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1. Strategic University Positioning: Fostering Student Satisfaction and Well-being (2024)	Journal of PSYCHOLOGY, MULTIDISCIPLINARY (Article from : SpringerNature)

Strategic University Positioning: Fostering Student Satisfaction and Well-being

Maha Khamis Al Balushi[1] · Khalid Hussain[1] · Asael Nasser Al Mahrouqi[1]

Abstract

In the higher education literature, matters of student ill-being, stress, and anxiety are some of the grave concerns among universities seeking to stand out in a highly competitive marketplace. Against this backdrop, the present study aimed to detail the role of university positioning attributes in addressing student satisfaction and well-being. For this purpose, data were collected from 385 undergraduate and postgraduate students from a large-scale public sector university. The findings revealed that the university's positioning attributes of learning environment, reputation, graduate career prospects, and destination image positively influenced student well-being via student satisfaction. However, the positioning attribute of cultural integration was found to have no significant effect on student satisfaction. On the basis of these findings, the present study discusses theoretical and managerial implications for academicians, accreditation agencies, marketing managers, and brand strategists.

In today's world, universities are witnessing dynamic changes in the higher education horizon and in student preferences. Hemsley-Brown and Oplatka (2006) stated that the higher education market has extended its reach beyond English-speaking countries, indicating a growing global presence and the influence of higher education institutions beyond traditional English-speaking regions. Additionally, there is a split among students, with some pursuing higher education while others opt for short-term courses to develop skills and become self-sufficient freelance professionals (Marcus, 2022). Marcus's report highlighted a substantial change in perceptions regarding the value of higher education, both before and after the COVID-19 pandemic. Prior to the pandemic, 50% of students believed that college costs were justified, but now only 32% hold this view. Similarly,

confidence in higher education has dwindled, with just 48% of adults expressing significant faith; a decline from 57% reported in 2015. These statistics highlight the growing skepticism toward college and students' willingness to consider non-traditional educational paths and career choices. Consequently, universities are facing increased competition for potential student enrollments.

Higher education institutions are further struggling owing to limited funding and market-based changes, and universities, in particular, are confronting competition for resources (Fowles, 2014). Traditionally, universities viewed competition in a negative light and did not anticipate having to struggle for resources, but now universities both compete and cooperate with one another. International expansion has become commonplace in the higher education landscape resulting in an increase in marketing efforts within the higher education sector (Harrison-Walker, 2009). The objectives of these marketing efforts include both the acquisition of new students and the retention of existing students. The recent mindset of higher education institutes has made branding an integral aspect of their marketing (Curtis et al., 2009).

University marketing literature suggests that *positioning* is a strategic approach that can help higher education institutes earn and maintain a favorable position

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compared to their competitors, portraying a clear and recognizable image of the institution within society and the economy (Popović et al., 2015). Well-defined positioning allows universities to communicate their identity and values effectively to potential students and focus their marketing efforts on what matters most to their audience (Lowry et al., 2001). Gray et al.'s (2003) model stands out as the most comprehensive framework for delineating university brand positioning. This model encompasses crucial aspects such as reputation, learning environment, destination image, graduate career prospects, and cultural integration. Notably, the model does not merely encapsulate the university's reputation and learning environment; it extends its focus into the future by incorporating graduate career prospects. This addition aligns with students' concerns about the future outcomes of their current degree pursuits. Furthermore, the model takes into account destination image and cultural integration, which are pivotal factors for a satisfying university education experience.

On the basis of the aforementioned key attributes, our study follows this framework to better comprehend the impact of university positioning on student satisfaction. It is crucial to understand the relationship of each positioning attribute with student satisfaction because in today's rapidly evolving educational landscape, higher education institutions are increasingly recognizing the significance of student satisfaction for their survival. This is because of the rapid growth of colleges, changing student demographics, and market forces (de Lourdes Machado et al., 2011). Student satisfaction is a major factor in furnishing the success of a higher education institute and is influenced by the quality of educational service providers (Gáti & Malota, 2017). University positioning may not only lead to increasing the satisfaction of its students but may also contribute to their well-being.

Recently, student well-being has gained significant attention within global educational systems for its extensive benefits (Joing et al., 2020). Student well-being is now at the top of educational agendas aiming to foster effective learning within schools and serve as a decisive outcome in twenty-first-century education (Govorova et al., 2020). It is critical for universities to take care of students' personal lives and their well-being in addition to teaching and learning activities. Well-being involves experiencing positive emotions such as happiness and contentment, personal growth, a sense of control over one's life, a defined purpose, and meaningful connections (Huppert, 2009). Student well-being is linked to enhanced academic performance and, in the long run, successful employment, active social participation, and contributions to society's overall well-being (Cárdenas et al., 2022).

Higher education in Oman

Oman is a small country nestled in the southeastern corner of the Arabian Peninsula with an authentic culture grounded in Islamic principles. Omani culture is a blend of ancient traditions and modern lifestyle. Oman is an international country with a total population, as of September 2023, of 5,136,957. Omani citizens made up 56.69% or 2,912,064 of the population, while expatriates accounted for the remaining 43.31%, totaling 2,224,893 individuals (Muscat Daily, 2023). Notably, young people aged 18 to 29 years represent 19% of the total population comprising 544,983 young men and women (Times of Oman, 2023).

To address the higher education needs of this young population, Oman has established 68 higher education institutions. However, Oman's higher education sector is relatively young, having experienced significant growth in recent years. Oman started its higher education journey in 1986 by establishing a large-scale public university in the capital city. The number of higher education institutions has grown rapidly since then with an exponential rise of private sector institutions. Higher education institutions in Oman have cultivated an inclusive environment that embraces students from diverse backgrounds, genders, and ethnicities (Al-Amri et al., 2020). This commitment aligns with Oman's culture and Islamic principles of equal opportunity for all which fosters a welcoming atmosphere for individuals regardless of their identities. Notably, Oman's dedication to gender equality is reflected in the higher education sphere with the current student ratio standing at 60% female and 40% male (Times of Oman, 2023). Besides enrolling local students, Oman's higher education institutions are striving to attract international students as Omani universities have begun ranking among the top 500 universities of the world. However, some universities still face challenges in effectively positioning themselves to both satisfy existing students and attract top-tier academic talent at national and international levels. Therefore, the present study attempts to delineate the university positioning attributes that foster student satisfaction and well-being.

In doing so, this study contributes in multiple ways: first, it is one of the first studies to investigate the impact of university positioning attributes, i.e., learning environment, university reputation, destination image, cultural integration, and graduate career prospects on student satisfaction. It is also one of the earliest attempts to gauge the impact of university positioning attributes, i.e., learning environment, university reputation, destination image, cultural integration, and graduate career prospects on student well-being. It is one of the few studies that evaluates the influence of student satisfaction on their well-being. This

study is also the first of its kind that investigates university positioning attributes, student satisfaction, and student well-being in Oman's higher education sector.

Literature review

University positioning attributes

Keller (2013) defined positioning as "the act of designing a company's offer and image so that it occupies a distinct and valued place in the target customer's mind" (p. 79). Positioning is the process through which a brand establishes a cognitive connection in customers' minds to capture a distinct place among competing brands. Saqib (2020) asserted that the concept of positioning is in its infancy and requires more attention. Saqib's review of positioning definitions revealed that existing literature lacks a unified definition for positioning with some conceptual differences. Saqib (2020) concluded that a positioning definition may have five facets: competition, vacant mental spaces, consumer perception, differentiation, and competitive advantage. This conceptualization aligns with Keller's (2013) definition of positioning on capturing a distinct position in customers' minds and differentiating the brand from competitors, which pertains to creating parity among brands to establish brand image and brand identity. However, Saqib (2020) included competitive advantage as an additional attribute of the brand positioning definition. Carlberg and Kjellberg (2018) embraced a conceptualization akin to that put forth by Keller (2013), asserting that positioning is instrumental in enabling brands to secure a distinct and valued place in the minds of target customers within a highly competitive environment. They argued that brand names enjoy substantial popularity, but each brand name inhabits a unique niche in the minds of consumers.

Positioning for service brands is much more complex and holds greater significance than positioning for product brands. This complexity arises from the difficulty in identifying the tangible features of a service or confining its benefits to a single offering (Kethüda, 2023). Nonetheless, the same positioning concept remains applicable to non-physical goods. Higher education institutions fall under the category of high-involvement services, as experiencing and consuming a university's offerings necessitates direct engagement. Therefore, positioning for universities entails crafting an image that distinguishes a university's stance in the perceptions of its multiple stakeholders, e.g., students, educators, employers, and investors in comparison to other institutions (Srikatanyoo & Gnoth, 2002).

Recent advancements have amplified the complexity of positioning for universities due to their expansion from national to international services (Hemsley-Brown & Oplatka, 2006). Universities have embraced international students, academicians, staff, and collaborations with global figures, nurturing a cross-cultural environment. Thus, the scope of positioning for universities must encompass a diverse audience hailing from various locations and harboring diverse priorities. Çati et al. (2016) found that positioning is fairly widespread in higher education institutions in the United States owing to the extensive number of available institutions. They find that the *University of Chicago* effectively emphasizes its quality of campus life, *Southern Illinois University* became recognizable for its substantial student scholarships, and the *University of Michigan* has earned the title 'Harvard of the Midwest' for its premium pricing and the luxury it offers. Fumasoli et al. (2020) suggested that positioning aspects help a university to attract qualified students and faculty who contribute to the university's research and overall achievements. Thus, increasing the institute's value in the eyes of stakeholders, e.g., donors, inspiring them to contribute more to the institution. These resulting funds are then allocated to different projects, allowing the university to enhance its services and reinforce its positioning.

Tight (2023) asserted that a university is characterized by three essential components: augmented integration of educational technology, expansion that extends beyond the university's traditional radius, and the widespread availability of undergraduate education. Çati et al. (2016) identified seven positioning strategies for universities: internationalization strategy, academic achievement strategy, training systems strategy, the social and sporting facilities strategy, job opportunity strategy, the rooted history strategy, and physical facilities strategy. Krücken and Meier (2006) asserted that universities' strategic positioning standpoints are constructed on the notion that organizations, and the individuals within them, act as unified and purpose-driven units proficient at making intentional decisions. Although peripheral elements furnish a context for a university's actions, institutions also actively participate, rather than merely reacting passively to external or environmental stimuli. The interaction between organizational-level dynamics and their surroundings becomes evident during the formulation of strategies and plans (Frølich et al., 2013). Gray et al.'s (2003) work serves key bases in measuring universities' perceptions from the students' perspective. That is also the precise reason for following Gray et al.'s (2003) measure for university positioning, as it explicates the rationale behind students' partialities and the standards they value when selecting higher educational institutions. Gray et al. (2003) presented five key factors vital for university selection amid numerous options: learning environment, reputation, destination image, graduate career prospects, and cultural integration.

According to Gray et al. (2003), *learning environment* refers to students' learning experience within the university

and outlook of the academic settings. The environmental settings significantly affect students' academic achievements and development, serving as a motivational factor for conscientiousness and achievement throughout their university experience, consequently affecting the university's outcomes. The expected environment impacts interaction and the cultivation of a shared culture among students, thereby enhancing the quality of education (Frølich et al., 2013). Gray et al. (2003) stated that *university reputation* is another crucial facet for its positioning. University reputation refers to the brand name a university establishes through its high standard of education, achievements, quality of courses, and rich history. Reputation significantly impacts the choices of both potential students and faculty members, resulting in competition among universities on a global scale. Steiner et al. (2013) noted that university reputation is a contributing factor in international university rankings.

According to Gray et al. (2003), *destination image* refers to the characteristics of a destination that influence students' decisions to pursue studies in a particular location and the view they form about it. This image is constructed through multiple channels, including news reports, magazines, personal experiences of family and friends, literature, and cinematic portrayals of the destination. *Cultural integration* is the next element of Gray et al.'s (2003) model for university positioning. The educational experience and learning environment set a landscape for students from diverse cultural backgrounds to interact and engage with their peers and other international students. The aspect of cultural integration constitutes a considerable component of students' comfort and expectations, which ultimately affects their productivity, skills, and interactions on campus (Volet & Ang, 1998). *Graduate career prospects* is the fifth attribute of Gray et al.'s (2003) model. It pertains to equipping students with the necessary skill set to meet the requirements of both society and the job market, thus leading them toward success after they graduate. Tien et al. (2022) stated that universities share a common trait, which is a dedicated work to enhance students' career prospects.

University positioning attributes and student satisfaction

Customer satisfaction refers to the process of assessing an experience with a provided service or product (Hussain et al., 2021). Accordingly, from the perspective of an educational institution, a student is valued as a client throughout their academic program. The satisfaction of students is their emotional or cognitive response to a diverse service provided by the university. According to Elliott and Shin (2002), student satisfaction is a short-term attitude that refers to students' subjective assessment of the degree to which their expectations concerning educational experiences have

been met or exceeded. Generally, this satisfaction is apparent through enhanced skill development, constructive word-of-mouth, and loyalty. Student satisfaction can directly enhance students' performance and motivation, which benefits both the university and its students (Chuah & Sri Ramalu, 2011).

Student satisfaction literature (e.g., Nastasić et al., 2019) suggests that students may develop a multitude of expectations regarding their academic encounters; therefore, student satisfaction can be seen as a multifaceted concept. Sirgy et al.'s (2010) framework of an overall satisfaction with academic life is divided into three components, including social interactions, encompassing satisfaction with academic facets, and the amenities and services offered by the college. Similarly, Wach et al. (2016) suggested that university students' perspectives on their academic pursuits can be assessed by gauging their satisfaction across three dimensions. These dimensions include learning content (i.e., delight and satisfaction students derive from their chosen subjects), learning conditions (i.e., students' contentment with the terms and provisions of academic programs), and personal adaptation to learning (i.e., students' satisfaction with their ability to manage study stress). However, the objective of our research is not to dissect and study the distinct types of students' satisfaction; therefore, we have operationalized student satisfaction as a unidimensional construct.

Marketing theory provides ample support to suggest that a brand's positioning earns it the targeted satisfaction. In an online learning context, Yousaf et al. (2022) found that learning environment is positively related with student satisfaction; however, their study did not explicitly outline the impact of university positioning attributes on fostering student satisfaction. Similarly, Thoo et al. (2022) found that destination image significantly influences student satisfaction in the context of students' loyalty to the study destination, although their study did not consider other attributes of university positioning. Al Hassani and Wilkins (2022) advocated that university reputation determines students' satisfaction; nevertheless, their study did not specifically analyze reputation as a constituent of university positioning. Instead, their research delved into various factors that might contribute to student retention within a university setting. According to Liu et al. (2022), the likelihood of a range of career prospects has a positive impact on student satisfaction. In their study, the researchers investigated the influence of career prospects in the hospitality sector against the backdrop of the COVID-19 pandemic. Notably, their focus did not encompass the broader context of university positioning.

The previously mentioned literature highlights the presence of evidence regarding the impact of individual attributes on enhancing student satisfaction. However, the existing body of literature offers limited insights into how these constructs concurrently contribute to shaping university

positioning and influencing student satisfaction. The dearth of empirical evidence concerning the role of university positioning attributes in fostering student satisfaction gives rise to the following hypothesis:

Hypothesis H1 University positioning attributes (a) learning environment, (b) university reputation, (c) destination image, (d) cultural integration, and (e) graduate career prospects positively influence student satisfaction.

Student satisfaction and student well-being

Quality of life and well-being are commonly seen as synonymous and are used interchangeably to describe a similar phenomenon (Brett et al., 2023; Junaid et al., 2020). Well-being encompasses multiple aspects, i.e., objective well-being that involves meeting material needs and having sufficient physical and social properties (Hartwell et al., 2018). Moreover, the concept of subjective well-being is an inclusive concept that captures an individual's evaluations of their lives and experiences (Diener et al., 2009). Interestingly, Zhong and Mitchell (2012) suggested that manipulating subjective well-being is very challenging and is integral to establishing a lasting relationship between any kind of consumers and their respective brands. In the context of a university–student interaction, subjective well-being pertains to the positive impact of students' university experiences on their overall quality of life (Soong & Maheepala, 2023). Extant marketing literature advocates that consumer (i.e., student) satisfaction can significantly lead to consumer (i.e., student) well-being. In their recent literature review and meta-analysis, Yu et al. (2018) also stated that satisfaction results in the well-being of an individual.

The aforementioned literature investigates the relationship of consumer satisfaction with consumer well-being which plays a guiding role in devising the relationship of student satisfaction and well-being. Recently, Kiltz et al. (2024) also recommended that it is necessary to satisfy students' psychological needs to achieve student well-being. Their study examines students' needs of autonomy, competence, and relatedness in contributing to students' well-being. However, their study does not consider student satisfaction as a standalone construct and investigates its relationship with student satisfaction. With the backdrop of this discussion, we present the following hypothesis:

Hypothesis H2 Student satisfaction leads to student well-being.

Researchers (e.g., Helou et al., 2019) have suggested that the learning environment of an institution impacts students' well-being. Capone et al. (2021) stated that it is important for students to examine the university's reputation as a way

of gauging their mental well-being. Rohman et al. (2023) found that destination image positively impacts tourists' well-being, and we extend that to students' well-being. Seligman (2011) suggested that finding a sense of growth comes from pursuing goals beyond oneself. According to Hill et al. (2013), career is a major source of meaning for students that feeds into well-being. Recently, Kiltz et al. (2024) documented that a learning environment that satisfies students' psychological needs helps in fostering their well-being. Similarly, Eloff et al. (2022) asserted that the learning environment and structural support systems at higher educational institutes augment student well-being. However, the extant literature lacks empirical evidence on how university positioning attributes simultaneously work to foster well-being among students. Therefore, we extend the following hypothesis:
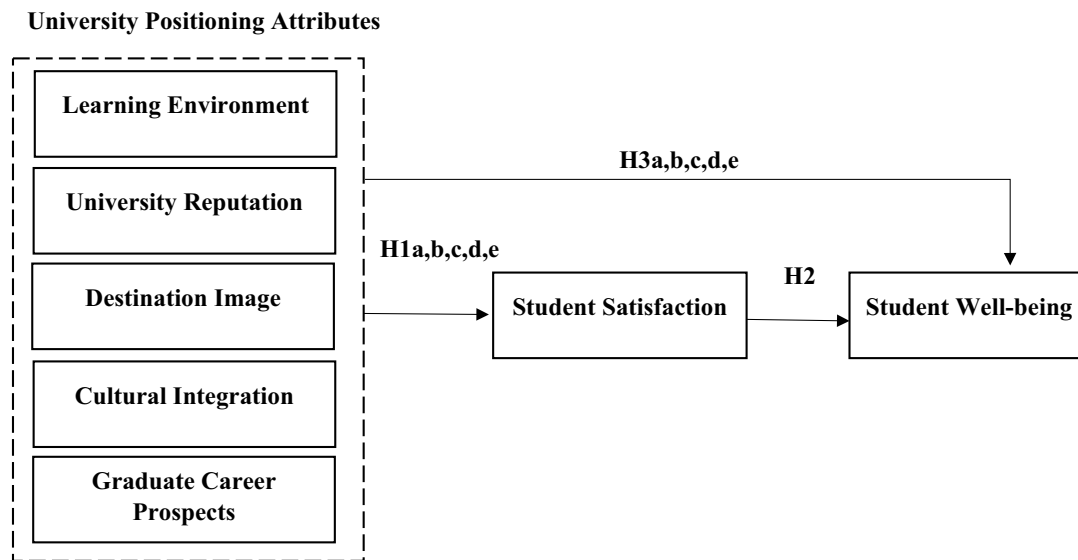
Hypothesis H3 University positioning attributes (a) learning environment, (b) university reputation, (c) destination image, (d) cultural integration, and (e) graduate career prospects positively affect student well-being (Fig. 1).

Method

Data collection procedure

This research is quantitative in nature and follows a survey-based cross-sectional research design. An online survey was prepared on Google Forms and distributed to all enrolled students of eight different departments, i.e., marketing, management, accounting, finance and economics, political science, information systems, business communications, and operations management at a large-scale public sector university in Oman. There are more than 2900 students registered in these departments, and we sent the survey form to all the registered students via email. At first, we received 227 responses and then we sent two reminder emails, so we received 385 complete responses as a result. According to Hair et al. (2010), our sample of 385 students falls under the large sample category in business and social sciences disciplines.

The survey consisted of three parts. In the initial section, participants were provided with an overview of the research topic, along with an assurance of confidentiality and amalgamation of their answers for result generation. Personal details such as names or contact information were not solicited from the respondents. The second section measured the key variables using the instruments adapted from the extant literature. The third section gathered demographic details and concluded the questionnaire with a statement of gratitude.

University Positioning Attributes

Source: *Developed by authors*

Fig. 1 Theoretical Framework

Table 1 Demographic profile of respondents

Factor		Frequency ($n=385$)	Percentage
Gender	Male	150	39.0
	Female	235	61.0
Age (years)	18–21	222	57.7
	22–24	160	41.6
	25 and above	03	0.80
Education	Undergraduate	356	92.5
	Postgraduate	25	6.50
	Other	4	1.0
Academic year	1st	40	10.4
	2nd	48	12.5
	3rd	85	22.1
	4th	71	18.4
	5th	91	23.6
	6th or more	50	13.0

Participants

We received 385 complete responses as a result of our online-administered questionnaire. Table 1 represents the demographic profile of study participants. According to the table, female participants constituted 61% of the total respondents. Among the respondents, 57.7% fell within the 18–21-year age bracket, 41.6% were between 22 and 24 years, and less than 1% were older than 25 years. Most of the respondents were enrolled in an undergraduate program (i.e., 92.5%) while 6.5% were in postgraduate programs and

only 1% of respondents were enrolled in other programs. The students' current academic year distribution showed that our study captured responses from all year levels starting from year one to the sixth year.

Measurement/instruments

The present study used established scales from existing literature to measure students' responses for the study variables. We used a 22 item, five-dimensional measure of university positioning from Gray et al. (2003), where six questions were used to measure learning environment, five questions for reputation, four questions for destination image, four questions for graduate career prospects, and three questions for cultural integration. Students' satisfaction was measured with a six-item scale adapted from Gray and DiLoreto (2016). Finally, student well-being was measured by a three-item scale from Junaid et al. (2020). All responses were taken on a five-point Likert-type scale, with 1 denoting "strongly disagree" and 5 denoting "strongly agree."

Data analysis

This study employed a two-step data analysis approach. In the first step, confirmatory factor analysis was conducted to assess data reliability and validity. Subsequently, structural equation modeling (SEM) was utilized with the software SmartPLS 4.0 to test the proposed hypotheses. It is important to note that SmartPLS utilizes partial least squares (PLS) rather than covariance-based SEM. Our emphasis on prediction over theory testing made PLS-SEM the

appropriate choice (Dash & Paul, 2021; Hair et al., 2017). Notably, Alam and Noor (2020) highlighted that PLS-SEM consistently produces more robust outcomes for mediation analysis compared to conventional regression analysis in SPSS. Additionally, PLS-SEM employs a bootstrapping method with 5000 iterations, which enhances the credibility of mediation analysis as noted by Dash and Paul (2021).

Common method bias

We addressed the issue of common method bias (CMB) in two ways. First, during the data collection stage, we proactively dealt with the potential for CMB by assuring respondents that there were no correct or incorrect answers. We emphasized the importance of honest and confidential responses, which would be used only in an aggregate manner for data analysis. Additionally, we conducted Harman's single-factor test (Podsakoff et al., 2003) to assess CMB, which revealed that the common factor explained only 31.38% of the variance. This result indicated that CMB was unlikely to be a significant concern for the present study.

