 Self-regulation, engagement and self-efficacy as predictors of study success

Variables	**B**	**SE**	**t**	**95% CI**		***p***
				LL	**UL**	
(Constant)	18.35	1.68	10.93	15.05	21.64	< 0.001
Self-regulation of learning	0.117	0.020	5.93	0.078	0.156	< 0.001
Engagement	0.349	0.058	5.99	0.235	0.463	< 0.001
Self-efficacy	0.188	0.047	4.01	0.096	0.281	< 0.001

Engagement, self-efficacy and self-regulation of learning predict academic success perceptions

To test the hypothesis (H2), we used regression analysis using the STEPWISE method. The conditions of use (multicollinearity, tolerance and VIF) were met .

Table 3 summarizes the results of the regression analyses. Model 1 includes self-regulation of learning as the sole predictor of academic success. The coefficient of determination R^2 = 0.30 (adjusted R^2 = 0.30) indicates that this model explains 30% of the variance in students' academic success, F(1.538) = 230.80, p <.001.

Model 2 expands upon the previous model by incorporating a second predictor, engagement. The R^2 value increases to 0.34 (adjusted R^2 = 0.34), signifying that this model accounts for 34.0% of the variance in academic success, representing an improvement of 4.0% over Model 1. The statistical test for model change confirms that the inclusion of engagement significantly enhances the explanatory power of the model, ΔF(1.537) = 35.25, p <.001.

Model 3 further extends the previous model by introducing a third predictor, self-efficacy. This final model achieves the highest explanatory power, with R^2 = 0.36 (adjusted R^2 = 0.36), indicating that it explains 36.0% of the variance in academic success, F(3.536) = 102.45, p <.001. The addition of self-efficacy improves the model's explanatory power by 2.0% compared to Model 2, and the statistical test confirms the significance of this improvement, ΔF(1.536) = 16.10, p <.001 (Table 3).

Dependent variable: study success

The Table 4 shows that if we increase students' self-regulation of learning, engagement and self-efficacy, we will also increase their subjectively perceived academic success. According to the standardized regression coefficient beta, self-regulation of learning (Stand. coeff. beta = 0.294) and engagement (Stand. coeff. beta = 0.260) have the most significant effect on subjectively perceived academic success.

Discussion

The aim of this study was to analyse the relationship between academic success and three selected variables (engagement, self-efficacy, self-regulation of learning) among the students enrolled in non-medical healthcare study programmes and to determine the predictive power of these constructs with respect to the level of academic success. The results demonstrated that all three examined variables exhibited a significant positive correlation with academic success: engagement (r =.50, p <.01), self-efficacy (r =.43, p <.01), and self-regulation of learning (r =.55, p <.01). Regression analysis confirmed that self-regulation of learning was the strongest predictor of academic success; with the model incorporating all three factors explaining 36.0% of the variance in academic success. Therefore, the contribution of this study is that it provides empirical evidence of the importance of engagement, self-efficacy and self-regulation for the perceived academic success of non-medical health students.

The results revealed a significant positive correlation between engagement and academic success (r =.50, p <.01), which aligns with prior research [5, 14] emphasizing the role of active involvement in learning communities. Similar studies, such as Wang and Eccles [39], reported a positive correlation (r =.28, p <.01), suggesting that student engagement fosters deeper learning experiences and improved academic outcomes. However, other studies [40] found weaker correlations (r =.14, p <.01),

highlighting possible contextual differences in student populations and institutional settings. The present study further confirms that engagement is not only beneficial for academic achievement but also plays a role in shaping students' motivation and persistence.

The findings related to students' engagement carry significant theoretical and practical implications. From a theoretical perspective, this study strengthens existing models of engagement by showing that active participation and motivation directly contribute to academic success. Unlike general academic disciplines, health-related programmes require students to engage both cognitively and behaviourally, suggesting that engagement-focused interventions should extend beyond the traditional classroom setting and into the clinical setting. This is consistent with self-determination theory [41], which posits that promoting autonomy and competence increases intrinsic motivation and engagement in learning. In practical terms, this suggests that educators should incorporate more interactive and problem-based learning techniques, simulations and real-world case studies to promote student engagement and subsequently improve learning outcomes.