Results

Confirmatory factor analysis

The results of the confirmatory factor analysis, as shown in Table 2, demonstrate that all measurement constructs satisfied the reliability and validity criteria (Fornell & Larcker, 1981; Hair et al., 2010). The composite reliability (CR) for all constructs surpassed 0.70. Additionally, the factor loadings of all questionnaire items exceeded 0.50, providing evidence of convergent validity with the exception of three items on the student satisfaction scale. We removed these items due to low factor loadings. Similarly, the average variance extracted (AVE) of almost all constructs was higher than 0.5 confirming the convergent validity.

The present study confirmed discriminant validity through heterotrait-monotrait (HTMT) ratio of correlations. HTMT statistics shown in Table 3 indicate that all the constructs are distinct from each other as all the values are lower than the 0.85 cutoff criterion.

Hypotheses testing

We analyzed the proposed hypotheses by running two different structural equation models. The structural model fits well with the data as the value of the standardized root mean square residual (SRMR) is 0.074, which meets the cutoff criteria of being less than 0.10 (Hair et al., 2010). In this regard, Dash and Paul, (2021) noted that PLS-SEM has a limitation in producing model fit indices due to its distinct

underlying concept. The literature on PLS-SEM is still developing in this area, and it is advised against relying on model fit indices to draw conclusive interpretations. Model 1 consists of a mediation model where we do not relate university positioning attributes with student well-being and student satisfaction completely mediates the relationship among university positioning attributes and well-being. Whereas model 2 directly relates the positioning attributes with student satisfaction and well-being.

The results of both models as presented in Table 4 support our hypothesis H1a, b, c, and e as positioning attributes, i.e., LE, REP, GCP, and DI positively influence student satisfaction. The results further revealed that learning environment has the highest impact on student satisfaction ($\beta = 0.283$, $p < 0.001$) followed by reputation ($\beta = 0.266$, $p < 0.001$) and graduate career prospects ($\beta = 0.209$, $p < 0.001$). Destination image has the lowest impact ($\beta = 0.105$, $p < 0.05$) on student satisfaction among all attributes. These university positioning attributes collectively explained 47% variance in student satisfaction. However, cultural integration did not yield significant coefficients. The results indicated that student satisfaction significantly enhances student well-being ($\beta = 0.515$, $p < 0.001$).

The university positioning attributes do not directly enhance student well-being except for graduate career prospects with a marginal impact ($\beta = 0.096$, $p < 0.05$) supporting our hypothesis H3c. This highlights the importance of achieving student satisfaction over the course of their learning process in the university. From these results, we infer that our hypothesis H3a, b, d, and e is not accepted. However, university positioning attributes indirectly influence student well-being via student satisfaction. As shown by the results of model 1 and model 2, student satisfaction mediates the relationship of positioning attributes and well-being. These results accentuate the central role of student satisfaction in the relationship of university positioning and student well-being.

Discussion

The ever-increasing competition among universities has made it difficult for academic institutes to stand out without properly positioning their key attributes. To better understand the role of university positioning attributes in satisfying students and enhancing their well-being, the present study endeavored to determine the importance of different positioning attributes according to students' perceptions. The present study examined five distinct positioning attributes, i.e., learning environment, reputation, graduate career prospects, cultural integration, and destination image. The findings revealed that learning environment is the most important positioning attribute in achieving student

Table 2 Statistics of confirmatory factor analysis

Construct	Factor loading
Learning environment (CR = 0.761)	
Excellent teaching staff	0.734
Excellent resources for research	0.597
Provide student support services	0.723
Excellent physical facilities	0.723
Flexible courses	0.655
Safety within institution	0.525
Reputation (CR = 0.798)	
Brand name of university	0.700
Achievements of the university	0.732
High standard of education	0.850
Quality of courses	0.735
Experience of university	0.509
Graduate career prospects (CR = 0.702)	
Graduate expected income	0.631
Employer's views of graduates	0.784
Graduate's employment prospects	0.762
International recognition	0.716
Cultural integration (CR = 0.702)	
Avenue for religious practices	0.577
Valuing cultural diversity	0.864
Multicultural environment	0.839
Destination image (CR = 0.682)	
Stable political environment	0.614
Safety in the country	0.748
Hospitality of the residents	0.734
Country's natural beauty	0.729
Student satisfaction (CR = 0.852)	
I am having a satisfying experience at this university	0.865
Overall, I am satisfied with this university	0.906
I feel good about this university, and I will recommend it to others	0.861
Student well-being (CR = 0.795)	
This university plays a very important role in my social well-being	0.850
This university plays an important role in my emotional well-being	0.790
This university plays an important role in enhancing the quality of my university life	0.844

Table 3 Statistics of discriminant validity – HTMT and AVE

Construct	CI	DI	GCP	LE	REP	SS	WB
CI	**0.594**						
DI	0.613	**0.502**					
GCP	0.602	0.432	**0.527**				
LE	0.794	0.708	0.638	**0.441**			
REP	0.68	0.696	0.711	0.769	**0.509**		
SS	0.557	0.584	0.671	0.746	0.719	**0.770**	
WB	0.515	0.481	0.586	0.569	0.586	0.787	**0.687**

The bold values on the diagonal represent average variance extracted (AVE)

CI cultural integration, *DI* destination image, *GCP* graduate career prospects, *LE* learning environment, *REP* reputation, *SS* student satisfaction, *WB* well-being

Table 4 Statistics of structural equation modeling – standardized coefficients

Hypothesized path	Model 1		Model 2	
	β	SD	β	SD
LE → SS	0.280***	0.053	0.283***	0.053
REP → SS	0.265***	0.052	0.266***	0.052
GCP → SS	0.209***	0.048	0.209***	0.048
CI → SS	0.012	0.052	0.009	0.053
DI → SS	0.111*	0.048	0.105*	0.048
SS → WB	0.653***	0.031	0.515***	0.055
LE → SS → WB	0.183***	0.036	0.146***	0.03
REP → SS → WB	0.173***	0.035	0.137***	0.031
GCP → SS → WB	0.137***	0.032	0.108***	0.027
CI → SS → WB	0.008	0.034	0.005	0.027
DI → SS → WB	0.073*	0.031	0.054*	0.026
LE → WB			0.003	0.061
REP → WB			0.066	0.065
GCP→ WB			0.096*	0.046
CI → WB			0.075	0.051
DI → WB			0.032	0.055
Construct	**Adjusted R ^{2}**		**Adjusted R ^{2}**	
SS	0.488		0.486	
WB	0.425		0.444	

***$p < 0.001$, *$p < 0.05$

satisfaction followed by university reputation and graduate career prospects. Destination image also matters, but its impact remains lower than other key attributes. It can be inferred that students are more concerned about a learning environment where they can find excellent teaching staff, research and learning resources, flexible courses, student support systems, and safety within the university premises. These findings are consistent with the extant literature (e.g., Yousaf et al., 2022), which suggested that the learning environment positively influences student satisfaction. Similar to other brands, students pay attention to a university's brand name, its past achievements, quality and standard of courses, and history. It is quite understandable because in this era of brand consciousness the reputation and prestige of a university offers social status and value to its students and graduates. Al Hassani and Wilkins (2022) earlier reported that university reputation serves as a key determinant of students' satisfaction.

Students are considerably vigilant about their career prospects after graduation from the university, no matter whether they are in the first year of their degree program or the final year. Students seek employment opportunities and employer recognition through the reflection of the brand strength of the university they are currently enrolled in. In this context, Liu et al. (2022) documented that students' perceptions of promising career prospects enhances their satisfaction.

Finally, the destination image with stable political environment and sense of security for students positively contributes to fostering student satisfaction. However, cultural integration does not augment student satisfaction. This constitutes an interesting finding as students encounter diverse cultures among the student and faculty body during their stay at the university. In the present context, it may be owing to students' cultural assimilation with diverse but overlapping cultural backgrounds.

Student satisfaction ingrained from university positioning directly contributes to augmenting student well-being. In fact, the impact of student satisfaction on student well-being is very strong, which shows that satisfying students is not only beneficial for the university, but it has great value for students' overall well-being. Our findings are consistent with existing literature in the realm of customer satisfaction and well-being, as noted by Yu et al. (2018). Specifically, in the context of student well-being, our results support the views of Soong and Maheepala (2023) that the university experience positively contributes to students' overall quality of life. These arguments are further validated by our findings of mediation analysis. The findings suggest that student satisfaction plays a bridging role between university positioning attributes and student well-being. It is surprising that we could not identify a significant association between university positioning attributes and student well-being. These findings contradict existing literature that implies a link between the learning environment and student well-being (Helou et al., 2019) and suggests that the destination image enhances tourists' well-being (Rohman et al., 2023). However, our study revealed that among the university positioning attributes, the attribute related to graduate career prospects promotes well-being among students. This finding aligns with the claims made by Hill et al. (2013) that students' career aspirations contribute to their overall sense of well-being.

The present study contributes to the body of knowledge in several ways. First, the present study is one of the preliminary attempts to delineate the role of university positioning attributes in achieving student satisfaction. The present study marks an initial attempt to simultaneously investigate the role of five distinct attributes of university positioning in fostering student satisfaction and outlines those attributes which play greater roles than others. Second, the present study is the first to incorporate university positioning attributes, student satisfaction, and well-being in an integrated model. Third, the current study is the first of its kind to investigate the impact of university positioning attributes on student well-being. This study provides novel evidence of the impact of five distinct university positioning attributes on enhancing student well-being. It underscores that university positioning attributes, with the exception of graduate career prospects, do not directly contribute to increasing student well-being.

In this context, the present study introduces an underlying mechanism that elucidates how university positioning attributes function to foster well-being among students, emphasizing the fundamental role of student satisfaction. Fourth, the present study examines the mediating role of student satisfaction in bridging the relationship of positioning attributes and student well-being. Finally, the present study marks the first attempt to investigate university positioning attributes in the context of Oman's higher education sector. Oman, as a small country in the gulf region, remains largely unknown to rest of the world. Although Oman's higher education sector is flourishing and some of its universities are accrediting their programs with international accreditation agencies, it remains far away from the limelight. Our study enhances academicians' understanding about Oman's higher education sector by delineating relevant university positioning attributes and how these attributes play a role in augmenting student satisfaction and well-being.

Managerial implications

The present study offers several managerial implications for university administration, marketing and brand managers, and academic regulatory/accreditation bodies. First, the university administration may emphasize providing a conducive learning environment to their students. The administration may focus on recruiting highly accomplished faculty and researchers because students perceive teaching excellence and research resources to be key components of their learning environment. In addition, the provision of student support systems, physical facilities, and availability of flexible courses by the university administration may be the core preferences of university administration to achieve student satisfaction and well-being. The university administration's endeavors to offer an enabling learning environment can be capitalized on by marketing and brand managers of the universities to better position the university among potential students and employers. Marketing and brand managers may use testimonials of highly satisfied students to enhance student enrollment and build university reputation in the target market. It will also help in creating a positive brand image and favorable positioning of the university.

The university administration's efforts in providing quality education and establishing high learning standards may also build the university's recognition factor among potential employers, which will enhance university graduates' career prospects among those employers. The university may also focus on establishing entrepreneurship incubation centers to enable graduates to initiate entrepreneurial ventures. It may help students to think beyond seeking a job following graduation. Students' entrepreneurial training and skill development may encourage them to tap into ever-increasing market demand through new business startups. The

university administration, marketing and brand managers may use such initiatives to build the university's image in the national and international market to attract more students. Finally, our study offers valuable insights in the context of Oman's emerging and competitive higher education landscape. Higher education institutions in Oman are striving to improve the quality of their education and competitive standing in the market through accreditation of their programs (Al-Amri et al., 2020). However, such efforts may not yield desired results unless universities improve their positioning in the minds of potential students and other stakeholders, including parents, employers, and government bodies. Our study shows that universities may improve their positioning by providing a conducive learning environment, improving their reputation using dedicated communication, and enhancing students' career prospects by engaging with employers and government bodies.

The extant literature indicates that students are suffering from stress, anxiety, and ill-being (Gan & Yuen Ling, 2019; Travis & Bunde, 2022). Therefore, university administration, academic regulatory bodies, and accreditation agencies may be more vigilant about such issues and encourage actions that contribute toward student well-being. In fact, student well-being should be at the forefront of all the academic regulatory bodies, accreditation agencies and university administration because the main purpose of all education is to improve the well-being of students. In this regard, the present study finds that university positioning attributes positively contribute to student well-being via student satisfaction. Therefore, the academic regulatory bodies and accreditation agencies may impel universities to offer conducive learning environments, establish student support systems, provide flexible courses, enhance student security at campuses, build inclusive environments, and provide state-of-the-art equipment for curricular and extracurricular activities.

Limitations of the study and future research direction

The present study also has some limitations. For instance, this study collected data from currently enrolled students and measured their satisfaction and well-being in relation to university positioning. However, the university positioning may also influence the enrollment intentions of prospective students; therefore, future research may consider collecting data from potential students who are considering enrolling in a university to understand how university positioning attributes impact their enrollment intentions. Similarly, potential students may also be influenced by a university's positioning in the online context, e.g., website, social media pages, blogs, and vlogs. Future

research may examine the impact of a university's efforts to build their positioning in the online context of students' enrollment intentions.

The present study incorporates well-being and student satisfaction as outcome variables of university positioning attributes; future research may investigate other outcome variables such as student engagement, knowledge sharing behavior among students, collaborative learning and students' entrepreneurial intentions. The importance of student well-being is steadily increasing, underscoring its enduring impact on students' lives, and warranting further research to promote their overall welfare. Future research endeavors could explore institutional factors, including counseling services, mental health awareness initiatives and training programs, financial support mechanisms, and the influence of academic pressure on student well-being. The evolving paradigm of the "new normal" in university education, characterized by a blend of online and offline learning practices, may also contribute to students' overall well-being. Universities, as part of their holistic approach, offer a diverse array of extracurricular activities that have the potential to significantly impact students' well-being. Additionally, investigating the dynamics of teacher–student relationships and peer-to-peer interactions could be crucial in understanding their roles in shaping students' overall well-being.

Conclusion

This study investigated the role of university positioning attributes in enhancing student satisfaction and well-being in the context of the highly competitive higher education landscape in Oman. Our findings revealed that four key university positioning attributes – (i) learning environment, (ii) reputation, (iii) graduate career prospects, and (iv) destination image – positively influence student satisfaction and well-being. However, cultural integration as a positioning attribute did not significantly impact student satisfaction. These findings offer valuable theoretical and practical implications for various stakeholders. Theoretically, this study marks the first attempt to examine the role of university positioning attributes in fostering student satisfaction and well-being. These findings are also helpful for decision-makers and marketing professionals. For instance, regulatory bodies and accreditation agencies may focus on these attributes when evaluating university positioning. Marketing managers and brand strategists can leverage these insights to develop targeted communication strategies while emphasizing the attributes that underpin student satisfaction and well-being.

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TITLE	SOURCE TITLE
2. Defining student success as a multidimensional concept: a scoping review (2025)	International Journal of Educational Research Open (Article from : Elsevier Ltd)

Defining student success as a multidimensional concept: A scoping review

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ARTICLE INFO

ABSTRACT

Student success is a critically important concept in educational assessment and research, yet a comprehensive synthesis of its defining elements remains absent. To address this gap, a scoping review was conducted, identifying 274 peer-reviewed studies published between 2011 and 2022. From these studies, data pertaining to conceptualizations of student success and related factors were extracted and analyzed using inductive coding to uncover key themes and recurring patterns. The review culminated in a comprehensive definition of student success, encompassing five core dimensions: persistence and academic progress, academic performance, attainment of learning objectives, satisfaction, and career success. Additionally, four distinct categories of factors related to student success were identified, including background and pre-college experiences, psychosocial capital, educational experiences, and institutional factors. These findings provide grounds for moving beyond traditional narrow interpretations of student success by acknowledging its multidimensional nature. This understanding of student success' multidimensionality is essential to equip educational institutions in better preparing students to navigate the complexities of contemporary societal challenges, leading to the development of more well-rounded and successful graduates.

1. Introduction

Student success is firmly cemented as a priority in higher education. Consequently, student success serves as a focal point for numerous initiatives aimed at enhancing the student experience. Examples of such efforts are implementing curriculum changes, offering student success programs, and promoting staff development opportunities (e.g., Bowering et al., 2017; Love et al., 2021; Rosser-Majors et al., 2022). Most, if not all, of these efforts are infused with evidence resulting from educational research, much of which is inspired by seminal theoretical models that have student success at their heart (e.g., Bean & Metzner, 1985; Cabrera et al., 1993; Pascarella, 1980; Tinto, 1975). One would expect that decades of educational research have resulted in a consensus on what student success and what the state of the art regarding student success is, but that does not seem to be the case (Tinto & Pusser, 2006; York et al., 2015). In fact, student success is associated with a smorgasbord of conceptualizations and fragmented evidence. Most of this evidence is undoubtedly valuable, but its fragmented nature prevents educational experts from making undisputed decisions on how to spend their resources to optimally benefit students.

Further complicating the issue is the fact that student success is frequently conflated with another catch-all phrase: academic success. York and colleagues define academic success as "inclusive of academic achievement, attainment of learning objectives, acquisition of desired skills and competencies, satisfaction, persistence, and post-college performance" (York et al., 2015, p. 5). They argue that while student success and academic success seem to be used interchangeably, academic success primarily pertains to outcomes directly related to educational experiences. In contrast, they view student success as a more comprehensive construct that not only encompasses academic success but also extends beyond it to include a wider array of outcomes. Unfortunately, clarifying what these outcomes could be and thereby contributing to a definition of student success goes beyond the scope of their work. However, clarifying and defining student success separate from academic success is important to capture a broader range of factors that influence students' overall development and long-term wellbeing, thereby enabling institutions to design more holistic support systems and policies.

Amid this conceptual ambiguity, one definition of student success has gained traction within educational research. In their narrative

review of contemporary research trends on student success, Kuh and colleagues define student success as "academic achievement, engagement in educationally purposeful activities, satisfaction, acquisition of desired knowledge, skills and competencies, persistence, attainment of educational objectives, and post college performance" (Kuh et al., 2006, p. 7). This seminal definition, now nearly twenty years old, continues to inspire research into (factors related to) student success, despite its unclear foundation. That is, Kuh and colleagues (2006) arrived at their working definition by selecting aspects from sources that they considered relevant. However, because the primary aim of their work was not to define student success, they did not clearly justify their selection of sources. As a result, it is difficult to assess the validity of their definition.

One way to get an impression of the validity of a definition is by examining the degree to which the definition is subjectively regarded as covering the construct(s) it intends to cover (i.e., face validity). At face value, there seem to be a few problems with the definition posited by Kuh et al. (2006) when regarded in light of the current educational climate. The two lead authors themselves, as well as several others, have suggested numerous improvements. For example, ten years after the publication of their seminal definition of student success, Kinzie and Kuh (2017) noted that the definition should be updated in line with current aspirations regarding educational equity and equality. Around the same time, York et al. (2015) proposed to narrow Kuh and colleagues' (2006) definition by omitting engagement from it. They argue that engagement is a mediating variable for the other aspects of the definition and, therefore, should not be part of the definition itself. These concerns about the validity of the current widely accepted definition of student success raised by experts in the field support a call for an updated and well-structured definition.

The scoping review presented in this paper aims to contribute to the ongoing discussion by 1) defining student success based on its conceptualizations in educational research and 2) identifying factors related to student success. The resulting definition will reflect the status quo of how student success is conceptualized by authors who have published about the subject and can therefore be assumed to be well-informed about the topic. It is likely that the definition will, to some extent, replicate the definitions proposed by Kuh et al. (2006) for student success and York et al. (2015) for academic success. This alignment can reinforce the reliability and validity of both the previous and new conceptualizations, while also offering insight into how understandings of student success may have evolved over time. In addition, this review sheds light on trends in which factors are considered relevant in relation to student success or specific dimensions thereof. Identifying these trends not only supports a more comprehensive understanding of student success, but also helps pinpoint potential gaps in the existing literature.

To explore the resulting definition in greater depth, this review examines to what extent it varies depending on perspective. Three perspectives are considered: stakeholder, temporal, and geographical. Regarding the stakeholder perspective, this review aims to investigate how definitions of student success differ among groups such as students, faculty members, and administrators. It is expected that, for example, a student's definition of student success will differ from that of faculty members (York et al., 2015). Regarding the temporal perspective, this review aims to uncover potential changes in conceptualizations of student success over time. This follows the suggestion by Kinzie and Kuh (2017) that such changes might, or even should, occur. Finally, the geographical perspective is explored, because seminal works on student success seem to originate mostly from the United States and views on student success could differ per country or culture. If conceptualizations of student success differ based on perspective, we also expect perspectival differences in the factors identified that relate to student success. The results of this review can assist educational practitioners, policymakers, and researchers in improving their assessment of the student experience by adopting a definition of student success that includes more than just academic achievement and acknowledges different

perspectives on what student success means.

2. Method

This scoping review was developed and performed following the Preferred Reporting Items for Systematic Reviews and Meta-analysis guideline extension for scoping reviews (PRISMA-ScR; Tricco et al., 2018). The review protocol is publicly available (https://osf.io/bnhjf/).

2.1. Literature search

In an effort to yield a broad range of relevant peer-reviewed literature, published in English from 2011 to mid 2022, multiple databases were searched: Educational Resources Information Center (ERIC), PsychINFO, and Web of Science. We searched for the keyword combination of *student success* and *higher education*. The exact search string is reported in the review protocol (https://osf.io/bnhjf/).

The literature search yielded 1139 journal articles, book chapters, essays, and dissertations/theses. Fig. 1 details the results from the search and the screening procedure. After removing 305 duplicates, the abstracts of the remaining 834 publications were reviewed to determine whether a full manuscript should be retrieved (review round 1). Eligibility of the 834 publications was checked by the first two authors of the present paper in a double-blind process using Rayyan AI software (Ouzzani et al., 2016). Afterwards, conflicting decisions were discussed in person until full agreement was reached. In total, 411 full texts were retrieved and further reviewed for eligibility (review round 2). In this review round, nearly twenty percent of full texts were reviewed by multiple authors of the present paper. A complete overview of all 834 publications and eligibility decisions is available (https://osf.io/bnhjf/).

In both review rounds, six criteria were applied in the exclusion of publications based on abstract or full text. First, publications were excluded if student success was not assessed in the presented study. This mainly concerned studies that focused on something that was theorized to relate to student success (without assessing that relation), such as team building or transfer programs. Second, publications were excluded if they were too course- or field-specific, meaning that they would provide limited insight into what student success is. Publications were regarded as too specific if the input or outcome of the presented study was either field-specific (e.g., engineering skills or knowledge of algebra) or if the outcome was operationalized as a 'pass' or 'fail' on a single course. Third, publications that did not concern the educational level of interest, i.e., higher education, were excluded. Fourth, to ensure that we included only peer-reviewed publications based on empirical evidence, publications were excluded if they were reported as a chapter of a book, an editorial note, an essay, a report, or an opinion piece. Fifth, publications were excluded if they did not focus on students' success but rather the success of other individuals, such as teachers, librarians, or student counsellors. Finally, publications were excluded if further investigation indicated that they were published prior to 2011, meaning that they were published outside the range of interest for this study.

2.2. Data extraction and analysis

A total of 274 studies were included for data extraction. A complete list of included studies is provided (Appendix A). The studies spanned 18 national contexts, with the majority situated in North America (incl. USA: $n = 209$; Canada: $n = 13$), followed by Europe (incl. UK: $n = 6$; Netherlands: $n = 5$; Germany: $n = 3$), and Oceania (Australia: $n = 11$; New Zealand: $n = 4$). The studies were published in 161 journals reflecting a wide variety of scopes and foci, with some emphasizing specific types of higher education institutions and others focused on specific themes or fields of education. For example, 25 of the 274 studies were published in journals specifically focused on community college research, with 16 appearing in Community College Journal of Research. Of the studies published in thematic journals, 22 studies were published
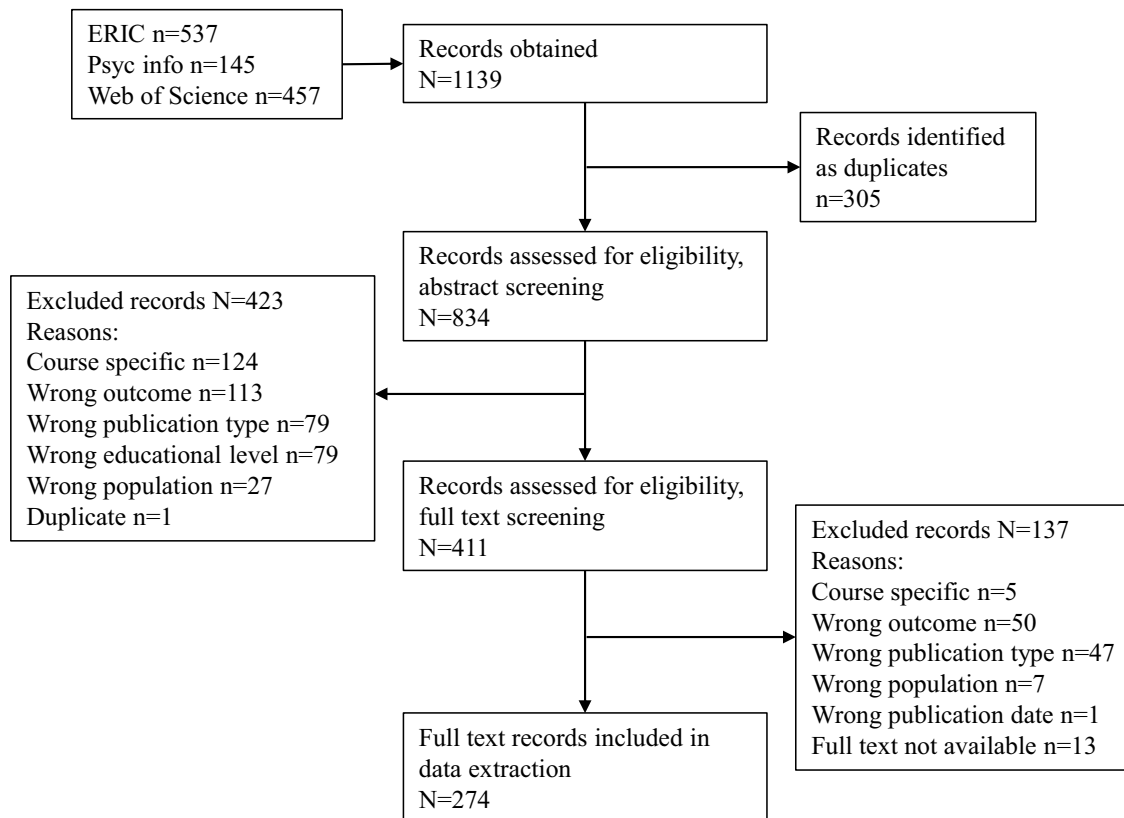
```
ERIC n=537          ──▶   Records obtained
Psyc info n=145           N=1139
Web of Science n=457                    │
                                        │
                                        ▼
                                              ──▶   Records identified
                                                    as duplicates
                                                    n=305

                          Records assessed for eligibility,
                          abstract screening
                          N=834
                                        │
Excluded records N=423   ◀──────────────┤
Reasons:                                │
Course specific n=124                   ▼
Wrong outcome n=113       Records assessed for eligibility,
Wrong publication type n=79   full text screening
Wrong educational level n=79   N=411                    ──▶   Excluded records N=137
Wrong population n=27                    │                     Reasons:
Duplicate n=1                           │                     Course specific n=5
                                        ▼                     Wrong outcome n=50
                          Full text records included in       Wrong publication type n=47
                          data extraction                     Wrong population n=7
                          N=274                               Wrong publication date n=1
                                                              Full text not available n=13
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Fig. 1. Flow chart for data selection.

in journals specifically focused on teaching, including 4 in Journal of the Scholarship of Teaching and Learning and 3 in Teaching of Psychology. Additionally, 18 studies were published in journals focusing on library services, with 7 appearing in College & Research Libraries; an additional 11 studies were published in a journal dedicated to student retention: Journal of College Student Retention: Research, Theory & Practise. Of the studies published in journals focusing on a specific field of education, notably 15 articles were published in journals related to nursing, including 4 in the Journal of Nursing Education and 3 in Nurse Educator. Together the 161 journals reflect a mix of general education research, institutional research, and discipline-specific publications, showcasing the depth and range of scholarly inquiry in the field of higher education.

From the 274 selected studies, information pertinent to answering the research objectives was extracted, including conceptualization of student success, factors related to student success, point of view (stakeholder perspective), year (temporal perspective), and country (geographical perspective) of publication. In our investigation regarding the temporal perspective, we omit papers published in 2022 because our study does not include papers published after June 7th (date of search) of that year.

To create an overview of how student success was defined in the 274 publications, the conceptualizations from these were categorized through inductive coding. That is, categories were determined by the first and third authors through iterative cycles of grouping conceptualizations until a set of overarching yet distinguishable categories of substantial sizes (i.e., present in at least 5 % of all publications) was found, and both authors fully agreed. The resulting categories represent dimensions of student success.

To assess variation and consistency across contexts, we cross-referenced conceptualization categories with point of view (stakeholder perspective), year of publication (temporal perspective) and country (geographical perspective) of publication.

In our effort to identify factors related to student success, factors identified in the 274 publications were summarized through inductive coding, resulting in categories of factors. The process was identical to the process performed to summarize the definitions of student success. To investigate whether type of identified factors depends on the stakeholders included, time and/or geographical region, we cross-referenced type of factors with point of view (stakeholder perspective), year of publication (temporal perspective), and country (geographical perspective) of publication.

The included studies varied in several key areas, including research design, analytical focus, and conceptual perspectives on student success. Some relied on large-scale quantitative datasets, while others employed in-depth qualitative case studies or mixed methods approaches. Perspectives on student success also varied, with some research emphasizing individual-level factors such as student behaviors and attributes, and others considering institutional or systemic outcomes. Additionally, the purpose behind defining student success ranged from informing institutional accountability and performance metrics to exploring themes of equity, inclusion, and student wellbeing. These variations across studies are not incidental but closely linked to the conceptualization of student success itself, which often informs, and may at times be shaped by, the methodological and analytical choices researchers make. This reciprocal relationship highlights the complexity of synthesizing findings across diverse studies. To address this complexity, our scoping review employed inductive coding to broadly map conceptualizations, allowing for the inclusion of diverse perspectives. By interpreting conceptual differences considering each study's disciplinary orientation, aims, and context, we were able to integrate these variations into a coherent and inclusive synthesis. The full dataset, including coded conceptualizations and associated factors, is openly accessible (https://osf.io/bnhjf/).

3. Results

We begin this section by presenting a definition and conceptual model of student success, derived from the analysis of the 274 studies selected for review. Additionally, we discuss perspectival differences observed in conceptualizations retrieved from those studies. Next, we present factors related to student success, including perspectival differences in these factors. Together these results represent what student success is and what relevant related factors are, according to experts. The results presented here are available in a condensed format as an infographic (https://osf.io/bnhjf/).

3.1. Conceptualizing student success

The primary purpose of this study was to define student success. Based on conceptualizations of student success found in the 274 selected studies, we define student success as inclusive of persistence and academic progress, academic performance, attainment of learning objectives, satisfaction, and career success. Fig. 2 depicts the corresponding model. Below we describe the five dimensions of student success in order of prevalence, arranged from most common to least common.

3.1.1. Persistence and academic progress

Persistence and academic progress refers to students' continued pursuit of and progress towards their educational goal, be it within a program or across multiple programs or institutions. More specifically, persistence captures whether a student continues to pursue their educational journey, whether it be from course to course, semester to semester, year to year, or through transfer to another program or institution. Academic progress, on the other hand, refers to milestones reached in the educational journey, typically captured with progress indicators such as credit points accumulated over time.

Persistence and academic progress was reflected in nearly seventy percent ($n = 189$; 69.0 %) of the studies included in our review. Within this subset of studies, student success conceptualizations more commonly also incorporated aspects from student success dimension academic performance ($n = 91$; 48.1 %) than from student success dimensions attainment of learning objective ($n = 36$; 19.0 %), career success ($n = 15$; 7.9 %), and satisfaction ($n = 12$; 6.3 %).
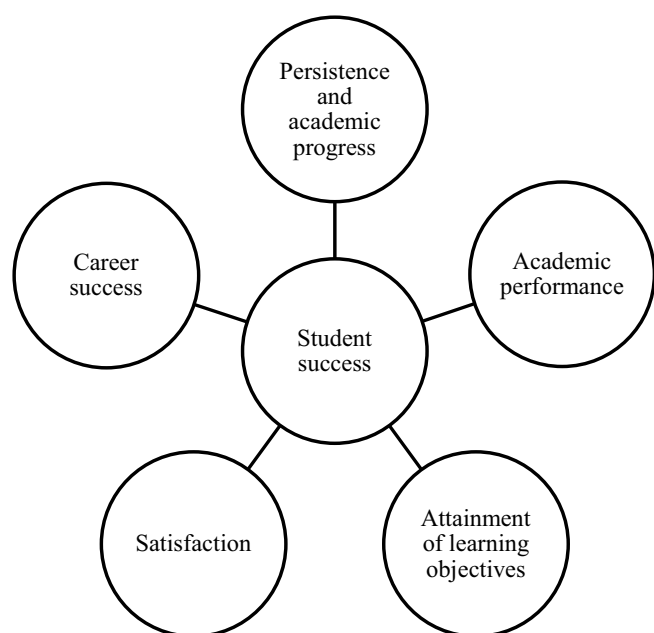

Fig. 2. A multidimensional conceptual model of student success.

3.1.2. Academic performance

Academic performance refers to students' results in their academic endeavors within a course, across multiple courses, semesters, years, or programs, captured through indices such as grades, pass/fail rates, rank (relative to other students), and students' grade point average (GPA). Note that indices such as grades directly indicate students' performance ability; they do not necessarily reflect learning or attainment of learning goals, which is included separately in our proposed definition of student success.

Academic performance was considered in approximately fifty-five percent ($n = 153$; 55.8 %) of the studies included in our review. Within this subset of studies, student success conceptualizations more commonly also incorporated aspects from student success dimension persistence and academic progress ($n = 91$; 59.5 %) than from student success dimensions learning objectives ($n = 37$; 24.2 %), satisfaction ($n = 19$; 12.4 %), and career success ($n = 12$; 7.8 %).

3.1.3. Attainment of learning objectives

Attainment of learning objectives refers to students' attained knowledge, understanding, behaviors, and skills that they are expected to have acquired within certain educational units, such as a course, a semester, a year, or an entire educational program. We found a distinction between three types of conceptualizations. The first included elements of learning gains, i.e., capacities, knowledge, skills, values, and dispositions. The second type included elements of students' inner development, such as attitudes or behavior related to students' cognitive, ethical/moral, emotional, social, and spiritual development. The third type of definition included elements of students' engagement (i.e., interest, attention, etc.), extending to the level of motivation displayed to be successful in education and life in general.

Attainment of learning objectives was reflected in approximately twenty-five percent ($n = 72$; 26.3 %) of all studies included in this review. Within this subset of studies, student success conceptualizations more commonly also incorporated aspects from student success dimensions academic performance ($n = 37$; 51.4 %) and persistence and academic progress ($n = 36$; 50.0 %) than from student success dimensions satisfaction ($n = 16$; 22.2 %) and career success ($n = 15$; 20.8 %).

3.1.4. Satisfaction

Satisfaction refers to students' perceptions of educational and life goal attainment, resulting from their experiences with and impressions of, for example, services and facilities provided by educational institutions and how well their learning journey prepared them for life outside the educational system. To clarify, *satisfaction* differs from *attainment of learning objectives* in the sense that *satisfaction* relies on what each individual student regards as relevant abilities and behaviors in education and life; while *attainment of learning objectives* is based on those abilities and behaviors considered relevant by those who design (parts of) educational programs.

Satisfaction was represented in approximately ten percent ($n = 29$; 10.6 %) of the studies included in this review. Within this subset of studies, student success conceptualizations more commonly also incorporated aspects from student success dimension academic performance ($n = 19$; 65.5 %) than from student success dimensions attainment of learning objectives ($n = 16$; 55.2 %), persistence and academic progress ($n = 12$; 41.4 %) and career success ($n = 6$; 20.7 %).

3.1.5. Career success

Career success refers to students' experiences after graduation, such as the experience of achieving meaningful professional goals and job attainment. These experiences are typically captured through indices such as time to employment after graduation, time between jobs, active registration as a practitioner, salary, and leadership success.

Career success was reflected in under ten percent ($n = 22$; 8.0 %) of the student success conceptualizations found in the studies included in

this review. Within this subset of studies, student success conceptualizations more commonly also incorporated aspects from student success dimensions persistence and academic progress ($n = 15$; 68.2 %) and attainment of learning objectives ($n = 15$; 68.2 %) than from student success dimensions academic performance ($n = 12$; 54.5 %) or satisfaction ($n = 6$; 27.3 %).

3.2. Student success from different perspectives

Next, we examined perspectival differences in the student success conceptualizations found in the 274 selected studies. We focused on the temporal perspective, the geographical perspective, and the stakeholder perspective.

3.2.1. Temporal perspective

Table 1 shows the prevalence of the five dimensions of student success contrasted to the year of publication of the studies. Two findings stand out. First, our search yielded a sudden increase in publications meeting our criteria from 2017 on. In fact, from 2017 on the annual number of publications was on average 2.6 times higher than in the years up until 2016. Second, after 2017 a decrease is noticeable in the relative prevalence of student success dimensions attainment of learning objectives and satisfaction, with factors of approximately 1.5 and 1.8, respectively. Yet, the annual relative prevalence of student success dimensions academic performance, persistence and academic progress, and career success remained fairly stable when comparing their prevalence from up until 2016 to their prevalence from 2017 on.

3.2.2. Geographical perspective

Table 2 shows the prevalence of the five student success dimensions contrasted to the geographical region that the published studies pertained to. There are four notable findings. First, the number of studies pertaining to North America far exceeds that of the other regions. Second, there is a general emphasis on two dimensions of student success: academic performance, and persistence and academic progress. Third, in studies pertaining to Africa, Oceania, and Asia, there is additional emphasis on attainment of learning objectives. Fourth, studies pertaining to Europe stand out because student success dimensions of satisfaction and career success are not considered at all.

3.2.3. Stakeholder perspective

We aimed to provide insight into how different stakeholder groups, such as students, faculty, policy makers, educational researchers, and employers, define student success. An overwhelming majority of the 274 studies selected for this study reflected the educational/institutional researcher perspective or contained insufficient information to determine the perspective represented. Consequently, the body of included

studies leaves unresolved how student success is conceptualized by other key stakeholders.

3.3. Factors related to student success

The second purpose of this study was to identify factors that are considered relevant in relation to (dimensions of) student success. The factors that were considered in the 274 selected studies can be grouped into four types: three directly pertaining to student characteristics (1. background and pre-college experiences, 2. psychosocial capital, and 3. educational experiences) and one pertaining to the educational environment (4. institutional factors). Fig. 3 provides insight into the extent to which the four types of factors are considered per dimension of student success.

3.3.1. Background and pre-college experiences

Background and pre-college experiences refer to demographic characteristics and students' (educational) life experiences. Demographic factors are captured by indices like age, gender, socioeconomic status, and cultural identifiers such as race, ethnicity, immigration status, identity, first-generation status. Pre-college experience factors refer to factors that indicate college preparation or readiness, such as indices of students' inherent talents and learned abilities prior to entering higher education (e.g., physical fitness, prior domain knowledge, language proficiency), their prior academic experiences (e.g., high school GPA, type of high school program), attendance at (pre-)college programs prior to entering higher education (e.g., early college credits, transfer status, prior graduate degree, use of orientation services), and entry and admission experiences (e.g., admission scores, use of pre-matriculation resources).

Student background and pre-college experience factors were considered in approximately thirty percent ($n = 86$; 31.4 %) of all papers included in this study. Background and pre-college experience factors were more commonly considered within studies encompassing student success dimensions academic performance ($n = 55$; 35.9 %) or persistence and academic progress ($n = 64$; 33.9 %) than in studies including student success dimensions career success ($n = 6$; 27.3), attainment of learning objectives ($n = 15$; 20.8 %) or satisfaction ($n = 6$; 20.7 %). Similar patterns were found when we considered studies with background factors and studies with pre-college experience factors separately.

3.3.2. Psychosocial capital

Psychosocial capital factors relate to students' psychological and social capital. Psychosocial capital factors are indicative of the degree to which students have developed positive psychological characteristics (e.g., emotional stability, mental health, study behavior, mindset) and the

Table 1

Temporal perspective on student success: prevalence of student success dimensions in publications contrasted with year of publication.

Year of publication[a]	Publications N	Student success dimensions				
		Academic performance N (%[b])	Persistence and academic progress N (%)	Attainment of learning objectives N (%)	Satisfaction N (%)	Career success N (%)
2011	11	4 (36.4)	9 (81.8)	4 (36.4)	3 (27.3)	1 (9.1)
2012	13	9 (69.2)	10 (76.9)	3 (23.1)	1 (7.7)	0 (0.0)
2013	12	8 (66.7)	10 (83.3)	3 (25.0)	2 (16.7)	2 (16.7)
2014	17	9 (52.9)	13 (76.5)	6 (35.3)	2 (11.8)	3 (17.6)
2015	15	8 (53.3)	8 (53.3)	6 (40.0)	1 (6.7)	0 (0.0)
2016	14	9 (64.3)	9 (64.3)	6 (42.9)	3 (21.4)	1 (7.1)
2017	35	21 (60.0)	26 (74.3)	5 (14.3)	2 (5.7)	1 (2.9)
2018	30	21 (70.0)	14 (46.7)	8 (26.7)	2 (6.7)	2 (6.7)
2019	38	18 (47.4)	27 (71.1)	10 (26.3)	3 (7.9)	4 (10.5)
2020	36	20 (55.6)	28 (77.8)	9 (25.0)	4 (11.1)	5 (13.9)
2021	38	19 (50.0)	26 (68.4)	8 (21.1)	4 (10.5)	3 (7.9)

Note.

[a] the year 2022 was omitted from this overview, because our study does not include papers published after June 7th of that year.

[b] number of publications relative to the included publications in this review within the same year.

Table 2

Geographical perspective on student success: prevalence of student success dimensions in publications contrasted with geographical region of data collection.

Geographic region	Publications *N*	Student success dimensions				
		Academic performance *N* (%[a])	Persistence and academic progress *N* (%)	Attainment of learning objectives *N* (%)	Satisfaction *N* (%)	Career success *N* (%)
Africa	11	5 (45.5)	9 (81.8)	5 (45.5)	1 (9.1)	4 (36.4)
North America	224	125 (55.8)	159 (71.0)	53 (23.7)	23 (10.3)	13 (5.8)
Europe	20	11 (55.0)	12 (60.0)	2 (10.0)	0 (0.0)	0 (0.0)
Oceania	15	9 (60.0)	8 (53.3)	9 (60.0)	2 (13.3)	3 (20.0)
Asia	4	3 (75.0)	1 (25.0)	3 (75.0)	3 (75.0)	2 (50.0)

Note.

[a] percentage of publications relative to the total amount of publications within the same region.

Fig. 3. Four types of factors considered within studies pertaining to five dimensions of student success.
Note. The percentages indicate prevalence of factors within student success dimension. Thicker arrows indicate higher percentages.

degree to which they feel socially supported by people in their direct environment (e.g., family, peers, cultural or social communities, communities of practice, educational or support staff).

Psychosocial capital factors were considered in over forty-five percent (*n* = 128; 46.7 %) of all papers included in this study. Psychosocial capital factors were more commonly considered within studies encompassing student success dimensions satisfaction (*n* = 21; 72.4 %), attainment of learning objectives (*n* = 46; 63.9 %), or career success (*n* = 13; 59.1 %) than in studies including student success dimensions academic performance (*n* = 72; 47.1) or persistence and academic progress (*n* = 76; 40.2 %). Similar patterns were found when we considered studies with psychological factors and studies with perceived support factors separately.

3.3.3. Educational experiences

Educational experiences refer to the actual and perceived curriculum and students' educational outcomes. Educational experience factors include factors related to teaching approaches and methods (e.g., pedagogies, academic interactions, forms of feedback), physical classroom (e.g., seating location, class size, online or on campus), curriculum (e.g.,

program flexibility, course load, exam scheduling), and outcomes (e.g. GPA, behaviors, abilities, career success, professional development).

Factors related to educational experiences were considered in over twenty-five percent (*n* = 75; 27.4 %) of all papers included in this study. Educational experience factors were more commonly considered within studies encompassing student success dimensions career success (*n* = 12; 54.5 %) or attainment of learning objectives (*n* = 24; 33.3 %) than in studies including aspects of student success dimensions satisfaction (*n* = 9; 31.0 %), academic performance (*n* = 38; 24.8 %), or persistence and academic progress (*n* = 46; 24.3 %). Roughly similar patterns were found when we considered studies with factors on teaching approaches and methods and studies with outcome factors separately. We did not investigate patterns for studies with classroom format and curriculum factors as they did not occur often enough to allow meaningful analysis.

3.3.4. Institutional factors

Institutional factors refer to students' experiences with institutional facilities and support. We found three types of institutional factors in the studies included in our review. The first category concerns faculty-related factors, meaning factors related to faculty characteristics (e.g.,

racial/ethnic diversity) and faculty competencies and attitudes (e.g., ability to identify at-risk students or awareness of accessibility differences between students). The second category concerns factors related to campus services, such as access to and use of (learning) material and spaces (e.g., library use, open educational resources, student housing), academic support (e.g., academic coaching, remediation courses), social support (e.g., accommodation and immigration support, residence heads, institutional support for minorities), and financial and career support (e.g., scholarship aid, employment support). The third and final category of factors is related to institutional policies regarding admission and inclusion (e.g., type of enrollment system and requirements), institutional characteristics (e.g., vision, mission, structure, culture, and student-to-staff ratio), and external collaboration (e.g., inter-institutional collaboration, partnership programs).

Institutional factors were considered in approximately forty-five percent ($n = 125$; 45.6 %) of all papers included in this study. Institutional factors were most commonly considered within studies encompassing student success dimension persistence and academic progress ($n = 103$; 54.5 %). Among studies including aspects of the other student success dimensions, institutional factors were included relatively less but equally frequently (career success: $n = 10$, 45.5 %; satisfaction: $n = 13$, 44.8 %; attainment of learning objectives: $n = 30$, 41.7 %; academic performance: $n = 62$, 40.5 %). Similar patterns were found when we considered studies with factors related to faculty and studies with factors related to campus support separately. The pattern within studies that included factors related to policy was slightly different. Policy factors were related relatively more often to student success definitions that included elements of satisfaction and career success than to definitions that included any of the other dimensions of student success.

3.4. Student success factors and different perspectives

Subsequently, we examined perspectival differences regarding factors related to student success considered in the 274 selected studies.

3.4.1. Temporal perspective

Table 3 shows the prevalence of the five types of factors contrasted to the year of publication of the studies. There is one notable finding: psychosocial and educational factors are considered relatively less often in studies published between 2017 and 2021 compared to those published earlier.

3.4.2. Geographical perspective

Table 4 shows the prevalence of the five types of factors contrasted to the geographical region that the published studies pertained to. There is a general emphasis on factors related to psychosocial capital, factors related to background and pre-college educational experiences, and

institutional factors. Yet, compared to studies pertaining to Africa, North America, and Oceania, Europe stands out because of relative over-representation of background and pre-college experience factors and relative underrepresentation of institutional factors.

3.4.3. Stakeholder perspective

We aimed to provide insight into what factors are considered in relation to student success by different stakeholder groups, but as previously explained, the overwhelming majority of the 274 studies selected for this study represented the educational/institutional researcher perspective or did not contain enough information to determine what perspective was included. As a result, there was too little variation in our dataset to draw meaningful conclusions.

4. Discussion

This study is perhaps the only and definitely the largest review study to date addressing the definition of student success. In this study, empirical data from 274 studies were used to define student success and to identify related factors, including temporal and geographical differences therein. The resulting definition reflects the status quo of how student success is conceptualised in literature and what factors are considered relevant in relation to student success. Based on our findings, we propose to define student success as inclusive of academic performance, attainment of learning objectives, persistence and academic progress, satisfaction, and career success. The main strength of this definition is that it does justice to the conceptual complexity of student success by being inclusive of a multitude of nuanced concepts that have been attributed to student success throughout the years. Yet, it also implicitly counteracts the status quo in current educational research that focuses predominantly – and often exclusively – on narrow definitions of student success: academic performance or achievement often conceptualized as grades or completion rates and derivatives thereof. Worse still is that the majority of these conceptualizations remain a black box, as curricula, testing and grading practices differ greatly between institutions, and yet they are often not (well) described in research reports, which does not bode well for the generalizability of findings. As a result, the current body of knowledge on student success is irrefutably severely limited. While studies focusing on narrow definitions of student success can be very valuable, using the comprehensive definition of student success suggested here will enhance knowledge on student success. Even if researchers merely use it to contextualize their findings based on specific aspects of student success within the broader concept, it will contribute to a better understanding and a more nuanced perspective.

Responding to the emphasis on academic outcomes in current educational discourse on student success, the proposed definition of the concept includes three such elements: performance, attainment of

Table 3

Temporal perspective on student success: prevalence of factors related to student success in publications contrasted with year of publication.

Year of publication[a]	Publications *N*	Factors related to student success				
		Background *N* (%[b])	Psychosocial *N* (%)	Institutional *N* (%)	Education *N* (%)	External *N* (%)