Furthermore, significant positive relationship was also identified between self-efficacy and academic success ($r = .43$, $p < .01$), consistent with previous findings [9, 21, 41]. The correlation coefficients observed in this study are comparable to those reported by Fang [42].

($r = .55$, $p < .01$) and Lynch and Trujillo [43] ($r = .53$, $p < .001$), reinforcing the idea that self-efficacy is a crucial determinant of academic success. Given that self-efficacy influences students' confidence in their abilities, it may also affect their approach to academic challenges and problem-solving strategies. The practical implications of these results suggest that targeted interventions such as self-efficacy training, increased mentor support within students' clinical practice, and structured feedback mechanisms to enhance students' confidence in their abilities should be incorporated into health professions education. This could be particularly useful in clinical teaching, where self-confidence may influence students' willingness to engage in hands-on learning and interactions with patients.

Finally, the strongest correlation was found between self-regulation of learning and academic success ($r = .55$, $p < .01$), supporting existing literature that emphasizes the role of self-directed learning in academic achievement [9, 10]. This result aligns with previous research by Rashid and Asghar [25] and Code [44], as well as Wang et al. [39]. Our findings seem crucial, as well as prior research showed that the ability to regulate one's own learning is a key competency for academic success, particularly in demanding healthcare education settings. Additionally, research by Sun and Rueda [45] found that self-regulation is significantly correlated with different types of engagement (behavioural, emotional, and cognitive), further strengthening the argument for its importance in higher education. Given the strong correlation between self-regulation and academic success, it is important to consider practical implications for curriculum design. Educational institutions should emphasize the development of self-regulated learning strategies, such as time management, goal setting, and reflective practice, to enhance student autonomy and long-term learning outcomes [27]. Furthermore, integrating structured mentorship programmes and peer-assisted learning initiatives could provide students with practical tools to improve self-regulation skills. These approaches could be particularly beneficial in non-medical healthcare education, where students must adapt to complex and dynamic clinical environments.

The overall results suggest that educational interventions designed to enhance self-regulation of learning, engagement, and self-efficacy could indeed contribute to improved academic performance and better preparedness for professional practice. On the other hand, this study's primary limitation lies in its cultural specificity. Educational frameworks vary across countries, and factors such as curriculum structure, student support systems and institutional expectations may influence the relationships between self-regulation, engagement, self-efficacy and academic achievement. For example, active learning and student-centred pedagogy may be more prevalent in some education systems, potentially altering the impact of these psychological determinants. Future research should consider longitudinal approaches to track changes in academic success over time.

The study contributes to the existing body of knowledge, especially in the European context, by providing empirical evidence on the psychological determinants of academic success in healthcare education. Future research could explore interventions aimed at strengthening self-regulation, engagement, and self-efficacy in order to optimize learning outcomes and professional readiness.

Conclusion

The study highlights the significant role of engagement, self-efficacy, and self-regulation of learning in predicting academic success among non-medical healthcare students. The results confirmed that these three factors positively correlate with academic success, with self-regulation of learning emerging as the strongest predictor. Educational interventions that enhance these psychological attributes—such as fostering self-regulation skills and promoting student engagement—could significantly improve academic performance and better prepare students for professional practice. These findings provide

valuable guidance for the development of targeted educational strategies in healthcare programmes—in the Czech Republic and beyond—that could ultimately enhance students' learning outcomes and their ability to succeed in dynamic clinical environments.

Implications for increasing academic success of non-medical healthcare students

It is important to stress that academic success in non-medical healthcare education differs from general academic success due to its dual emphasis on theoretical knowledge and clinical competencies. Unlike traditional academic disciplines, where success is often measured by GPA and exam performance alone, success in non-medical healthcare programmes must also consider students' ability to apply knowledge in clinical settings, develop professional competencies, and transition effectively into the workforce. Our findings highlight that engagement, self-efficacy, and self-regulation of learning are critical determinants of academic success in this specific educational context. These factors not only enhance academic achievement but also contribute to students' preparedness for real-world healthcare challenges.