2011	11	4 (36.4)	3 (27.3)	9 (81.8)	5 (45.5)	1 (9.1)
2012	13	3 (23.1)	5 (38.5)	5 (38.5)	4 (30.8)	0 (0.0)
2013	12	4 (33.3)	7 (58.3)	6 (50.0)	2 (16.7)	1 (8.3)
2014	17	6 (35.3)	12 (70.6)	10 (58.8)	6 (35.3)	0 (0.0)
2015	15	5 (33.3)	6 (40.0)	5 (33.3)	6 (40.0)	0 (0.0)
2016	14	6 (42.9)	10 (71.4)	4 (28.6)	6 (42.9)	0 (0.0)
2017	35	10 (28.6)	20 (57.1)	15 (42.9)	8 (22.9)	1 (2.9)
2018	30	15 (50.0)	15 (50.0)	10 (33.3)	10 (33.3)	2 (6.7)
2019	38	9 (23.7)	12 (31.6)	20 (52.6)	10 (26.3)	0 (0.0)
2020	36	9 (25.0)	15 (41.7)	17 (47.2)	7 (19.4)	1 (2.8)
2021	38	12 (31.6)	14 (36.8)	18 (47.4)	7 (18.4)	0 (0.0)

Note.

[a] the year 2022 was omitted from this overview, because our study does not include papers published after June 7th of that year.

[b] number of publications relative to the number of publications in the same year.

Table 4

Geographical perspective on student success: prevalence of factors related to student success in publications contrasted with geographical region of data collection.

Geographic region	N	Factors related to student success				
		Background N (%[a])	Psychosocial N (%)	Institutional N (%)	Education N (%)	External N (%)
Africa	11	4 (36.4)	7 (63.6)	6 (54.5)	2 (18.2)	1 (9.1)
North America	224	69 (30.8)	101 (45.1)	105 (46.9)	58 (25.9)	3 (1.3)
Europe	20	10 (50.0)	10 (50.0)	6 (30.0)	6 (30.0)	1 (5.0)
Oceania	15	2 (13.3)	7 (46.7)	7 (46.7)	8 (53.3)	2 (13.3)
Asia	4	1 (25.0)	3 (75.0)	1 (25.0)	1 (25.0)	0 (0.0)

Note.

[a] number of publications relative to the number of publications included from the same region.

learning objectives, and persistence and progress. Together they represent students' learning, performance ability, and continued pursuit of degree completion. We intentionally separate students' ability to meet performance criteria from their attainment of learning objectives to explicitly acknowledge that grades and derivatives thereof, although widely used as a proxy for the attainment of learning goals, only directly express students' test-taking ability. Based on that notion, one could even argue that performance ability should not be included in the definition of student success. Nevertheless, the capacity to articulate knowledge and skills offers advantages, including heightened confidence, improved time management, and reduced stress during high-pressure tasks. These benefits extend beyond academic settings, positively influencing scenarios such as job interviews and promotional exams. In other words, test-taking ability benefits students beyond the academic setting and can, for example, impact students' career prospects and is therefore relevant to include in the definition of student success.

Alongside the three outcome-related dimensions of student success outlined above, the proposed definition of student success encompasses career success and satisfaction. The latter represents students' perceptions of (the likelihood of) educational, professional, and life goal attainment. Together, the five dimensions of the proposed student success definition capture students' academic, personal, and social development, which seems fitting considering the aforementioned complexity of student success.

Comparing our definition to Kuh et al.'s (2006) definition of student success and York et al.'s (2015) definition of academic success, there are three noteworthy differences. First, in our definition we distinguish between academic performance (i.e., achievement regarding individual program components) and students' general academic progress (e.g., progress in students' educational journeys), whereas York et al. (2015) and Kuh et al. (2006) seem to capture both in the term academic achievement, without clearly distinguishing between the two and with an emphasis on what we refer to as performance ability. Kuh et al. (2006) call for acknowledging students with different patterns of participation in education, such as adult learners and transfer students. We argue that explicitly distinguishing between individual component achievement and general academic progress accommodates that as it allows for more emphasis on student journeys beyond one program or institution.

A second noteworthy difference between our definition and those provided by Kuh et al.'s (2006) and York et al.'s (2015) pertains to the attainment of educational/learning objectives and the acquisition of knowledge, skills, and competencies. Kuh et al. (2006) include both separately in their definition of student success, but like York et al. (2015), we acknowledge that theoretically there is very little difference between the two. As a result, we capture both in one dimension of student success: the attainment of learning outcomes. The attainment of learning outcomes covers students' learning gains (i.e., capacities, knowledge, skills, values, dispositions), inner development (i.e., attitudes and behaviors related to ethical/moral, emotional, social, and spiritual development), and engagement (i.e., interest, attention, and

behavior).

The third and final notable difference between our definition and those provided by Kuh, York, and their respective colleagues pertains to engagement. Our definition of student success adopts a liberal view on student engagement as it includes both the psychological aspiration to learn and actual student involvement in relevant educational activities. The latter is included in Kuh et al.'s (2006) definition as 'engagement in educationally purposeful activities'. York et al. (2015) abstain from doing so as they, presumably based on their findings, choose to view the psychological desire to learn as a mediating variable for actual aspects of academic success, yet they acknowledge that the psychological desire to commit to learning could be part of the definition. We propose that, although York et al. (2015) repeatedly mention that academic success and student success are used interchangeably, perhaps this difference in view on student engagement demonstrates that academic success is, in fact, conceptually a bit more confined than student success.

The notion that student success is conceptually complex and broad is reflected across the body of studies included in this study, but is typically not reflected very well within individual studies. That is, the vast majority of studies include student success conceptualizations that pertain to persistence and academic progress, academic performance, or both. The remaining dimensions of student success (e.g., attainment of learning objectives, satisfaction, career success) are far less prevalent. Of course, that is not very surprising as information regarding persistence, progress and performance is often readily available within institutions whereas information regarding, for example, career success is not. In other words, conceptualizations of student success are perhaps predominantly prompted by practical rather than substantial considerations, which York et al. (2015) also allude to.

This practical rather than substantial motivation is not apparent in the factors that were related to student success in the studies selected for this review. We identified four types of factors: background and pre-college experiences, psychosocial capital, educational experiences, and institutional factors. Of these four types, institutional factors and psychosocial capital factors were most prevalent in the selected studies. That is, per dimension of student success, institutional aspects were considered in forty to fifty-five percent of studies, and psychosocial factors in forty to seventy-five percent. While information pertaining to institutional factors is typically readily available at institutions, information pertaining to psychological characteristics and perceived social support presumably is not. Our findings imply that researchers put more time and effort into collecting information to relate to student success than they do collecting information on student success itself. However, our findings also show a recent increase in attention to a wider variety of student success dimensions, including a stronger focus on satisfaction and the attainment of learning objectives, perhaps reflecting a shift in educational discourse on the topic. The empirically based definition proposed in this study can further progress educational research into embracing the conceptual complexity of student success.

4.1. Strengths and limitations

After scanning 834 abstracts, screening 411 full texts and eventually extracting data from 274 publications, this study resulted in a proposed definition of one of the most widely used concepts in educational research: student success. The proposed definition condenses a wide variety of interpretations and conceptualizations of student success and thus essentially provides an overview of a large body of literature. To ensure a broad search of literature, the search strategy included four electronic bibliographic databases, a fairly lenient search string, and a publication range of over ten years.

Despite attempts to be as comprehensive as possible, this review may not have identified all relevant student success literature. For example, we acknowledge that our findings mainly represent a western view on student success and that valuable other perspectives might be missing, either because the term student success is not common in some parts of the world, or for other reasons. We tried to mitigate the effect of the obvious overrepresentation of certain mainstream views on student success by performing a scoping review focused on discovering variety rather than critical appraisal of individual studies. This means that this scoping review includes a greater range of study designs and methodologies, and thus potentially a wider variety of views on students' success, than a systematic review would have (Pham et al., 2014). The benefit of this is that the resulting definition is less biased by conceptualizations of student success that may have originated from practical rather than substantial considerations.

A potential downside of this lack of critical appraisal is that the resulting definition possibly does not fully reflect the expert opinion on what student success is and what factors are relevant to consider, but rather reflects the ambiguity surrounding the concept. However, the proposed definition bears notable resemblances to the nearly twenty-year-old seminal definition of student success provided by Kuh and colleagues (2006), lending a degree of credibility to the definition proposed in this study.

What the old and the new definitions have in common is that they both, unfortunately, only include the institutional / researcher perspective on what student success is. This study aimed to investigate other perspectives, such as the student and labor market perspectives, as they will likely view student success differently. Ultimately, the endeavor was unsuccessful as it turns out that different perspectives on student success are lacking in literature. Paradoxically, this gap in the literature underscores the relevance of the present study, highlighting the need for the generic framework proposed herein, which is based on a systematic review of student success conceptualizations across a wide range of contexts. This framework is a valuable step toward capturing the full spectrum of what student success means to different people in different contexts. Beyond clarifying the concept, it can facilitate dialogue and foster mutual understanding among stakeholders with different experiences, perspectives, and values. In doing so, it can help ensure that equity and equality are central to how student success is defined and achieved.

As is the case in most, if not all, studies, the interpretation of the data in our study was subject to reviewer bias. By making our data, including the results of our inductive coding, openly accessible, we have enhanced the transparency, objectivity, and reproducibility of our research process. This reduces the potential for reviewer bias to impact the assessment of our work, and it provides the scientific community with the opportunity to collaboratively accelerate education research in the field of student success.

4.2. Conclusion

We define student success as inclusive of academic performance, attainment of learning objectives, persistence and academic progress, satisfaction, and career success. This definition, derived from the synthesis of 274 empirical studies, offers, to our knowledge, the most comprehensive overview to date of how student success is conceptualized in educational research. It reflects a multidimensional perspective that accounts for academic, personal, and professional development.

While grounded in a wide and diverse body of literature, the definition reflects predominantly Western, discourses and research practices, with limited incorporation of student and labor market perspectives. These constraints highlight the need for continued exploration of alternative perspectives and contexts that have received less attention to date. As such, the definition should be seen not as a fixed endpoint but as a foundation for further dialogue, refinement, and contextual adaptation.

4.2.1. Implications for practice and future research

Having a well-defined concept of student success provides a framework for educational institutions and practitioners that guides them in enhancing their strategies, policies, and practices. This includes reviewing and aligning current curricula and academic programs to ensure they comprehensively support the multidimensional nature of student success as defined. Furthermore, the findings of this study can help strengthen academic and career advising services by empowering study/student advisors with the comprehensive student success definition proposed in this study, enabling them to guide students not only on their academic journey but also on how their education aligns with their career and life goals. Together such efforts can contribute to better preparing students for the complexities and current-day societal challenges, ultimately leading to more well-rounded and successful graduates.

We encourage further exploration of the concept of student success that specifically targets the engagement of other perspectives on student success, including the students' perspective, in order to create an even more holistic and relevant definition of the concept that better serves the needs of students and the broader community of educational institutions, policy makers, the labor market, etc. This ensures that the education provided aligns with the expectations of those who employ and rely on graduates, thus enhancing the overall quality and effectiveness of educational programs.

Future research could additionally delve into the implications and impact of the multidimensional definition of student success presented in this study. Researchers can investigate how persistence and academic progress, academic performance, attainment of learning objectives, satisfaction, and career success interact. Understanding the interplay of these dimensions can help educators tailor support systems and interventions that address the diverse aspects of student success.

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

During the preparation of this work, the authors used ChatGPT-4 in order to assist with grammar and style refinement. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

CRediT authorship contribution statement

Jorien Vugteveen: Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Fabiola Figueroa Esquivel:** Writing – review & editing, Visualization, Validation, Methodology, Data curation, Conceptualization. **Claudia Luijer:** Writing – review & editing, Visualization, Formal analysis, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

the work reported in this paper.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijedro.2025.100518.

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3. Exploring stress and recovery among students: examining the role of study modes (2025)	**Discover Mental Health (Article from : Springer Nature**

Research

Exploring stress and recovery among students: examining the role of study modes

Philipp Stang[1,2] · Maren Weiss[1] · Peter Jaensch[3] · Stefanie Scholz[4]

Abstract

Understanding stress and recovery dynamics among students is essential for promoting their well-being and academic success. This study delves into the complex interplay of stressors and coping mechanisms among university students. Drawing upon health psychology and resilience research, we investigate the experiences of stress and recovery among both full-time and part-time students, considering gender and age. Our findings reveal significant differences between full-time and part-time students in various aspects of stress, including emotional stress, conflicts, and lack of energy. Full-time students reported higher levels of stress in these dimensions, which could indicate possible effects on their academic performance and general well-being. Moreover, gender-specific differences in stress experiences were observed, with female students exhibiting higher levels of stress compared to their male counterparts, particularly in terms of emotional stress and lack of energy. Interestingly, while age did not significantly impact stress and recovery experiences, other variables such as workload and coping strategies appeared to play crucial roles. Our study underscores the importance of the diverse needs of students. Overall, this research sheds light on the intricate relationship between stress, recovery, and study program variables among students, offering valuable insights for educators, policymakers, and mental health practitioners seeking to enhance student well-being and academic success in higher education settings.

1 Introduction

In terms of health psychology, stress and recovery are key aspects for people's bio-psychosocial health and performance, which resilience research also deals with [1, 2]. Students are a particularly vulnerable group of people with regard to stress in terms of homeostatic dysregulation, especially in specific situations such as the Covid pandemic [2–9]. On the one hand, students face typical university challenges, e.g. the experience of stress-associated examination situations [10, 11] and on the other hand, students can also be exposed to specific stresses, such as student loan burdens due to tuition fees [12].

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Scholz and Stang [7] showed that students were confronted with psychological and organizational challenges during the Covid pandemic. Scholz and Stang [7] found significant differences between non-students, full-time and part-time students on various items of the RESTQ battery [13], e.g. in terms of irritability, pressure to perform, sense of achievement and ability to recover.

According to this explorative pilot study ($N = 649$), students had a significantly higher specific stress experience during the Covid pandemic than non-students, and full-time students had a significantly higher specific stress experience than part-time students. Based on these preliminary results, the hypothesis that full-time students experience a higher level of stress than part-time students should be examined more closely. In addition, the effects of age and gender in relation to the experience of stress should be examined more closely in this study.

2 Theoretical and empirical foundations

The relationship between stress and recovery can be described as non-linear and non-symmetrical [13] as different physiological, psychological, including behavioral, and social processes are involved. Resources are specifically related here. There is a positive correlation between resources and "overall stress", e.g. in terms of coping strategies, and between resources and "overall recovery", e.g. expansion of resources [14].

Verma et al. [15] investigated gender-specific differences in stress reactions in $n = 395$ men and women in the transition phase from unemployment to employment. They report that the female sex is associated with higher stress levels and postulate the relevance of specific health promotion interventions. The American Psychological Association [16] also reports that women have a higher level of stress than men. The main sources of stress for women are finances, family responsibilities and relationships.

Concerning the influence of student age, Franke et al. [17] did not find age effects on student stress, However, Gumz et al. [18] report that younger students feel more stressed by examinations, older students report less social problems in the study context and less performance pressure [18].

In general, students are debated to experience stress, which is associated with burnout, procrastination, exam anxiety, other work disorders, interpersonal problems and psychological complaints [18]. Students are considered a vulnerable group in terms of stress experience and mental disorders [19]. Stress is negatively associated with the experience of relaxation and happiness [20].

Benton et al. [21] found that, retrospectively between 1988 and 2001, there was an increase in anxiety, depression, suicidal thoughts and personality disorders among American students who visited a campus counselling center. However, there was no significant increase when considering the severity of distress [17]. Holm-Hadulla et al. [22] concluded that even between 1993 and 2008, the type and extent of psychological distress among German students attending a counselling center was fairly stable. Klug et al. [23] assessed distress among German students ($n = 535$) who had undergone counselling. Students who attended Bachelor/Master study programs did not report higher general stress levels than students who attended traditional Diploma or Magister degree programs, which were the standard at German universities before the Bologna reform. Gumz et al. [18] analyzed ($N = 358$) the stress levels of students and identified interpersonal problems and psychological symptoms in particular for specific graduation groups. Berger et al. [24] found that the self-reported psychological problems of students had decreased significantly between 1994 and 2012. This finding contrasts with earlier studies that postulated a fundamental increase in mental disorders in the German general population [25]. In a more recent study, mental stress (e.g. anxiety, somatization, interpersonal sensitivity) in students was analyzed by Franke et al. [17]. 18.4% of the students met the criteria for a clinically relevant mental disorder according to the Brief Symptom Inventory. This is a significantly lower percentage compared to a sample from 1994–1998. Concerning differences between full-time and part-time students, Schöpf [26] reports that 70 per cent of part-time students report to effectively cope with study stressors and feel competent balancing the demands of study, work, and private life. This is in agreement with the results of our pilot study [5], where we also found higher stress levels in full-time than part-time students. It should be noted that younger students more often learn in full-time study models, whereas older students more frequently study in part-time study models, often accompanied by part-time employment [27].

According to Mache et al. [28], students use different adaptive relaxation activities ($N = 1513$): meeting with friends (86% of test subjects), sleeping (83%), healthy eating (81%) and going for a walk (74%). In terms of maladaptive strategies, alcohol consumption (55%), cigarette smoking (21%), television (77%) and additional coffee consumption (39%) were mentioned. With regard to gender-specific differences, significantly more male students consume nicotine, alcohol and THC than female students.

Stallman et al. [29] reported that American students (*N* = 509) used distraction, deep breathing, relaxation and social activities as healthy strategies and being alone and eating as unhealthy strategies. Students who used more unhealthy and less healthy coping strategies were more likely to have depressive and anxiety symptoms. According to Schöpf [26], part-time students cope by prioritizing their private life and reducing their study performance expectations of themselves. Various preventative interventions are already in place at some universities, including relaxation interventions such as massage chairs, chi machines, rejuvenation loungers and sitting meditation [30, 31]. Prevention courses have a positive effect on students' experience of stress. For example, mindfulness-based group training and mindfulness- and compassion-based training together with peripheral biofeedback increase life satisfaction and enhance mindfulness as well as reduce stress, increase self-efficacy and reduce anxiety and depression [32–35]. Within the framework of specific didactic concepts, such as the CORE principle, attempts are made to influence the development of students' competences, which also include self-competences, including dealing with stress and maintaining recovery [36, 37]. New approaches to work, such as New Work [37] are also being discussed with regard to the experience of stress. Social support and support structures are particularly important for students during major changes, such as the coronavirus pandemic [20, 38].

3 Research questions

Against this background, the following questions were analyzed:

1. Are there differences in the experience of stress and recovery between full-time and part-time students?
2. Are there differences in the experience of stress and recovery between male and female students?
3. Are there differences in the experience of stress and recovery between younger and older students?

Stress and recovery are assessed on differentiated aspects (such as emotional stress, social stress, fatigue, social and somatic recovery) as well as global aspects using the RESTQ.

4 Methodology

4.1 Questionnaire

The study is a quantitative study with a cross-sectional design using an online questionnaire. Concerning sociodemographic data, we assessed age, gender, federal state of Germany, and study program (part time vs. full-time student). The Recovery-Stress Questionnaires (RESTQ) (German: Erholungs-Belastungs-Fragebogen EBF-48) was used to assess stress and recovery [13]. The RESTQ/EBF-48 comprised seven subscales on stress and five subscales on recovery by 48 items with a 7-point scale (0 = "never" to 6 = "always"):

1. General stress (4 items, α = 0.84, e.g. item 45: "… everything became too much for me")
2. Emotional stress (4 items, α = 0.80, e.g. item 5: "… I was irritable")
3. Social stress (4 items, α = 0.84, e.g. item 21: "… I got annoyed with others")
4. Conflicts/pressure to perform (4 items, α = 0.74, e.g. item 44: "… I was under pressure to perform")
5. Fatigue (4 items, α = 0.83, e.g. item 35: "… I was overtired")
6. Lack of energy (4 items, α = 0.81, e.g. item 31: "… I could only do my work slowly")
7. Somatic stress (physical complaints) (4 items, α = 0.82, e.g. item 7: "… I had physical complaints")
8. Success (4 items, α = 0.62, e.g. item 17: "… I was successful")
9. Social recovery (4 items, α = 0.83, e.g. item 23: "… I met friends")
10. Somatic recovery/physical recovery (4 items, α = 0.83, e.g. item 9: "… I felt physically relaxed")
11. General well-being (4 items, α = 0.87, e.g. item 10: "… I was in good spirits")
12. Sleep (Sleep Quality) (4 items, α = 0.79, e.g. item 19: "… I fell asleep satisfied and relaxed")

The "Overall Stress" index can be formed from scales 1 to 7. This can be specified in the areas of "social-emotional stress" (scales 1–3) and "performance-related stress" (scales 4–7). Scales 8 to 12 form the "Overall recovery" index. The questionnaire is a valid, reliable, objective and standardized psychometric instrument for surveying stress symptoms and recovery activities [13], which has proven to be a valuable instrument in student samples in our pilot study [7]. By now, a specific version for students [1] is available but was not at time of the survey. After data collection, the samples were divided into two groups based on the socio-demographic information on gender and study program.

4.2 Sample description

4.2.1 Distribution and response

The study was designed and conducted as an online survey. For this purpose, the link to the survey was distributed via the campus management system and the university's official social media channels (e.g. SRH-WLH Instagram page, Facebook, Twitter) as well as in social networks (e.g. WhatsApp groups) via snowballing. The survey link was also distributed in seminars and student contacts at other universities such as FAU Erlangen-Nuremberg and the University of Bayreuth as well as the respective personal working student environment at Siemens Healthineers and Bosch REXROTH. As there was no control over the distribution of the survey link, no response rates can be calculated.