Building on these implications, the following interventions may effectively support student development both academically and clinically.

Recommendations for educational interventions

To enhance self-regulation and engagement, structured interventions should be implemented both in academic and clinical settings. In the learning environment, promoting self-regulation can be achieved by integrating planning techniques and metacognitive strategies into the curriculum. Regular planning workshops and reflective learning journals can help students develop effective learning strategies and improve their ability to adapt to challenges. To foster engagement, interactive teaching methods, such as gamification and peer learning, should be employed to maintain students' motivation and active participation. In clinical practice, engagement and self-regulation can be strengthened by incorporating structured reflection, setting clear clinical objectives, and providing intensive one-on-one mentorship. Additionally, technology-based tools, such as virtual simulations and personalized feedback mechanisms, can further support students' self-directed learning and confidence in clinical decision-making. These approaches align with the unique nature of academic success in non-medical healthcare education and provide a pathway for optimizing student outcomes and professional readiness.

Limitations of the research

The reliability of the self-constructed questionnaire may be influenced by social desirability bias and students' subjective perceptions, as respondents might adjust their answers to align with perceived expectations rather than their actual experiences. Additionally, self-reported data are inherently susceptible to cognitive biases and variations in personal interpretation.

To mitigate these risks, a preliminary study was conducted, allowing for refinements based on respondent feedback. Furthermore, the reliability of the questionnaire was tested, ensuring its internal consistency before full-scale implementation.

Abbreviations

DAUS1	Questionnaire of Self–Regulation of Student Learning (Czech acronym)
F	F–statistic (used in ANOVA and regression analysis)
GDPR	General Data Protection Regulation
GPA	Grade point average
IBM SPSS Statistics	International Business Machines Corporation, Statistical Package for the Social Sciences. Statistical software used for data analysis
IHIS	Institute of Health Information and Statistics
LL	Lower limit
LL	Lower limit (of Confidence Interval)
p	Significance level (p–value)
$p < .001$	p–value indicating a highly significant result
r	Pearson's correlation coefficient
R^2	Coefficient of determination
r^2	Explained variance in regression
SD	Standard deviation
UL	Upper limit
UL	Upper limit (of Confidence Interval)
UWES	9 S–Utrecht Work Engagement Scale for Students (9–item version)
VIF	Variance inflation factor
ΔF	Change in F–statistic (for model comparison)

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Authors' contributions

Petr Snopek conducted a detailed analysis of the data with a specific focus on non-medical healthcare fields, providing critical insights into this specialized perspective. He played a pivotal role in conceptualizing the theoretical framework of the article and contributed substantially to the interpretation of the data, ensuring the findings were grounded in relevant academic discourse.Iva Staňková contributed extensively to the development of the theoretical foundation of the manuscript. She collaborated closely in interpreting the data and played an integral role in shaping the conclusions, ensuring their relevance and applicability to the broader field of healthcare education.Jana Martincová was instrumental in the organizational aspects of the research. She oversaw the design and implementation of data collection tools and coordinated the data collection process. Additionally, she led the data analysis and ensured that the research findings were rigorously connected to existing scholarly knowledge. Her efforts ensured that the study's outcomes were thoroughly contextualized within the current body of academic literature. Lucie Zemánková collected and organized the data. All authors contributed to the manuscript preparation, reviewed the content critically for intellectual merit, and approved the final version for submission.

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Data availability
The datasets generated and analysed during the current study are not publicly available due to institutional confidentiality policies but are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
The data collection was approved by the Ethics Committee of Tomas Bata University in Zlín. The research file did not contain vulnerable population groups and was implemented in accordance with the GDPR. The students gave their informed consent to the processing of the answers in the questionnaire. The questionnaire was anonymous. To ensure anonymity and confidentiality, all participants were informed that their responses would be collected and analysed in an aggregated and anonymized form, with no personally identifiable information recorded. The data were used exclusively for research purposes and handled in accordance with ethical guidelines and data protection regulations.

Consent for publication
Not applicable. The manuscript does not contain any individual person's data in any form (including individual details, images, or videos).

Competing interests
The authors declare no competing interests.

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