During the survey period from 2–30 December 2021, a total of 416 people showed interest in the survey. Of these, 176 participants had to be excluded from the evaluation due to implausible information (e.g., "Gender: Unicorn", $n = 2$) and processing times (under 3 min: $n = 26$; over 60 min: $n = 3$) or incomplete data ($n = 145$), leaving 240 data sets for further analysis. Based on previous studies [13], which used a sample size of N between 72 and 420, we aimed to achieve a sample within this range. With a total sample size of N = 240, this target range was successfully achieved. Some recovery questions, which were reverse coded in relation to the stress questions, were used as test items to assess their plausibility (i.e., items on overall recovery versus items on overall stress) The analysis of the EBF-48 questionnaire only appears meaningful if it has been completed in full. In addition, the few socio-demographic characteristics of the participants were placed at the end of the questionnaire. Thus, even imputations of the EBF-48 data (theoretically possible to a certain extent) would not have provided any further insights, as no reference to other independent variables could have been established.

4.2.2 Statistics

Analyses were carried out using SPSS 29.0 for Windows. For bivariate Analyses, Chi-Square tests were performed. For hypothesis testing concerning the RESTQ scales, we conducted multivariate analyses of variance with the factors "study type", "age group", and "gender" for the RESTQ stress and recovery subscales and the RESTQ overall scales. In order to predict global RESTQ values, we conducted linear regression analyses with predictors "study type", "gender", and "age group". Means for RESTQ subscales of male and female students were compared to the mean values of the German RESTQ standardization sample [13] using one sample t-tests.

5 Results

5.1 Sample description

The socio-demographic information requested included the type of study program (full-time vs. part-time), age group, gender and federal state (see Table 1). With 125 (53%) part-time students and 110 (47%) full-time students, the sample was relatively evenly distributed in terms of the type of study program. The participating students were in age groups between 18 and 49 years (no information in categories over 49 years). The categories originally surveyed were dichotomized for further analysis into the groups of young students, up to and including the age of 25, and older students, aged 26 and over. All participants provided information on their gender. The numbers of valid answers correspond to those of the overall sample. In addition to the binary categorization of male/female, there was also the option of indicating "diverse". Four (1.7%) people made use of this option. As the group was too small, they were excluded from further analyses, resulting in a distribution of men and women of around one quarter to three quarters. With one exception, all participants provided information on their federal state. Despite the inclusion and distribution of the participation link to the survey via social media, it is evident that 187 of the respondents (78%) came from Bavaria. A further $n = 10$ people

Table 1 Sample description

	N	%
Type of study		
Part-time	125	52
Full-time	110	46
No answer	5	2
Age group		
18–25 years	122	51
26 years and older	118	49
Gender		
Male	59	25
Female	177	74
Diverse	4	2

(4%) were from Saxony, $n = 9$ (4%) from Baden-Württemberg and $n = 8$ (3%) from Thuringia. The remaining $n = 25$ people were from the other federal states.

Due to the small sample size, the analysis is based exclusively on the binary gender classification male–female. The gender distribution in full-time and part-time degree programs did not differ ($\chi^2(1) = 0.004$, $p = 0.949$). However, the gender distribution across the age groups was unequal ($\chi^2(1) = 10.51$, $p = 0.001$): In the 18–25 age group, only 14% of respondents were male and in the 26+ age group, 33% were male. It was also found that 70% of part-time students were aged 26 and over, while in the group of full-time students only 23% were aged 26 and over ($\chi^2(1) = 17.79$, $p < 0.001$).

5.2 Descriptive data on stress and recovery

Table 2 shows the descriptive data of the gender, age group, and study type subsamples. Descriptive data on stress and recovery of younger and older students did not differ. Full-time students reported higher stress scores than part-time students. Descriptively, females scored higher on the stress and lower on the recovery scales than men.

Compared to the female German standardization sample [13], female persons in our sample scored significantly less favorable on all scales. Compared to the male German standardization sample, male persons in our sample scored significantly less favorable on all scales except for the subscale "Fatigue".

5.3 Significance testing

First, we conducted MANOVA on the RESTQ stress subscales considering the factors gender, age group, and study model. We found significant effects of study model (F(7, 218) = 2.94, p = 0.006), but not of age group (F (7, 218) = 0.93, $p = 0.482$) and gender (F(7, 218) = 1.48, $p = 0.175$). Between subject effects on the stress subscales found significant effects of study mode on the "Conflicts/Pressure" Scale (F(1) = 6.56, $p = 0.011$) and a tendency on the "Lack of Energy" scale (F(1) = 2.30, $p = 0.085$), indicating higher stress in full-time students. Effects on the remaining RESTQ stress subscales (general stress, emotional stress, social stress, fatigue, physical complaints) did not reach statistical significance (data not shown).

Second, MANOVA on the RESTQ recovery subscales did not indicate any effects of study model (F(5, 220) = 1.25, $p = 0.288$), age group (F(5, 220) = 1.03, $p = 0.401$), or gender (F(5, 220) = 1.54, $p = 0.178$). A further investigation on the recovery subscales level is not indicated considering the nonsignificant overall results.

Last, we conducted MANOVA on RESTQ overall stress and recovery scales (overall stress, social-emotional stress, performance-related stress, overall recovery) which revealed no significant effects for the factors gender (F(3, 222) = 1.48, $p = 0.222$), type of study (F(3, 222) = 0.59, $p = 0.624$), and age group (F(3, 222) = 1.24, $p = 0.296$).

Finally, multiple regression analyses were used to determine the linear relationship between the variables gender, age and study type and the respective stress and recovery overall scales. Only the scales "Overall stress" (F(3, 228) = 3.22, $p = 0.023$) and "Performance-related stress" (F(3, 228) = 3.43, $p = 0.018$) were significantly predicted by the age, gender, and study type, albeit with a low variance explanation (in each case $R^2 = 0.04$; see Table 3). Female gender and study type were significant predictors for both "overall stress" and "performance-related stress", while age was not significant (see Table 3).

Table 2 M(SD) of the RESTQ scales values, divided by gender, age group, and study modes

	M(SD)					
	Gender[a]		Age group		Study type[b]	
	Female (n = 177)	Male (n = 59)	18–25 years (n = 122)	Over 25 years (n = 118)	Part-time (n = 125)	Full-time (n = 110)
Stress subscales						
General stress	2.59 (1.46)	2.26 (1.31)	2.53 (1.45)	2.45 (1.43)	2.29 (1.37)	2.72 (1.48)
Emotional stress	2.40 (1.25)	2.25 (1.30)	2.38 (1.21)	2.37 (1.31)	2.19 (1.29)	2.59 (1.21)
Social stress	2.47 (1.26)	2.13 (1.32)	2.36 (1.29)	2.42 (1.29)	2.42 (1.31)	2.37 (1.26)
Conflicts/pressure	2.70 (1.23)	2.64 (1.29)	2.69 (1.24)	2.71 (1.25)	2.48 (1.18)	2.97 (1.28)
Fatigue	2.98 (1.42)	2.35 (1.27)	2.88 (1.34)	2.80 (1.46)	2.81 (1.45)	2.88 (1.38)
Lack of energy	2.76 (1.36)	2.54 (1.11)	2.89 (1.35)	2.49 (1.22)	2.43 (1.18)	3.02 (1.38)
Physical complaints	2.64 (1.38)	2.22 (1.52)	2.54 (1.38)	2.52 (1.47)	2.43 (1.34)	2.66 (1.53)
Recovery subscales						
Success	2.19 (1.00)	2.30 (1.01)	2.25 (0.98)	2.22 (1.04)	2.24 (0.99)	2.25 (1.05)
Social recovery	2.60 (1.26)	2.77 (1.29)	2.78 (1.25)	2.49 (1.26)	2.49 (1.27)	2.81 (1.26)
Physical recovery	2.24 (1.23)	2.63 (1.29)	2.36 (1.16)	2.32 (1.33)	2.32 (1.27)	2.37 (1.24)
General wellbeing	2.88 (1.24)	3.05 (1.26)	2.94 (1.21)	2.90 (1.28)	2.97 (1.26)	2.87 (1.25)
Sleep quality	2.96 (1.30)	3.35 (1.46)	3.16 (1.24)	2.93 (1.44)	3.09 (1.41)	2.99 (1.29)
Overall stress and recovery scales						
Overall stress	2.65 (1.12)	2.34 (1.03)	2.61 (1.08)	2.54 (1.11)	2.44 (1.11)	2.74 (1.09)
Social-emotional stress	2.48 (1.22)	2.21 (1.17)	2.42 (1.18)	2.41 (1.23)	2.30 (1.24)	2.56 (1.17)
Performance-related Stress	2.77 (1.13)	2.44 (1.00)	2.75 (1.10)	2.63 (1.11)	2.54 (1.08)	2.88 (1.11)
Overall recovery	2.57 (0.94)	2.82 (1.03)	2.70 (0.90)	2.57 (1.01)	2.62 (0.99)	2.66 (0.94)

[a] n = 236 (n = 4 persons with diverse gender were excluded from the analysis due to insufficient sample size)

[b] N = 235 due to missing data

Table 3 Multiple regression analysis to predict overall stress and recovery scales

AV	Overall stress	Social-emotional stress	Performance-related stress	Overall recovery
Predictors	Beta	Beta	Beta	Beta
Type of study	0.19*	0.16*	0.19*	− 0.04
Gender	− 0.14*	− 0.14*	− 0.14*	0.14*
Age	0.10	0.12	0.07	− 0.11
Type of study	0.19*	0.16*	0.19*	− 0.04
Complete model	$F(3, 228) = 3.22, p = 0.023$ $R^2 = 0.04$ Corrected $R^2 = 0.03$	$F(3, 228) = 2.58, p = 0.054$ $R^2 = 0.03$ Corrected $R^2 = 0.02$	$F(3, 228) = 3.43, p = 0.018$ $R^2 = 0.04$ Corrected $R^2 = 0.03$	$F(3, 228) = 1.78, p = 0.15$ $R^2 = 0.03$ Corrected $R^2 = 0.01$

Annotations. $p < 0.05$; those who rated their gender as "diverse" were left out of the regression analysis due to small subsample size

6 Discussion

The present study was able to obtain a differentiated picture of the stress and recovery experience of female and male students in the full-time and part-time study model.

The hypothesis that full-time students experience a higher level of stress than part-time students [7] was confirmed by the present study. Significant differences between part-time and full-time students were found in relation to conflicts and pressure and lack of energy [13]. In each case, full-time students were more stressed than part-time students. Among other things, it can be assumed that full-time students spend more time with their fellow students

than part-time students, which could have a moderating effect on the interaction [26]. This could lead to more or a higher potential for conflict and possibly an experience of competition, which ultimately manifests itself in higher levels of stress, e.g. on the "Conflicts/Pressure" scale. In addition, full-time students experience a higher lack of energy than part-time students—a sign of chronic stress. This corresponds to the results of the preliminary study by Scholz and Stang [7]. Part-time students seem to cope more effectively with performance-related stress, e.g., by lowering personal performance standards an re-prioritizing [26]. As we did not find any significant effect of study type on the recovery scales, further research is needed to explain differences in stress levels.

While the differences between students and non-students in Scholz and Stang [7] showed medium and large effect sizes, the group differences between full-time students and part-time students were rather small in the current study. This discrepancy is explained by the fact that the realities of students' and non-students' lives differ considerably more than students of different study programs [39]. Differences between students and people in working life in terms of recovery and stress can also be explained by the special type of student social relationship [26].

With regard to gender-related differences in students' experiences of stress and recovery, however, no significant overall effect was found. However, a comparison with the RESTQ standard sample showed that although both genders in our student sample performed less favorably in terms of stress and recovery, women were even more affected by this.

The gender-specific differences can be seen as consistent with the current state of research [15, 16]. Female students show higher descriptive values in the stress experience compared to male students, and gender was a significant predictor of overall and socio-emotional stress.

Higher levels of stress and lower levels of recovery in students compared to non-students in the norm sample are also in line with the current state of research, as expected [7, 17].

There were no stress and recovery differences between students up to the age of 25 and students aged 26 and over in our sample. Previous studies found heterogeneous results concerning the influence of age on student stress [17, 18]. It cannot be ruled out that other results would have been found if the sample had been categorized more finely or if there had been a greater spread of ages.

The analysis of the RESTQ global scales showed that overall only little variance could be explained by age, gender and study type. Only total stress and performance-related stress could be significantly predicted by gender and study type. It appears that stress and recovery are more strongly determined by other influencing variables than by gender and age. This is also shown by the low variance explanation of the regression models (R^2 maximum 0.04). Stereotypes or traditional gender roles do not appear to have a direct influence on the stress and recovery of students. It is also possible that students have sufficient coping strategies to manage gender- and age-associated stress. Our study shows that full-time students have a higher stress level compared to part-time students, as they are exposed to more intense academic pressure and often have less time for relaxation or secondary activities. The tendencies of the preliminary study between full-time students and part-time students were confirmed in the present study [5]. Women tend to report more stress than men, which could be due to additional challenges such as social expectations, self-doubt or the double burden of studying and care work. The interplay of various factors such as social culture, educational environment and family background also influences the experience of stress. These complex interactions show that stress should not be viewed in isolation, but must be understood as a dynamic interplay of individual, social and structural factors.

In terms of practical implications, mental health education at universities can be promoted through compulsory courses for first-year students, workshops on stress management, mindfulness-based group training and awareness-raising campaigns, particularly targeting full-time students and women [32–35]. In addition, curricula should be made more flexible by introducing alternative examination formats, integrating breaks and relaxation exercises and creating a health-promoting study environment and the development of self-competencies [36, 37]. The expansion of support systems, such as psychological counseling centers with short waiting times, anonymous online counseling and specific programs for women, can further reduce the mental strain on students. For students with childcare responsibilities, expanded childcare options and flexible study structures are essential to enable a better balance between studying and family life. Various interventions, such as cognitive behavioral therapy, hypnotherapeutic intervention, diaphragmatic breathing, moderated support groups or break interventions with physical activity or relaxation exercises, are able to reduce stress in students, reduce self-reported anxiety regarding socially evaluated situations, optimize subjective well-being or modify fatigue and vitality [40–43]. Overall, these measures can help to improve the mental well-being of students and support them in their academic careers [1, 2]. Reference should also be made here to the students' suggestions for improvement as part of the qualitative results of the preliminary study: requests for changes to online teaching, concerns for teaching institutions, concerns for lecturers and need for literature research [5].

Future research should systematically examine the hypothetical assumptions on influencing factors and interactions presented here in order to gain a more comprehensive understanding of the stress levels of different student groups. In particular, empirical studies are needed that analyze the influence of gender, type of study, age cohorts and social and cultural contexts in a differentiated manner. In addition, specific prevention and intervention measures should be developed and their effectiveness evaluated on the basis of evidence. This includes both structural adjustments in the higher education system and targeted programs to promote mental health that are adapted to the particular needs of vulnerable groups—especially female and full-time students. In the long term, such research can contribute to the development of sustainable strategies that improve students' mental health and promote their academic performance and general well-being.

Limitations of the present study include both methodological and results-related aspects. The willingness to participate in an online questionnaire can be criticized. In addition, only people with sufficient digital skills were addressed. Gender was categorized binary in this study. This can be explained by the fact that other genders were very poorly represented with n = 4. A dichotomous analysis was therefore carried out. The results of the present study therefore refer exclusively to students with binary gender. Future studies should explicitly motivate people who belong to non-binary genders to participate in the study. The age distribution was also analyzed in a less differentiated manner in the present study, as a sufficient sample size was excluded by forming the subgroups "young", < 26, and "older", ≥ 26 years.

With regard to the heterogeneous age and gender distribution, care should be taken to ensure an appropriate sampling in terms of implications for research when replicating the study. In addition, a new specific instrument for the stress and recovery of students [1] offers itself as an instrument for future research in this context.

7 Conclusion

The results of this study show a differentiated picture with regard to the stress and recovery of students. In particular, global experiences of stress, specifically "lack of energy" [13] in full-time students and the performance-related stress should be addressed in further studies and in prevention programs. In terms of implications for practice, universities should take on the task of recognizing that they also have an influence on the stress and recovery of students at various levels. Stress reduction can be achieved by counselling, prevention and intervention, but also by improving everyday teaching and examination practice. For example, in the context of university teaching, didactic concepts such as CORE [36], and in the context of student activities, such as New Work [37], can influence recovery and stress.

As part of their studies, students should focus on dealing with stress, health-psychological measures, e.g. maintaining their own mental hygiene, preventive measures, e.g. mindfulness-based group training, both for their studies and for their (working) life after graduation [33, 34] as well as the development of emotion regulation strategies [28, 29] and to actively create a recreational experience. In terms of higher education didactics, such a competence orientation can offer opportunities to expand the scope of experience and behavior [36, 44]. In addition, social networks and support structures should be taken into account [38]. Specific programs at universities must continue to be developed, established and evaluated.

Author contributions All the authors Philipp Stang, Maren Weiss, Peter Jaensch and Stefanie Scholz made substantial contributions to the conception and design of the work; all the authors Philipp Stang, Maren Weiss, Peter Jaensch and Stefanie Scholz made substantial contributions to the analysis and interpretation of data; drafted the work and revised it critically for important intellectual content; approved the version to be published; agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Data availability Data are available on request.

Code availability Not applicable for that paper.

Declarations

Ethics approval and consent to participate Before data collection, the opinion of an expert discourse was obtained and the self-assessment of the Joint Ethics Commission of Bavarian Universities (GEHBa) was carried out. Since the present study was a non-clinical treatment and no risks or harm were expected for the participants, the Joint Ethics Commission of Bavarian Universities and the Ethics Committee of SRH

Wilhelm Loehe Universitys waived the need for approval. The basic ethical principles of the psychological professional associations BDP and DGPs were adhered to during the study. Additionally, the study was solely a psychometric online questionnaire study. Informed consent was obtained from all individual participants included in the study, both consent to participate and consent for publication. This research was performed in line with the principles of the Declaration of Helsinki.

Competing interests The authors declare no competing interests.

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TITLE	SOURCE TITLE
4. Unlocking academic success: the impact of time management on college students' study engagement (2025)	BMC Psychology (Article from : BioMed Central Ltd)

Unlocking academic success: the impact of time management on college students' study engagement

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Abstract

Background In this study, the purpose was to examine the impact of time management on college students' study engagement and to determine the mechanisms involved. Consequently, we examined the relationship between time management and engagement in study, as well as self-control and mobile phone dependence.

Methods The Adolescence Time Management Disposition Scale (ATMD), College Student Mobile Phone Dependence Questionnaire (CSMPDQ), Utrecht Work Engagement Scale-student (UWES-S), and Self-Control Scale (SCS) were administered to 1016 college students. A Pearson's correlation analysis and a mediation analysis using bootstrapping were performed in order to test for standard method bias using SPSS 22.0.

Results ①Time management was positively associated with self-control and study engagement, and negatively associated with mobile phone dependence ($p < .001$). self-control was positively associated with study engagement, and negatively associated with mobile phone dependence ($p < .001$). Mobile phone dependence was negatively associated with study engagement ($p < .01$). ②Time management can not only directly predict study engagement (95%CI, $0.102 - 0.208$) but also affects study engagement through three indirect paths: self-control was a mediator (95%CI, $0.066 - 0.158$), mobile phone dependence was a mediator (95%CI, $0.043 - 0.109$), and self-control and mobile phone dependence were a chain mediator (95%CI, $0.012 - 0.032$).

Conclusion Time management not only influences study engagement directly, but also through the mediating effect of self-control and mobile phone dependence indirectly.

Keywords Chinese college students, Time management, Self-control, Mobile phone dependence, Study engagement

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Introduction

The quality of education serves as a crucial metric for evaluating the effectiveness of educational efforts, serving as the foundation for higher education and essential for the sustainability and advancement of academic institutions. Enhancing educational quality is a central objective in the advancement of higher education. With the continual growth of China's higher education sector, there is a growing emphasis on the importance of maintaining high standards in educational quality across various sectors of society. Traditionally, the evaluation of educational quality has predominantly concentrated on external metrics, including physical infrastructure and scientific research outcomes. In recent years, scholars have shifted towards a student-centric approach to evaluating education quality, prioritizing the learning and development of students. Study engagement has gained increasing attention from researchers as a determinant of students' experiential growth and of higher education quality [1, 2].

Estell and Perdue (2013) defined study engagement as the perceptions and attitudes of students towards school, which impact their participation in learning activities and sense of belonging to the school community [3]. Study engagement represents a novel approach to assessing the quality of undergraduate education in China by prioritizing students' subjective perspectives. This paradigm shift holds significant implications for enhancing the quality of undergraduate education in China, advancing theoretical research on higher education assessment, and fostering deeper exploration of quality assessment in higher education. It can enhance the theoretical and methodological framework for assessing the quality of undergraduate education, advance the field of higher education quality assessment, and contribute to the enhancement of higher education quality, particularly in the realm of fostering talent. To gain a more comprehensive understanding of the influence of study engagement on educational quality, scholars have initiated investigations into various determinants affecting study engagement.

Time management and study engagement

The concept of time management tendency primarily pertains to the psychological and behavioral attributes associated with one's capacity to manage time effectively and the perceived value of time [4]. Individuals who exhibit a high proficiency in time management demonstrate robust skills in coordinating and controlling time, enabling them to organize their academic and personal lives efficiently. Consequently, they tend to lead fulfilling lives, maintain positive interpersonal relationships, and experience a heightened sense of well-being [5]. Schaufeli (2002) emphasizes that study engagement encompasses vitality, dedication, and concentration, indicating a positive state characterized by initiative in thought and behavior, enthusiastic participation, and focused attention on learning [6]. Empirical research indicates that time management significantly influences the level of study engagement among college students. The relationship between individual time management and study engagement has been explored in several studies. Pan et al. (2011) found that higher levels of time management were associated with increased study engagement [7]. Similarly, Zhao et al. (2012) demonstrated that a tendency towards effective time management positively predicted levels of study engagement [8]. Additionally, Huang et al. (2017) showed that improving students' time management skills led to greater dedication to important learning tasks, ultimately enhancing study engagement [9]. A meta-analysis conducted by Claessens et al. (2007), which integrated data from 32 studies, established a significant correlation between time management behaviors (such as planning and prioritization) and both academic performance ($r = .38$) and engagement ($r = .29$) among college students [10]. These results are consistent with the findings of Liu and Zhang (2020), whose meta-analysis demonstrated that time management interventions, including goal-setting training, enhance study engagement by mitigating procrastination and promoting self-regulated learning [11]. Collectively, these meta-analytic findings highlight the critical role of time management in enhancing study engagement. Consequently, it is hypothesized that time management is a significant predictor of study engagement (Hypothesis 1).

The mediating role of self-control

As previously stated, our hypothesis posits that time management significantly impact study engagement. However, mere confirmation of a positive correlation between time management tendencies and study engagement is insufficient; it is imperative to elucidate the specific processes or mechanisms by which time management tendencies operate, including identifying potential mediating variables. Muraven and Baumeister (2000) proposed that self-control encompasses the capacity of an individual to consciously restrain impulses, desires, and manage their own conduct in order to enhance the attainment of enduring objectives [12]. In determining the mediating variables for this study, we evaluated various potential factors, including emotional regulation and cognitive flexibility, among others. Nevertheless, self-control has demonstrated a more extensive and significant impact on the regulation of individual behavior and emotional responses. Consequently, we have chosen to designate self-control as the primary mediating variable in this research [13]. Diamond (2013) posited that self-control is demonstrated through the capability to maintain concentration amidst external diversions, restrain impulsive actions, and consistently fulfill assigned duties

[14]. According to the power model of self-control, self-control ability is primarily shaped by personality traits, emotions, and the tendency for effective time management. Specifically, the trait of time management plays a significant role in enhancing self-control, as evidenced by its positive correlation with the regulation of emotions, behaviors, and cognitive processes in individuals [15]. Individuals who exhibit higher levels of time management tendencies are also likely to demonstrate greater self-control [16]. A meta-analysis conducted by de Ridder et al. (2012), which examined 102 studies, identified self-control as a significant predictor of academic success ($r = .33$) and as a mediator in the relationship between time management and study engagement [17]. These results align with the findings of Duckworth et al. (2016), whose meta-analysis of 67 studies revealed that self-control interventions, such as delayed gratification training, substantially enhance study engagement by minimizing distractions and fostering persistence [18]. Furthermore, Mercer et al. (2011) reported a positive correlation between self-control and study engagement [19]. Based on these findings, we propose Hypothesis 2: Self-control mediates the relationship between study engagement and time management.

The mediating role of mobile phone dependence

According to the 50th Statistical Report on the Development of the Internet in China, published by the China Internet Network Information Center, as of June 2022, the number of Internet users in China had reached 1,051 billion. Among these users, 99.6% accessed the Internet via mobile phones, with students comprising the largest demographic group at 23.7% [20]. The term "mobile phone dependence," often referred to as mobile phone addiction or problematic mobile phone use, describes the condition where individuals experience significant physiological, psychological, and social dysfunction as a result of excessive mobile phone usage and an inability to control it [21]. Mobile phone dependence is considered a significant non-drug addiction of the 21st century. Research indicates that the factors contributing to mobile phone dependence are closely associated with external environmental influences, including family upbringing styles, school belonging, and school adaptation [22–24]. Additionally, individual factors such as personality traits, self-esteem, basic psychological needs, depression, anxiety, and sleep quality also play a crucial role [25–28]. Time management propensity, as a facet of personality traits related to the temporal dimension, reflects an individual's capacity for self-regulation over time, a factor closely associated with addictive behaviors. In their study, they highlighted the significant negative correlation between college students' ability to manage time and their dependence on mobile phones [29, 30]. A meta-analysis conducted by Liu et al. (2021), which synthesized data from 41 studies, corroborated the negative impact of mobile phone dependence on study engagement, with a correlation coefficient of $r = -.41$. The study identified poor time management and low self-control as significant risk factors [31]. These results are consistent with the findings of Elhai et al. (2017), whose meta-analysis of 53 studies revealed an association between mobile phone dependence and diminished attention spans, increased academic procrastination, and decreased study engagement, with a correlation coefficient of $r = -.37$ [21]. Additionally, Li et al. (2019) discovered that mobile phone dependence can predict study engagement levels, with the development of mobile phone dependence directly impacting the amount of study engagement [32]. Huang et al. (2019) discovered a negative correlation between study engagement and mobile phone dependence [33], while Gao et al. (2021) found that core self-evaluation moderates the predictive effect of mobile phone dependence on study engagement [34]. Hypothesis 3 suggests that mobile phone dependence mediates the relationship between time management and study engagement.

The chain intermediary role of self-control and mobile phone dependence

In their research on the association between mobile phone dependence and self-control among college students, Li et al. (2017) [35] found a significant negative correlation between mobile phone dependence and self-control. Similarly, Zhang et al. (2017) [36] reported that mobile phone dependence was significantly negatively correlated with self-control and was associated with lower levels of self-control in individuals. Zhang et al. (2019) [37] research revealed that mobile phone dependence is a predictor of self-control, leading to a decrease in students' ability to regulate their behavior. Zhao (2021) [38] study demonstrated that time management tendencies can indirectly influence mobile phone dependence through self-control. Additionally, Wang and Jia (2020) [39] findings indicated that individuals with higher levels of time management tendencies exhibit greater self-control, which in turn can mitigate the likelihood of developing mobile phone dependence. Rozgonjuk et al. (2020) conducted a meta-analysis involving 28 studies, which confirmed that self-control mediates the relationship between time management and technology addiction, including mobile phone dependence, with a standardized indirect effect of $\beta = -0.18$ [40]. This finding supports the chain mediation model proposed in their study. Additionally, Billieux et al. (2015) highlighted that interventions targeting self-control, such as cognitive-behavioral therapy, are effective in reducing mobile phone dependence and enhancing academic engagement [41]. In conclusion, time management propensity is typically

considered an individual's capacity to effectively organize their time and resources, which is crucial for sustaining an efficient learning environment. However, time management alone does not directly influence an individual's susceptibility to phone dependence; rather, it operates through the individual's ability to exercise self-control. Therefore, an individual with strong time management skills, who can effectively regulate their behavior and impulses, is more likely to avoid excessive reliance on their phone, thereby maintaining a productive learning state. Consequently, Hypothesis 4 posits that self-control and mobile phone dependence serve as mediators in the relationship between time management and study engagement.

The tertiary education phase is a critical period for academic growth, where the degree of students' engagement in learning serves as a pivotal indicator of their academic success. Therefore, this study focuses on college students as participants to delve deeper into the factors that impact study engagement. This study examines the characteristics and interrelationships of time management, self-control, mobile phone dependence, and study engagement. It explores the impact of time management on study engagement, investigating the mediating roles of self-control and mobile phone dependence. Additionally, it uncovers the connections among these four variables. This research contributes to the empirical literature on study engagement and offers theoretical insights for mental health education in higher education settings.

Materials and methods
Participants
This research utilized a randomized questionnaire survey to gather data from undergraduate college students in Shandong Province, utilizing the Questionnaire Star platform. The research protocol received approval from the Ethics Committee of Jining Medical University. Participation in the study required completion of an informed consent form, with additional parental or guardian consent obtained for participants under the age of 18. Upon obtaining subjects' consent, online surveys were administered adhering to protocols for voluntary participation, confidentiality, and anonymity. The surveys were completed within a time frame of 10 to 20 min, and all data collected were kept confidential. Monetary incentives were not provided to volunteers during the trial. In this study, a total of 1,100 subjects were analyzed, collected from October to December 2023. Eighty-four questionnaires were excluded from the analysis due to insufficient response time (less than 200 s), the presence of randomized or patterned responses, uniform selection of options across all questions, and consistent responses to both reverse and forward questions. Consequently, 1,016 questionnaires were deemed valid, resulting in an effective response rate of 92.36%. The sample comprised 487 male students (47.93%) and 529 female students (52.07%). The ages of the participants spanned from 17 to 25 years, with a mean age of 21.80 years and a standard deviation of 1,770 years. Of the participants, 616 individuals (60.6%) were only children, whereas 400 individuals (39.4%) had siblings. Furthermore, 497 participants (48.9%) reported residing in urban areas, while 519 participants (51.1%) indicated that their families lived in rural areas.

Measurements
Adolescence time management disposition scale (ATMD)
Chinese scholars Huang and Zhang (2001) [42] compiled the Adolescence Time Management Disposition Scale (ATMD) according to the domestic situation in China based on foreign research literature. The scale consists of three dimensions: sense of time value (e.g., "I think the phrase 'an ounce of time is worth an ounce of gold' is true"), time monitoring (e.g., "I usually organize my daily activities into a schedule"), and time effectiveness (e.g., "The phrase 'time is money' is true"). It consists of a total of 44 items, assessed using a five-point Likert scale ranging from 1 (hardly at all) to 5 (always). Total scores were calculated by summing all items, with higher total scores indicating better time management skills. The scale exhibited a commendable overall consistency coefficient of .962, indicating strong reliability. Construct validity was supported by confirmatory factor analysis (CFA) in the original study, with fit indices meeting acceptable thresholds (CFI =.93, TLI =.91, RMSEA =.05) [42].

College student mobile phone dependence questionnaire (CSMPDQ)
The study employed the Mobile Phone Dependence Scale for College Students, which was developed by Wang (2013) [43]. This scale includes five dimensions: conflict (e.g., "Mobile phones interfere with my daily life"), salience (e.g., "Mobile phones are more important than clothes and food"), withdrawal (e.g., "I feel uneasy without my cell phone"), persistence (e.g., "I spend more time on my phone than I intend to"), and technology (e.g., "I'd rather lose my wallet than my mobile phone"). It consists of a total of 20 items, assessed using a five-point Likert scale ranging from 1 (hardly at all) to 5 (always). Total scores were derived by summing all items, with higher scores indicating a stronger inclination towards mobile phone dependence. The questionnaire exhibited a commendable overall consistency coefficient of 0.936, indicating acceptable internal consistency. Construct validity was established in the original validation study through exploratory factor analysis (EFA), which confirmed the five-factor structure (cumulative variance explained = 68.4%) [43].

Utrecht work engagement scale-student (UWES-S)

In this study, the utilization of the Utrecht Work Engagement Scale-student (UWES-S) developed by Liao (2011) was implemented [44]. This scale comprises three distinct dimensions: behavioral input (e.g., "The usual holiday will not relax study"), cognitive input (e.g., "Spare time will not relax study"), and emotional input (e.g., "After class will be self-review"). It consists of a total of 20 items, assessed using a five-point Likert scale ranging from 1 (not at all) to 5 (completely). Total scores were calculated by summing all items, with higher scores on this scale indicate higher levels of study engagement. The scale demonstrated a high internal consistency, with an alpha coefficient of 0.916, indicating favorable structural validity.

Self- control scale(SCS)

Tan and Guo (2008) [45] revised Tangney's (2004) [46] Self-Control Scale based on the reality of Chinese college students. The scale includes five dimensions: impulse control (e.g., "I can resist temptation well"), healthy habits (e.g., "It is difficult for me to break bad habits"), resisting temptation (e.g., "I can delay gratification"), focusing on work (e.g., "I am lazyv), and entertainment moderation (e.g., "I can control my leisure activities"). It consists of 19 items, assessed using a five-point Likert scale ranging from 1 (not at all) to 5 (completely). Total scores were obtained by summing all items, with higher scores, greater self-control was indicated, as measured by a five-point Likert scale. The internal consistency reliability of the SCS was.941, indicating strong reliability.

Statistical analysis

Analyses were conducted using total scores of all scales. SPSS 22.0 was used to perform descriptive statistics and correlation analysis. To test the hypothesized mediation effects, we employed Hayes' PROCESS macro program (Models 4 and 6) to conduct mediation analysis. Simultaneously, this study employed the Bootstrap method to examine the mediation effect. A total of 5,000 Bootstrap samples were selected to investigate the effects of self-control and mobile phone dependence on time management and study engagement, within a 95% confidence interval. To assess the potential for common method bias, Harman's single-factor test was conducted. This test

examines whether a single factor accounts for the majority of the covariance among the variables, which would indicate the presence of common method bias.

Results

Common method bias test

Harman's single-factor test was used to determine whether the dataset under examination had a common method bias in order to validate the precision of the statistical analysis. A total of 18 common factors exhibiting eigenvalues exceeding 1 were identified, with the unrotated first factor explaining 25.32% of the variance, falling short of the recommended threshold of 40%. Consequently, it can be deduced that the outcomes derived from the survey instrument are not substantially influenced by common method bias.

Descriptive statistics and correlation analysis of the research variables

The mean scores on time management, self-control, mobile phone dependence, and study engagement were 3.760 ± 0.697, 3.698 ± 0.796, 3.000 ± 0.939, and 3.508 ± 0.763, respectively. Table 1 displays the relationships between each variable. Pearson correlation analysis showed that time management was positively correlated with self-control ($r = .481$, $p < .01$) and study engagement ($r = .365$, $p < .01$), and negatively correlated with mobile phone dependence ($r = -.462$, $p < .01$). These correlations provide preliminary support for the hypothesized mediation pathways.

Analysis of the mediating effect

The mediation effects were tested using the process v4.1 macro program model 6 developed by Hayes et al.(2013) [47]. Self-control and mobile phone dependence were used as mediating variables, time management as the independent variable, and study engagement as the dependent variable. The mediating effects of self-control and mobile phone dependence between time management and study engagement were explored. The analysis results are shown in Table 2. In Model 1, the independent variable time management has a significant positive effect on the dependent variable study engagement ($\beta = 0.365$, $t = 12.474$, $p < .001$), indicating that the total effect of time management on the impact of study engagement is

Table 1 The main variables and their correlation analysis

	M	SD	Time management	Self-control	Mobile phone dependence	Study engagement
Time management	3.760	0.697	1			
Self-control	3.698	0.796	0.481**	1		
Mobile phone dependence	3.000	0.939	−0.462**	−0.385**	1	
Study engagement	3.508	0.763	0.365**	0.367**	−0.350**	1

$N = 1016$; M, mean; SD standard deviation

**$p < .01$

Table 2 Tests of the mediation model for each variable

	Model 1		Model 2		Model 3		Model 4	
	Study engagement		Self-control		Mobile phone dependence		Study engagement	
	β	t	β	t	β	t	β	t
Time management	0.365	12.474***	0.481	17.453***	−0.360	-11.602***	0.177	5.222***
Self-control					−0.212	-6.835***	0.209	6.407***
Mobile phone dependence							−0.188	-5.815***
R	0.365		0.481		0.499		0.455	
R^2	0.133		0.231		0.249		0.207	
F	155.594***		304.594***		167.457***		88.169***	

***P<.001

Table 3 Tests of the mediation model for each variable

Benefit type		Effect	BootSE	BootLLCI	BootULCI	Proportion of relative effect
Total effect		0.399	0.040	0.314	0.473	/
Direct effect		0.194	0.045	0.102	0.280	48.63%
Indirect effect	TOTAL	0.205	0.027	0.153	0.260	51.37%
	Ind1	0.110	0.024	0.066	0.158	27.56%
	Ind2	0.074	0.017	0.043	0.109	18.54%
	Ind3	0.021	0.005	0.012	0.032	5.26%
	(C1)	0.036	0.032	−0.027	0.099	/
	(C2)	0.089	0.024	0.045	0.139	/
	(C3)	0.053	0.015	0.028	0.084	/

Ind1: Time management→Self-control→Study engagement

Ind2: Time management→Mobile phone dependence→Study engagement

Ind3: Time management→Self-control→Mobile phone dependence→Study engagement

(C1): Ind1-Ind2

(C2): Ind1-Ind3

(C3): Ind2-Ind3

significant. Model 2 independent variable time management (β = 0.481, t = 17.453, *p* <.001) has a significant positive effect on the mediating variable self-control. Model 3: Time management (β = − 0.360, t = -11.602, *p* <.001), self-control (β = − 0.212, t = -6.835, *p* <.001) has a significant negative effect on the mediator variable mobile phone dependence, indicating that the first half of the two mediating paths are significant. Model 4: Time management (β = 0.177, t = 5.222, *p* <.001), self-control (β = 0.209, t = 6.407, *p* <.001) have a significant positive effect on the dependent variable study engagement, and mobile phone dependence (β = − 0.188, t = -5.815, *p* <.001) have a significant negative effect on the dependent variable study engagement, indicating that the mediator's direct effect was significant and the two second half paths were significant. The mediating effect exists, and self-control and mobile phone dependence partially mediate the relationship between time management and study engagement.

The mediating roles of self-control and mobile phone dependence between time management and study engagement were tested using the bootstrap method, and the results are shown in Table 3; Fig. 1 below. The analysis revealed both direct and indirect effects of time management on study engagement. The direct effect of time management on study engagement was significant

(β = 0.194, 95% CI [0.102, 0.280]), indicating that time management has a substantial direct impact on study engagement, independent of the mediating variables. The first indirect path through "self-control" was significant (β = 0.110, 95% CI [0.066, 0.158]), indicating that time management enhances study engagement by improving self-control. The second indirect path through "mobile phone dependence" was also significant (β = 0.074, 95% CI [0.043, 0.109]), suggesting that time management reduces mobile phone dependence, which in turn increases study engagement. The third indirect path through the "chain mediation of self-control and mobile phone dependence" was significant (β = 0.021, 95% CI [0.012, 0.032]), indicating that time management improves self-control, which reduces mobile phone dependence, ultimately leading to higher study engagement. The total effect of time management on study engagement was significant (β = 0.399, 95% CI [0.314, 0.473]), with the indirect effects accounting for 51.37% of the total effect. These results suggest that self-control and mobile phone dependence partially mediate the relationship between time management and study engagement.

The results of this study show that time management predicts study engagement indirectly through
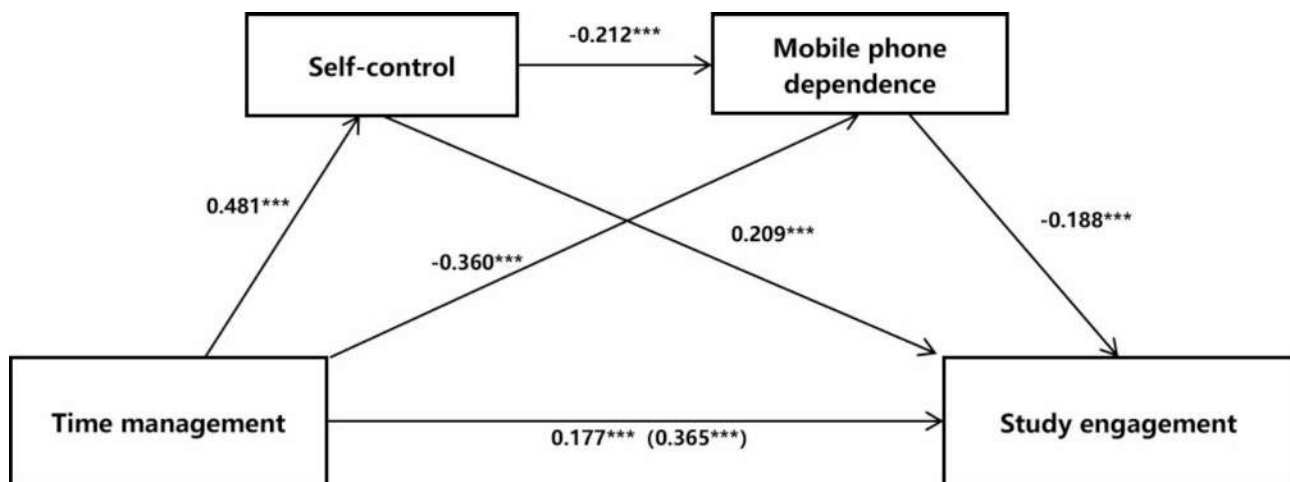
Fig. 1 The chain mediating effects of self-control and mobile phone dependence. *** *P* <.001

self-efficacy and mobile phone dependence, as well as a chain mediation pathway.

Discussion

In this study, time management and study engagement among college students were examined, along with possible mediating factors. The results indicate that time management may influence study engagement by way of self-control and mobile phone dependence, offering theoretical backing for enhancing study engagement.

The relationship between time management and study engagement

This study examined 1,016 Chinese college students using a survey to determine the relationship between time management and study engagement. The results indicated that individuals who excel in time management also exhibit higher levels of study engagement, supporting the validity of Hypothesis 1. The direct effect of time management on study engagement (β = 0.194, 95% CI [0.102, 0.280]) is consistent with previous research. For example, Pan et al. (2011) reported a similar effect size (β = 0.21) in their study on time management and learning adaptability among Chinese university students [7]. Similarly, Zhao et al. (2012) found a moderate positive correlation (r =.34) between time management and study engagement, which aligns with our findings [8]. These comparisons suggest that the effect sizes observed in our study are within the range reported in prior research, further validating the robustness of our results. Time management tendency, considered a multidimensional personality trait, comprises cognitive, emotional, and behavioral sub-dimensions. These dimensions not only reflect an individual's attitude towards time but also indicate how effectively they control and utilize time. Students who exhibit a high propensity for time management are able to effectively prioritize tasks, allocate time efficiently, experience a

sense of accomplishment, enhance learning efficacy, and proactively address challenges. Conversely, students with a low inclination towards time management struggle to appreciate the importance of time, lack effective planning skills, exhibit weak control over their learning attitudes, and fail to fully engage in their academic pursuits, resulting in subpar academic performance. The research conducted by Zhao et al. (2012) [48] demonstrated that students who possess proficient time management skills are able to appreciate the importance of time, effectively assess and organize their time, and allocate the majority of their time to essential learning activities [8]. This results in enhanced personal investment of time and energy in learning and practice. Enhancing students' time management and planning capabilities facilitates their accurate and complete allocation of time to significant learning tasks, thereby progressively enhancing their study engagement [9]. Additionally, certain elements of Chinese culture may also contribute to the positive correlation observed between time management and study engagement. In Chinese culture, there is a strong emphasis on the adage "an inch of time is an inch of gold, and an inch of gold cannot buy an inch of time," highlighting the invaluable nature of time. This cultural value instills in students the importance of valuing their time and utilizing it effectively for learning and personal development. Furthermore, the collectivist ethos prevalent in Chinese culture encourages students to prioritize collective interests and educational achievements, thereby motivating them to manage their time more efficiently to enhance both learning efficiency and outcomes. These cultural factors may partly explain why Chinese college students with high time management tendencies show higher levels of study engagement.

Based on the findings of this study, several constructive recommendations are proposed to enhance the relationship between college students' time management and

study engagement. These include enhancing time management education, promoting the use of time management tools, reinforcing students' self-monitoring and feedback mechanisms, fostering a positive learning attitude among students, and establishing a collaborative home-school partnership. By implementing these strategies, colleges and universities can improve students' time management skills and subsequently elevate their level of study engagement.

The mediating effect of self-control

The findings of this research indicate that time management has a significant impact on study engagement, mediated by self-control. The indirect effect of time management on study engagement through self-control ($\beta = 0.110$, 95% CI [0.066, 0.158]) is comparable to previous studies. Mercer et al. (2011) found a positive correlation ($r = .32$) between self-control and study engagement, which is consistent with our findings [19]. Individuals with higher levels of time management tendencies demonstrate a belief in their ability to effectively manage their time, allocate tasks appropriately, and exhibit greater self-control [16].

Self-control has been found to be a significant predictor of study engagement, as evidenced by the positive correlation between levels of self-control and study engagement [34]. This phenomenon can be elucidated through the lenses of volitional control theory and self-regulated learning theory. According to the volitional control theory, successful learning requires not only internal motivation to drive individuals towards their goals, but also the presence of strong willpower to sustain their efforts until the desired outcome is achieved [49]. According to Simons et al. (2004) [50], setting valuable goals can enhance individuals' sense of control and discipline, leading to improved self-control behaviors towards achieving their ultimate objectives as suggested by Miller and Brickman (2004) [51]. Additionally, the self-regulation learning theory underscores the proactive nature of individuals in regulating their behaviors and perceptions to effectively attain their learning objectives. Self-control, a key component of self-regulation, necessitates students to utilize their willpower to manage their actions, sustain focus during learning tasks, and enhance their engagement amidst learning challenges. Consequently, individuals with robust self-control tend to exhibit high levels of mental toughness, enabling them to mitigate the influence of adverse factors on goal attainment and enhance their engagement in learning activities [52].

To enhance students' study engagement and time management skills, it is imperative for educators to focus on fostering students' self-regulation capabilities. Initially, educators can facilitate students' understanding of the significance of self-control through thoughtfully designed curricula and instructional activities, guiding them in acquiring strategies to enhance self-regulation. Furthermore, educators can implement targeted training programs that incorporate practical exercises aimed at strengthening students' self-control. Additionally, the establishment of positive feedback mechanisms can serve as an encouragement for students to further develop their self-regulatory skills.

The mediating effect of mobile phone dependence

This study demonstrates that mobile phone dependence serves as an indirect mediator in the relationship between time management and study engagement among college students, providing support for Hypothesis 3. The indirect effect of time management on study engagement through mobile phone dependence ($\beta = 0.074$, 95% CI [0.043, 0.109]) is consistent with prior research. For example, Li et al. (2019) reported a similar indirect effect size ($\beta = 0.08$) in their study on mobile phone dependence and academic burnout [32]. Additionally, Huang et al. (2019) found a negative correlation ($r = -.31$) between mobile phone dependence and study engagement, which aligns with our findings [33]. These comparisons suggest that the mediating role of mobile phone dependence is consistent across studies, further validating our results.

Existing research on Internet addiction indicates that effective time management strategies are important to solve the problem of Internet use. Furthermore, time management tendencies, considered as a dimension of personality traits, are significantly associated with addictive behaviors. Effective time management involves reducing reliance on mobile phones by enhancing self-control, minimizing impulsive phone use, and bolstering self-efficacy. Time management plays an important role in enabling individuals to regulate their behavior and decision-making processes, thereby diminishing their reliance on mobile phones. Additionally, effective time management aids individuals in managing their attention and curbing impulsive mobile phones usage. Moreover, the practice of time management empowers individuals to take charge of their personal and professional responsibilities, fostering a heightened sense of self-efficacy. By successfully managing their time and accomplishing tasks, individuals may experience increased confidence and self-esteem, ultimately reducing their dependence on mobile phones.

The theory of media dependence posits that increased reliance on a medium, such as a mobile phone, leads to a greater influence of the medium on the individual [53]. Higher levels of mobile phone dependence are associated with more pronounced negative effects on the individual, particularly in the context of college students' study engagement. Research has demonstrated that mobile phone dependence is a significant predictor of decreased

study time and effort, aligning with the findings of this study [54]. Excessive reliance on mobile phones among college students can impede study time, disrupt normal work and rest routines, diminish sleep quality [55], deplete energy needed for study engagement, and ultimately decrease overall study engagement. Additionally, mobile phone dependence is associated with heightened risk of negative emotions like depression and anxiety [56], which can further contribute to decreased attention and reduced learning efficacy [57]. Based on the above, mobile phone dependence has a negative impact on individuals' cognition, emotions, and daily learning behaviors, which in turn leads to a decrease in the level of individuals' engagement in learning.

Considering the significant detrimental impact of mobile phone dependency on study engagement, the following recommendations are proposed: Firstly, educational institutions should recognize the issue of mobile phone dependency and incorporate it into the framework of students' mental health education. Secondly, schools and families should collaborate to offer students a greater variety of non-mobile-based entertainment and learning opportunities. For instance, students are encouraged to engage in sports, social events, reading, and other activities that promote physical and mental well-being to enhance their life experiences and interpersonal communication skills, while simultaneously reducing reliance on mobile devices. Furthermore, the development and implementation of time management and mobile usage monitoring tools are effective strategies. Lastly, students exhibiting symptoms of mobile phone dependence should seek professional psychological counseling promptly. Through psychological counseling and behavioral therapy, help students identify and change bad mobile phone use habits, improve self-control ability, so as to restore healthy learning and life status.

The chain mediating effects of self-control and mobile phone dependence

Self-control and mobile phone dependence mediated the chain between time management and study engagement in college students, which tested Hypothesis 4.

Both time management and self-control have a significant impact on teenagers' academic performance. Within the framework of the three-dimensional structure of time management tendency, the dimension of time monitoring, which encompasses activities such as scheduling, goal setting, and time allocation [42], serves as a tangible representation of an individual's self-control capacity in managing time effectively. Numerous studies have confirmed a significant positive relationship between self-control and time management, with findings suggesting that individuals with low self-control tend to exhibit poor time management tendencies as a result of challenges in

regulating and restraining their own psychological and behavioral impulses, ultimately leading to decreased investment in learning. This relationship has been supported by previous research [57].

Self-control, as posited by Billieux et al. (2007), is a crucial individual factor impacting mobile phone dependence [58]. This phenomenon can be elucidated through the dual-systems theoretical model and the use-satisfaction theory. The dual-systems theoretical model posits that individuals with higher levels of self-control possess a reflexive system that is sufficiently robust to regulate impulsive behaviors, thereby enabling them to manage their urges to use mobile phones and mitigate problematic usage patterns [59]. Parker and Plank's (2000) use-satisfaction theory suggests that the interactive and convenient nature of mobile phones fulfills an individual's social needs, with lower levels of self-control correlating with increased difficulty in suppressing the impulse to use mobile phones and a heightened likelihood of developing dependence on them [60]. Empirical research has further indicated that an individual's self-control capacity, defined as the ability to resist immediate temptations, suppress inappropriate impulses and behaviors through logical reasoning, and attain objectives in the absence of external limitations, serves as a detrimental predictor of mobile phone dependence [61]. Research has established a correlation between mobile phone dependency and study engagement, particularly among college students. Studies have indicated that the extent of mobile phone dependency among college students is inversely related to their level of study engagement [62]. The abundance of content available on mobile phones serves as an external source of distraction for college students, potentially undermining their academic focus. Failure to effectively manage the balance between mobile phone usage and academic responsibilities may predispose individuals to diminished study engagement.

To tackle this issue, educators and parents may implement a range of strategies aimed at enhancing college students' self-control and time management abilities. Initially, students' time management competencies can be developed through instruction in techniques such as creating study schedules, establishing both short-term and long-term objectives, and prioritizing tasks effectively. Secondly, fostering self-control among students can be facilitated through the establishment of rules and boundaries, the regulation of time spent on mobile devices and the Internet, and the promotion of engagement in sports and social activities. Furthermore, collaboration between educational institutions and families is essential in creating a supportive environment for adolescents, enabling them to receive appropriate guidance and assistance when confronted with temptations and impulses. By employing these strategies, college students

can enhance their ability to manage time and behavior, thereby improving their study engagement.

Limitations

While the study successfully validated its hypotheses, it is important to acknowledge the limitations inherent in its research design. Firstly, while the model validated in this study is grounded in existing research and theoretical frameworks, the use of a questionnaire-based, cross-sectional research design precludes the establishment of definitive causal relationships. Future research could employ longitudinal methodologies to explore the impact of time management on study engagement more thoroughly. Secondly, due to constraints related to time and other objective conditions, this study was limited to a sample of representative undergraduate universities within Shandong Province. Consequently, the sampling scope may not be sufficiently extensive and primarily reflects the local context. The conclusions drawn from this study are not entirely generalizable to other contexts, necessitating the expansion of subsequent research to encompass a broader scope. Furthermore, this investigation focuses on college students to examine the relationship and mechanisms between time management and study engagement. However, additional research is required to ascertain the applicability of these findings to middle and high school students. Lastly, the study controlled for a limited number of extraneous variables, which may have compromised its external validity. Therefore, relevant background factors should be considered in future studies, so as to clarify the relationship between time management and study engagement more clearly.

Conclusion

The findings of the study suggest that time management plays an important role in predicting college students' level of study engagement. Additionally, the results indicate that self-control and mobile phone dependence act as significant mediators in the relationship between time management and study engagement. This study provides further evidence supporting the importance of time management in improving self-control and study engagement, while also decreasing reliance on mobile phones. The findings of this research have the potential to enhance college students' comprehension of the significance of time management, foster awareness of the importance of bolstering self-discipline and diminishing reliance on mobile phones, and ultimately facilitate heightened engagement in study engagement. Consequently, institutions of higher education should implement strategies aimed at enhancing college students' time management skills and self-regulation, reducing their reliance on mobile devices, and thereby fostering increased study engagement and enhancing learning outcomes.

Declarations

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5. Unpacking the dynamics of online learning in higher education through the interplay of engagement, readiness and attitudes (2025)	Discover Education (Article from : Discover

Research

Unpacking the dynamics of online learning in higher education through the interplay of engagement, readiness and attitudes

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Abstract
We explored the relationships among university student's gender, online learning engagement, attitudes toward online learning, readiness, and academic achievement in a public university. While previous research highlights the importance of these factors in online learning, their combined effects remain underexplored, particularly in the Nigerian context. We employed a quantitative research design, collecting data from 353 students through a structured questionnaire. Descriptive statistics, correlation analysis, and multiple regression were used for data analysis. Our results reveal that students exhibit high engagement, readiness, and positive attitudes toward online learning. However, none of these factors significantly predicted academic achievement, suggesting that success in online learning may depend on other elements, such as instructional quality and technological infrastructure. Gender also showed no significant impact on performance. We emphasize the need for a holistic approach to online education, focusing on systemic improvements in teaching practices, course design, and support systems to enhance student success.

1 Introduction

Online learning, or e-learning, refers to using Information and Communication Technology (ICT) tools to facilitate education in both on-campus and off-campus settings [67]. The rapid advancement of digital technology has revolutionized teaching and learning in the twenty-first century, leading to the widespread adoption of online education. Although e-learning has existed since the nineteenth century, its global prominence surged during the COVID-19 pandemic, which forced a shift to remote

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learning. Enrollments in online courses have significantly increased during and after the pandemic [38], as e-learning allows individuals to access education from various locations, promoting self-directed and autonomous learning (Martin et al., 2020).

Despite the many benefits of online learning, challenges such as disengagement and reduced student participation have been reported in some studies [8, 39]. While online learning is often associated with improved academic performance and positive learning outcomes [38], it has also been linked to lower levels of engagement in certain contexts [8]. Online learning has become mandatory in many higher education institutions [40]. Despite initial unpreparedness, many students and instructors have adapted to this new form of education (George, 2022). However, the mode presents psychological, emotional, and financial challenges [14]. Popular platforms like Zoom, Telegram, Microsoft Teams, and Google Classroom now enhance learning by delivering content in interactive formats [41]. For online learning to be truly effective, student's attitudes, readiness, and engagement are crucial factors that directly impact academic outcomes [42].

Student engagement is critical in online learning environments, where students often feel isolated or disconnected [43]. Engagement refers to student's active participation in course content, peer collaboration, and instructor interaction. Effective engagement requires pedagogical strategies that align with 21st-century technologies [2, 43]. Several factors influence engagement, including motivation and attitudes toward ICT adoption. Attitudes, shaped by external factors, significantly impact student's emotional readiness and responses to learning activities [21]. Positive attitudes toward online learning are essential for fostering acceptance and successful adoption [27]. They directly influence student's engagement, readiness, and academic achievement.

Another critical factor is readiness for online learning, reflecting student's skills, experiences, and access to technology. Studies have shown that the quality of course delivery, instructor competence, institutional support, and student satisfaction play essential roles in determining the success of online education [44–46, 4]. The rise of fourth-revolution technologies has improved e-learner's attitudes, readiness, engagement, and academic outcomes [28]. However, research on the role of gender in online learning remains inconclusive. While [68] found no significant gender differences in online engagement [29] reported that male students showed more positive attitudes and engagement. On the other hand, studies by [30, 31] found no significant gender differences, highlighting the need for further exploration of gender dynamics in online learning.

Despite a growing body of research on online learning, gaps remain regarding the specific challenges faced by students in Nigerian higher education. Studies from other regions may not fully capture Nigeria's unique learning environments [47]. This study investigates the levels of online learning engagement, attitudes, readiness, gender, and academic achievement among students at the Federal University Oye-Ekiti (FUOYE), a public university in Nigeria. The study provides insights into how online learning can be effectively implemented and supported in Nigerian higher education by examining these factors. The findings will offer gender-controlled empirical data on the relationships between student's online engagement, attitudes, readiness, and academic achievement, contributing to the existing literature.

This research will be valuable for university administrators and instructors in improving online learning platforms, allocating resources, and enhancing professional development programs. Furthermore, it will assist instructional designers in creating student-friendly virtual environments that promote academic success. The study focuses on several key questions: (1) What is the level of online learning engagement among FUOYE students? (2) What is their level of readiness for online learning? (3) What are their attitudes toward online learning? (4) How do engagement, attitudes, readiness, and gender correlate with academic achievement? (5) To what extent do these factors predict academic achievement? Answering these questions will provide insights into enhancing the online learning experience for students in Nigerian higher education.

2 Theoretical framework

2.1 The community of inquiry (CoI)

The Community of Inquiry (CoI) framework, introduced by [32, 33] has become an essential model in the study of online learning. The CoI framework outlines three interconnected elements—teaching presence, social presence, and cognitive presence—that support student learning in both asynchronous and synchronous online settings [26]. Grounded in social constructivist theory, the framework posits that meaningful learning arises through social interaction and collaborative knowledge construction [16]. Teaching presence is crucial, emphasizing the design, facilitation, and direction of the educational experience [48], while cognitive presence fosters critical thinking and problem-solving through reflective discourse [11, 49]. Social presence, which encourages learners to feel connected and engaged, is critical in promoting learning satisfaction and academic success. Together, these elements create a robust and supportive online learning environment that fosters student's engagement, satisfaction, and achievement [11].

2.2 The technology acceptance model (TAM)

The Technology Acceptance Model (TAM), proposed by [50] is widely used to understand factors influencing technology adoption, including online learning platforms. The model suggests that two key factors—perceived ease of use and perceived usefulness—drive user's intentions to adopt a given technology [50]. These factors shape attitudes toward technology, subsequently influencing actual use [51]. In online education, student's perceptions of a platform's ease of use and usefulness directly impact their readiness to adopt it and their performance in online courses [51]. TAM also highlights external factors, such as previous experience and technological support, which shape user's attitudes toward technology [50]. Studies show that students who find online platforms easy to navigate and useful are more likely to engage with course content and perform better academically [51]. Thus, TAM provides a valuable framework for understanding how psychological and external factors affect student's engagement with online learning, influencing their academic outcomes.

2.3 Concept of online learning

The internet and technological advancements have transformed education in the digital age, making online learning widely adopted [52]. Lawal et al. [53]define online learning as an internet-supported environment that facilitates communication between teachers and students and provides access to educational resources. According to [54], online learning employs digital devices and electronic teaching aids to enhance learning effectiveness and improve student achievement [10]. The flexibility of online learning allows students to access information, complete assignments, and address academic needs at their convenience [55]. Higher education institutions increasingly adopt online learning due to its efficiency, innovation, and ability to deliver high-quality education in a collaborative and flexible format [56].

2.4 Student's online engagement

Student engagement in online learning refers to the extent of their active participation in learning activities and interactions with peers and instructors. Grey and DiLoreto (2016) define engagement as the interest, interaction, and motivation that students exhibit in relation to course content. Research has shown a positive correlation between engagement and academic outcomes [7]. Engagement encompasses various dimensions, including skill engagement, emotional engagement, participation/interaction engagement, and performance engagement [34]. Skill engagement relates to applying psychomotor skills in the learning process, while emotional engagement involves student's attitudes and feelings toward learning [19, 20]. Participation and interaction engagement measure the extent of involvement in collaborative activities and discussions. Studies show that higher levels of student engagement lead to better academic performance, but technical difficulties or a lack of necessary skills to navigate online platforms can hinder engagement [8].

2.5 Student's attitudes toward online learning

Student's attitudes toward online learning significantly influence their engagement and academic success. Attitudes, shaped by previous experiences, can determine behavior and willingness to participate in online courses (18). Positive attitudes toward online learning correlate with higher engagement, performance, and satisfaction (Naser & Neger, 2022 [57]. For instance, students with positive attitudes are more likely to actively engage in discussions and collaborate with peers, leading to improved academic outcomes [58]. Conversely, negative attitudes can hinder participation and result in lower academic performance [59]. Studies have consistently shown that fostering positive attitudes toward online learning is crucial for improving student's outcomes [6, 23].

2.6 Student's online learning readiness

Online learning readiness refers to student's preparedness to effectively engage with online platforms and resources. It encompasses both mental and physical preparation for the learning process and is essential for success in online courses [35]. Students with higher levels of readiness tend to engage more with course content and achieve better academic outcomes [60]. Factors such as prior experience with technology and self-directed learning skills significantly impact readiness [9]. Studies have shown that readiness is positively correlated with engagement and

academic performance [61, 12]. However, many students exhibit only moderate levels of readiness, highlighting the need for institutions to provide adequate support and resources to enhance student's preparedness for online learning, [36, 37].

2.7 Relationship among student's gender, online engagement, attitudes, readiness, and academic achievement

The relationship between gender and online learning readiness, engagement, and academic achievement has been widely debated. Some studies, such as [62], have found a strong relationship between student's academic achievement, emotional competencies, and readiness for online learning. In Nigeria, 53 found that pre-service teachers were well-prepared for online learning and held favorable attitudes toward it. Similarly, Zeybek [25] found that pre-service teachers exhibited high levels of engagement and readiness for online learning. Other studies confirm that online readiness and engagement are positively correlated with academic success [63, 1]. A meta-analysis by Liu et al. (2022) also revealed that negative attitudes are associated with poor academic performance, further reinforcing the importance of attitudes in determining academic success in online learning environments. Regarding gender, studies show mixed findings. Some, like report no significant gender differences in readiness or engagement, while others, such as found that female students displayed more positive attitudes toward online learning. In contrast, research by indicated that female students exhibited higher levels of fear toward online learning, while male students had more positive attitudes. Although there is no consensus, research generally suggests that attitudes, readiness, and engagement are stronger predictors of academic success than gender alone. Thus, the complex interactions between these factors warrant further investigation to better understand how they shape student's experiences and outcomes in online learning environments.

3 Methodology

3.1 Research design

We employed an ex-post facto research design, a non-experimental approach that examines existing conditions to explore relationships between variables [64]. This method was chosen to investigate the influence of online learning readiness, engagement, and attitudes on pre-service teacher's academic achievement. Since no manipulation of variables occurred, this design allowed us to explore cause-and-effect relationships in a setting where variables could not be ethically or practically manipulated [65]. A cross-sectional approach was also employed, collecting data at a single point in time to provide a snapshot of student's experiences.

3.2 Context and participants

The study was conducted at the Federal University Oye-Ekiti (FUOYE), Nigeria, where online learning was mandated during the 2021/2022 academic session in response to institutional disruptions. Participants were third-year pre-service teachers from the Faculty of Education, enrolled in EDU 311: Test and Measurement in Education, a course delivered entirely online. From the initial enrollment of 695 students, 353 consented to participate by clicking on the "I accept to participate" icon of the Google Form. These participants were then purposively selected upon their voluntary consent to participate in the study and consenting to the researcher's access to their achievement scores from the Faculty examination committee. These pre-service teachers were selected because their academic performance in mandatory online courses could be objectively measured, and they represent future educators who will influence digital learning environments.

3.3 Measurement instruments

Four instruments were used to measure online learning readiness, engagement, attitudes, and academic achievement:

Online Learning Readiness Scale: We adopted the Student's Online Learning Readiness (SOLR) scale by Yu and Richardson [24], which assesses technical, social, and communication competencies through 20 items on a 5-point Likert scale. The scale demonstrated strong reliability in the pilot test (α = 0.83).

Online Student Engagement Scale: Adapted from [43], this 19-item scale assesses student's engagement in online learning using a 5-point Likert scale. The reliability of this scale was confirmed in our study (α = 0.86).

Student's Attitude Towards Online Learning Questionnaire: Based on Kisanga's [17] TeLRA scale, this 22-item questionnaire measured student's attitudes across four factors: technology use, satisfaction, motivation, and perceived usefulness, with a 4-point Likert scale. Reliability was confirmed during pilot testing (α = 0.85).

Student's Academic Achievement: Academic achievement was measured using student's scores from the EDU 311 course, obtained through FUOYE's Computer-Based Testing (CBT) system, providing objective performance data.

3.4 Content validity and pilot testing

Content validity was assessed by faculty experts at FUOYE, who reviewed the instruments for relevance and clarity. The Content Validity Index (CVI) for each instrument exceeded 0.80, confirming their suitability for the study. A pilot test with 50 students confirmed the internal consistency of the instruments, with Cronbach's alpha values ranging from 0.83 to 0.86.

3.5 Data collection procedure

Following ethical approval from the Faculty of Education Research Ethics Committee at FUOYE, data were collected via a Google Form distributed through the EDU 311 Telegram group. Participants were informed about the study's purpose, the voluntary nature of participation, and confidentiality measures. They provided consent before completing the survey, and reminders were posted to encourage participation. Data collection occurred from April 1 to June 1, 2022.

3.6 Data analysis

We used SmartPLS 4.0 for data analysis, starting with descriptive statistics to summarize the central tendencies in online learning readiness, engagement, and attitudes. The median was used as the primary measure of central tendency to provide a robust summary unaffected by outliers. We then assessed the measurement model's reliability and validity using composite reliability (CR) and Average Variance Extracted (AVE). CR values above 0.70 confirmed internal consistency, and AVE values above 0.50 indicated adequate convergent validity. Discriminant validity was assessed using the Heterotrait-Monotrait Ratio (HTMT), with values below 0.85 confirming that the constructs were distinct. Regression and correlation analyses were employed to explore the relationships between readiness, engagement, attitudes, and academic achievement. This analysis helped determine the predictive power of these variables on student's academic performance.

3.7 Common method bias

To minimize common method bias, Harman's single-factor test was conducted, revealing that no single factor accounted for more than 50% of the variance, indicating that common method bias was not a significant concern.

3.8 Ethical considerations

Ethical approval was obtained from FUOYE's Faculty of Education Research Ethics Committee. Participants were fully informed about the study's aims, confidentiality measures, and their right to withdraw at any time. Informed consent was obtained, and all data were anonymized using unique participant codes. Data were securely stored and accessible only to the research team to ensure confidentiality.

4 Results

The demographic data of the participants offer a clear understanding of the sample composition in terms of gender, age, and discipline. Female participants comprised 65.7% (232 students), and male participants represented 34.3% (121 students), showing a significant female majority, which is common in education-related fields. Regarding age, the majority of the participants (85.6%) were between 20 and 24 years, while 11.9% were aged 25–29, and only a small percentage were either younger (1.7%) or older than 30 (0.8%). In terms of academic discipline, participants were from various fields within the Faculty of Education. The largest groups were from Library and Information Science (22.4%) and Business Education (21%), together representing over 40% of the sample. Other notable disciplines included Biology Education (10.8%), Educational Management and Economics (10.2%), and Agricultural Education (9.1%). Smaller disciplines included Physics Education (3.7%), Economics Education (1.7%), and Human Kinetics (0.6%). This distribution shows the diversity of academic backgrounds within the sample.

4.1 RQ1: What is the level of online learning engagement among students in FUOYE?

The analysis of online learning engagement at FUOYE revealed that students exhibit high engagement across all 19 items on a 5-point Likert scale (see Table 1). Values between 1.0 and 2.9 indicated low engagement, while values between 3.0 and 5.0 reflected high engagement. Students consistently reported high engagement in online learning activities, such as studying regularly (median=4.00), making efforts in online learning (median=4.00), and staying up-to-date with readings (median=3.00). Additionally, students showed high engagement with course materials, such as carefully reading materials and taking notes (median=4.00), and found the online materials relevant to their lives, applying them to real-world contexts (median=4.00). Regarding collaborative engagement, students were slightly less engaged in group activities and discussions, although still scoring relatively high (median=3.00 to 4.00). For instance, while small-group discussions saw active participation (median=4.00), helping fellow students and getting to know others through online forums scored slightly lower (median=3.00). Students also perceived their engagement as beneficial to their academic performance, reporting good grades due to participating in online learning (median=4.00).

4.2 RQ2: What is the level of online learning readiness among FUOYE students?

Online learning readiness at FUOYE was measured across four domains: technical confidence, social competencies with lecturers, social competencies with classmates, and communication competencies. Table 2 shows that students exhibited a high level of readiness. For technical readiness, students demonstrated moderate confidence in using various technologies (median=3.00). However, they expressed high comfort in using computers (median=4.00) and motivation to engage in learning activities involving technology (median=4.00). In social competencies with lecturers, students reported moderate to high comfort levels in asking questions (median=3.00) and initiating discussions (median=3.00). Social competencies with classmates were generally high, especially in developing friendships and interacting respectfully (median=4.00). However, slightly lower scores were observed in initiating social interactions (median=3.00). In communication competencies, students were confident in expressing their opinions in writing (median=3.00) and providing constructive feedback (median=3.00). Overall, students demonstrated strong readiness across all domains, although some areas, such as initiating peer interactions, may require further support.

4.3 RQ3: What attitude do FUOYE students have toward online learning?

Table 3 showed that students at FUOYE generally held positive attitudes toward online learning, agreeing with statements about technology's benefits in education. They found online learning economical (median = 3.00), believed it improved the quality of their work (median = 3.00), and appreciated the flexibility it offers in accessing and revising materials (median = 3.00). They also expressed excitement about using computers for learning (median = 3.00) and agreed that online learning provides better opportunities than traditional methods (median = 3.00). Students disagreed with statements suggesting difficulties or frustrations with technology. For example, they did not find using computers for online learning frustrating (median = 2.00) and disagreed that e-learning tools were difficult to master (median = 2.00). While

Table 1 Online learning engagement among students

S/no	Manifested variable	Median	Remarks
1	Making sure to study regularly	4.00	High
2	Putting forth efforts for better online learning	4.00	High
3	Staying up on the readings after every online learning class	3.00	High
4	Carefully reading materials and texts sent via online classes	4.00	High
5	Taking good notes over readings, powerpoints, or video lectures from online classes	4.00	High
6	Listening/reading carefully during and after online classes	4.00	High
7	Finding ways to make the online course materials relevant to my life	4.00	High
8	Applying online course materials to my life	4.00	High
9	Finding ways to make online courses interesting to me	4.00	High
10	Really desiring to read and learn more from online materials	4.00	High
11	Having fun in online chats, discussions or via email with the lecturers or other students	3.00	High
12	Participating actively in small-group discussion forum	4.00	High
13	Helping fellow students during and after every online classes	3.00	High
14	Getting a good grade as a result of participating in online classes	4.00	High
15	Doing well in online tests/quizzes	4.00	High
16	Engaging in conversations online (chat, discussions, email)	4.00	High
17	Posting in online discussions forum regularly	3.00	High
18	Getting to know other students through online class forums	3.00	High
19	Giving great attention during online classes	4.00	High

Table 2 Online learning readiness among students in FUOYE

	Manifested variable	Median	Remarks
TC1	I have a sense of self-confidence in using computer technologies for specific tasks	3.00	High
TC2	I am proficient in using a wide variety of computer technologies	3.00	High
TC3	I feel comfortable using computers	4.00	High
TC4	I can explain the benefits of using computer technologies in learning	4.00	High
TC5	I am competent at integrating computer technologies into my learning activities	3.00	High
TC6	I am motivated to get more involved in learning activities when using computer technologies	4.00	High
SCL1	Clearly, I ask my lecturers questions	3.00	High
SCL2	Initiate discussions with the lecturers	3.00	High
SCL3	Seek help from lecturers when needed	3.00	High
SCL4	Timely inform the lecturers when unexpected situations arise	3.00	High
SCL5	Express my opinions to lecturers respectfully	3.00	High
SCC1	Develop friendships with my classmates	4.00	High
SCC2	Pay attention to other student's social actions	3.00	High
SCC3	Apply different social interaction skills depending on the situation	3.00	High
SCC4	Initiate social interaction with classmates	3.00	High
SCC5	Socially interact with other students with respect	4.00	High
CC1	I am comfortable expressing my opinion in writing to others	3.00	High
CC2	I am comfortable responding to other people's ideas	4.00	High
CC3	I can express my opinion in writing so that others understand what I mean	4.00	High
CC4	I give constructive and proactive feedback to others even when I disagree	3.00	High

TC Technical confidence, *SCL* Social competencies with lecturers, *SCC* Social competencies with classmates, *CC* Communication competencies

students acknowledged that online learning requires expensive technical support (median = 3.00), they did not believe this reduced the quality of education. Overall, students at FUOYE had a significantly positive attitude toward online learning, recognizing its benefits while expressing minimal concerns about technological difficulties.

4.4 Measurement model assessments

The reliability and validity (see Table 4) of the constructs were assessed using Cronbach's Alpha, Composite Reliability (CR), and Average Variance Extracted (AVE). Cronbach's Alpha values for most constructs exceeded the 0.7 threshold, indicating acceptable internal consistency, with high scores for Student's Online Learning Engagement ($\alpha = 0.953$) and Technical Confidence ($\alpha = 0.908$). Motivation ($\alpha = 0.654$) and Satisfaction ($\alpha = 0.672$) fell slightly below 0.7, acceptable in exploratory studies. CR values exceeded 0.7 across all constructs, further affirming the reliability of the measurement model. AVE values above 0.5 confirmed good convergent validity, with constructs explaining more than half of the variance in the observed variables. Discriminant validity (see Table 5), assessed using HTMT values, showed no significant overlap among constructs, indicating strong construct validity.

4.5 RQ4: What relationship exists among student's online learning engagements, attitudes, readiness, gender, and academic achievement?

Correlation analysis at a 0.05 significance level revealed no significant relationship between gender and academic achievement ($r = 0.100$), gender and online learning readiness ($r = -0.158$), or gender and online learning engagement ($r = -0.096$). Similarly, no significant correlations were found between academic achievement and student's online learning engagement ($r = -0.034$), attitudes ($r = -0.022$), or readiness ($r = -0.007$). These findings suggest that gender, online learning readiness, engagement, and attitudes do not significantly influence academic achievement in the online learning context at FUOYE.

Table 3 Student's attitude towards online learning

Manifested variable	Median	Remarks
TUT1-I make errors frequently when using a computer	2.00	Disagree
TUT2-It will be difficult for me to become skillful in using e-learning tools	2.00	Disagree
TUT3-Using a computer at home is very frustrating	2.00	Disagree
TUT4-I find computer online interaction unexciting	2.00	Disagree
TUT5-Communicating through electronic mail is annoying	2.00	Disagree
TUT6-Online learning infrastructure is very expensive for the government to afford	2.00	Disagree
SAT1-Online learning is very economical for educational institutions to adopt	3.00	Agree
SAT2-I believe using e-learning will improve the quality of my work	3.00	Agree
SAT3-Computers make work more interesting	3.00	Agree
SAT4-It is easier to revise electronic educational materials than printed material	3.00	Agree
SAT5-I prefer using a computer to prepare my lessons	3.00	Agree
MOT1-Working with computers is exciting	3.00	Agree
MOT2-My institution has enough teaching–learning resources to carry out online learning	2.00	Disagree
MOT3-I like discussing about new e-learning innovations	3.00	Agree
MOT4-Online learning will provide me with better learning opportunities than traditional means of learning	3.00	Agree
MOT5-Using online learning technologies will allow me to accomplish more work than would otherwise be possible	3.00	Agree
MOT6-I enjoy learning using computers	3.00	Agree
USF1-Online learning reduces the quality of knowledge attained	2.00	Disagree
USF2-Online learning requires expensive technical support	3.00	Agree
USF3-Delivering a lecture through electronic technologies is very difficult	2.00	Disagree
USF4-Interacting with the computer system is often frustrating	2.00	Disagree
USF5-Discussions on e-learning technologies are uninteresting	2.00	Disagree

Table 4 Reliability and validity assessment of the constructs

Constructs	Cronbach's alpha	Composite reliability (rho_c)	Average variance extracted (AVE)
Communication competencies	0.717	0.865	0.763
Motivation	0.654	0.777	0.653
Satisfaction	0.672	0.780	0.644
Social competencies with classmate	0.824	0.872	0.698
Social competencies with learners	0.807	0.876	0.704
Students online learning engagement	0.953	0.953	0.558
Technical confidence	0.908	0.930	0.727
Tendency to use technology	0.737	0.877	0.782
Usefulness	0.679	0.819	0.604

Table 5 Discriminant validity – Heterotrait-Monotrait ratio correlation

Constructs	Achievement score	CC	MOT	SAT	SCC	SCL	SOE	TC	TUT	USF
Achievement score										
CC	0.050									
MOT	0.052	0.398								
SAT	0.077	0.384	0.787							
SCC	0.026	0.783	0.347	0.210						
SCL	0.021	0.521	0.324	0.228	0.450					
SOE	0.042	0.665	0.463	0.432	0.581	0.620				
TC	0.081	0.597	0.348	0.292	0.583	0.558	0.580			
TUT	0.094	0.084	0.114	0.336	0.168	0.109	0.103	0.129		
USF	0.062	0.255	0.208	0.202	0.149	0.123	0.215	0.071	0.485	

4.6 RQ5: To what extent do student's gender, online learning engagements, attitudes, and readiness predict their academic achievement in online learning?

Regression analysis was conducted to examine the predictive relationships between student's gender, online learning readiness, engagement, attitudes, and academic achievement. Table 6 indicated that online learning readiness (Beta = −0.018, p = 0.806), online learning engagement (Beta = -0.003, p = 0.965), and attitudes (Beta = 0.011, p = 0.843) did not significantly predict academic achievement. Gender approached significance (Beta = 0.099, p = 0.070), suggesting a marginal influence, though not statistically significant. These findings indicate that while gender may have a slight impact, student's online learning readiness, engagement, and attitudes are not strong predictors of academic achievement in this context.

5 Discussion

In this study, we assessed the levels of and relationships among university student's gender, online learning engagements, attitudes toward online learning, online learning readiness, and academic achievement in a Nigerian public university. Our findings provide crucial insights into the dynamics of online learning in this context and have significant implications for educational practices and policies.

Our study revealed high levels of online learning engagement among students who actively participated in activities like attending online classes, submitting assignments, and interacting with peers and lecturers. Given that online teaching and learning are fairly a new phenomenon in the context under study, educators and students alike would be eager to engage with the process fully. Several modules/academic courses in the university under study must

Table 6 Summary statistics of direct effect relationship among the variables

Model	Standardized Coefficients Beta	T	Sig	95.0% Confidence interval for beta Lower bound	Upper bound	Collinearity statistics Tolerance	VIF
Constant							
		12.595	0.000	50.812	69.619		
SOLR	− 0.018	− 0.246	0.806	− 0.125	0.098	0.511	1.958
SOE	− 0.003	− 0.044	0.965	− 0.108	0.103	0.480	2.085
SATOL	0.011	0.199	0.843	− 0.116	0.142	0.869	1.151
Gender	0.099	1.817	0.070	− 0.166	4.193	0.963	1.038

transition these modules to fully online learning mode. As such, students have no choice but to engage fully in the learning mode. This aligns with [27, 28] and Zeybek [25], who noted that innovative and flexible online learning strategies significantly enhance student engagement. The support provided by the university in promoting online learning—especially post-pandemic—likely contributed to these high engagement levels. Geng et al. [12] similarly emphasized that student engagement is critical for learning outcomes in online settings. However, our results contradict Hollister et al. [13], who reported lower engagement, potentially due to differences in technology infrastructure, institutional readiness, and support systems. These variations suggest that further research is needed to understand the factors driving online engagement across diverse educational contexts. Also, our findings showed that students demonstrated high levels of online learning readiness, likely influenced by their experiences during the COVID-19 pandemic when online learning became essential. Student's readiness for online learning may have been enhanced by the sampled university's establishment of several computer training and assessment centers, where students are trained and assessed on their readiness and eventual competence regarding the adoption of online learning technologies for their academic concerns [3]. This finding is consistent with studies by Carvalho and Cunha [9, 61] Geng et al. [12], who reported increased online readiness among students familiar with digital learning platforms during the pandemic. However, our results differ from Kabir et al. who found only moderate readiness levels, likely due to varying access to technology and internet resources. In our case, strong institutional infrastructure and support might have enhanced student's confidence in using online learning tools.

Furthermore, students in our study displayed significantly positive attitudes toward online learning, with a willingness to engage in this mode of education. Since these students view online teaching and learning as a new and emerging educational tool, they have a keen interest in exploring the tool to the latter. This keen interest results in positive attitudes and acceptance of online learning among these students. This aligns with findings from Baczek et al. [5, 52] and Juraković et al. [15], where students appreciated the flexibility and convenience of online learning. The growing integration of technology into everyday life and familiarity with digital platforms likely contributed to these positive attitudes. However, our results contrast with Prakasha et al., Liu et al. (2022), and Basar et al. [6], who found negative attitudes in their samples, possibly due to differences in the quality of online platforms or institutional support. The university's endorsement of online learning in our study may have fostered more positive perceptions. One notable finding was the lack of a significant relationship between student's gender, online learning readiness, engagement, attitudes, and academic achievement. Academic performance, especially within the context of this study, may not have a strong connection with the investigated variables. Individual Differences, including student's unique psychological and learning profiles, can mitigate standardized predictive models, the nature of the academic calendar, where students seem too overloaded with numerous academic tasks, and other external factors such as family support, institutional environment, and socioeconomic background could be significantly impacting these sampled student's academic outcomes. This contrasts with studies suggesting a link between these factors and academic outcomes, such as Benny [7], Bergdahl [8, 39]. In our study, while students displayed high readiness, engagement, and positive attitudes, these did not directly translate into improved academic performance. Our findings align with 52 Whitely [22, 66] who found no significant impact of gender or these factors on academic outcomes.

We believe that in our context, other factors—such as teaching quality, course design, and institutional resources—may play a more critical role in determining academic success. This highlights the complex nature of online learning, where multiple variables interact to influence performance. The high levels of online learning engagement, online learning readiness, and positive attitudes toward online learning, although not significantly associated with student's academic

success are supported by the CoI and the TAM theories. Since online education requires some levels of student's learning engagement, readiness, and positive attitudes, educator's and student's cognitive and social engagements, readiness, and positive attitudes are paramount for the continued functionality of online teaching and learning in several Nigerian universities.

6 Conclusion

Our study assessed the levels of and relationships among gender, online learning engagement, attitudes toward online learning, online learning readiness, and academic achievement in a Nigerian public university. We found that students exhibited high levels of engagement, readiness, and positive attitudes toward online learning. However, these factors did not significantly predict academic achievement, suggesting that additional variables may play a more critical role in determining student success in online learning environments. While gender showed a minor influence, it was not a statistically significant predictor of academic achievement. In conclusion, our findings suggest that although students are well-prepared and engaged in online learning, other factors beyond those examined in this study may be necessary to fully understand and enhance academic performance in online learning. Universities should adopt a more comprehensive approach to supporting students in these environments, considering the full range of factors that influence learning outcomes. The study's findings highlight key implications for online learning in education. High levels of student engagement, readiness, and positive attitudes suggest that universities should continue investing in online platforms as viable alternatives to traditional learning. However, the lack of a significant relationship between these factors and academic achievement points to the need for a more comprehensive approach, including improving teaching quality, course design, and support services. While gender was not a significant predictor, its minor influence (p=0.070) suggests that universities should maintain inclusive practices to ensure equitable learning environments for all students. The findings of this study contribute to global educational challenges, such as the Sustainable Development Goals (SDGs) 4 (quality education), 5 (gender inequality), and 10 (reduced inequalities) of the United Nations. Contextual, personality traits and psychological factors not considered in this current study could provide a nuanced prediction of student's academic performance in online learning. Increased funding and support should be provided for all Nigerian universities (and universities in other parts of the world) to improve adoption and engagement with online education and performance in online learning assessment. Professional training and development centers be established and fully equipped to prepare educators and students in universities for continued adoption of online teaching and learning mode.

7 Limitations and future directions

Our study has several limitations that should be considered in future research. First, the study was conducted at a single Nigerian public university, which may limit the generalizability of our findings to other institutions, both within and outside of Nigeria. Future research could expand the scope by including multiple institutions to provide a more representative understanding of online learning dynamics across different contexts. Second, while our study focused on variables such as engagement, readiness, and attitudes, we did not examine other important factors, such as teaching quality, course design, and technological infrastructure. Future research should explore these additional factors to gain a more nuanced understanding of what drives academic achievement in online learning environments. Finally, our study employed a quantitative research approach, which provides valuable statistical insights but may not capture the full complexity of student's experiences in online learning. We suggest that future research adopt a mixed-methods approach, incorporating both quantitative and qualitative data to explore student's experiences more deeply and understand the challenges and opportunities they face in online learning environments.

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Data availability The dataset used in this research is available upon request.

Declarations

Competing interests The authors declare no competing interests.

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TITLE	SOURCE TITLE
6. Examining the effects of academic stress on student well-being in higher education (2025)	Humanities and Social Sciences Communications (Article from : Springer Nature)

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Examining the effects of academic stress on student well-being in higher education

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This study examines the impact of academic stress, exacerbated by the COVID-19 pandemic, on the mental health of university students. Using a mixed methodology, quantitative data obtained through a validated questionnaire and qualitative data collected in focus groups were combined, providing a comprehensive picture of stress's physical, psychological, and behavioral manifestations in 256 students at the Faculty of Education of the University of La Laguna. Quantitative results show that the main stressors are homework overload, assessment pressure, and difficulty reconciling academic and personal life. The qualitative analysis delves into how students perceive and manage these factors, revealing strategies such as planning and emotional support to mitigate stress. The combined findings suggest institutional interventions to reduce academic stress and promote an environment conducive to students' holistic well-being.

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Introduction

Academic stress is a complex phenomenon significantly affecting global university students' well-being and academic performance. This pressure's scope manifests in their educational environment and personal lives. Students frequently exhibit psychological reactions such as anxiety and depression, along with physiological symptoms such as sleep disturbances, drowsiness, and chronic fatigue. Conducted at the Faculty of Education at the University of La Laguna (ULL), this study aims to analyze the variables that generate stress in students, their responses, and how they influence their daily lives and academic performance.

Academic stress in times of COVID-19 pandemic. The impact of the pandemic on academic environments has been evident across various educational systems. A descriptive study conducted in the Republic of Ecuador, using the SISCO Inventory of Academic Stress by Barraza, identified task overload as one of the main stressors for students (Pérez-Jorge et al., 2021; Moreno-Montero et al., 2022). If not properly managed, this type of stress can lead to burnout, characterized by profound exhaustion and negative physiological and psychological consequences (Marenco-Escuderos et al., 2017).

Numerous studies have emphasized how the transition to online learning increased stress and anxiety among university students. Son et al. (2020) highlighted that the rapid shift to virtual models, combined with social isolation, significantly impacted students' mental health in the United States, leading to increased stress, anxiety, and depression. Similarly, Kecojevic et al. (2020) noted that undergraduate students in New Jersey faced considerable mental health challenges, primarily due to academic pressure and uncertainty about the future. Gavurova et al. (2022) also linked virtual learning and excessive use of digital technologies with symptoms of internet addiction, stress, anxiety, and depression.

Lee et al. (2021) examined how stress, anxiety, and depression manifested among undergraduate students during the pandemic, noting an increasing demand for mental health services as students sought support to manage these psychological impacts. These findings align with Martínez-Líbano et al. (2023), who studied post-pandemic mental health issues among Chilean higher education students and found that stress, anxiety, and depression persisted beyond the most acute phase of the pandemic. This underscores the need for psychological and social interventions to support student recovery even today.

Tsantopoulos et al. (2022) discussed the broader implications for higher education in a post-pandemic world, emphasizing the importance of adapting educational policies to support student well-being better. This includes addressing academic challenges and building more resilient systems to manage future crises. Similarly, Ross et al. (2023) emphasized the need to foster stress adaptation and resilience within higher education institutions, highlighting the importance of training students and academics in coping skills for potential critical situations that require a return to virtual teaching models.

Regarding student well-being, Kiltz et al. (2024) analyzed the satisfaction of basic psychological needs during the pandemic in the Netherlands. Their study revealed that the frustration stemming from the conditions imposed by the pandemic contributed to increased stress. They advocated for fostering environments supporting students' psychological needs, emotional autonomy, and technological competencies to improve well-being and academic performance.

Although much of the literature has examined the effects of the pandemic, few studies have explored effective strategies for managing academic stress in the post-pandemic context. Recent research suggests that mindfulness training, emotional regulation techniques, and structured peer support programs are effective in helping students cope with academic stress (Martínez-Líbano et al., 2023; Kiltz et al., 2024). These strategies strengthen students' resilience and provide them with tools to navigate academic challenges in the current educational landscape.

Anxiety and academic stress. On the one hand, differentiating between anxiety and academic stress is crucial to addressing these phenomena effectively. According to Broks et al. (2024), academic stress and test anxiety are often intertwined, particularly in students with specific self-regulated learning profiles, where poor coping mechanisms exacerbate stress and anxiety, affecting both mental health and academic performance. Anxiety, according to Ruiz-Ruiz et al. (2021), manifests through physiological changes such as muscle tension, restlessness, and worry. There are two types of anxiety: non-specific, which is not related to a concrete stimulus, and specific, which is. On the other hand, stress is an adaptive response to situations or stressors perceived as challenging or threatening. This can be acute, acting as a performance facilitator in certain situations, or chronic, where its persistence can cause exhaustion and a series of mental health problems. Academic stress originates when students face demands perceived as excessive compared to their resources or capabilities, leading to a cycle of negative thoughts and diminished academic performance (García-Ros et al., 2012). Dumitrescu and De Caluwé (2024) further explore how the impostor phenomenon—characterized by fear of failure and self-doubt—can heighten academic stress, leading to burnout and generalized anxiety common among university students. This phenomenon, described by Barraza (2008) and López et al. (2021), indicates that inadequate tools to manage conflicts and academic demands can result in chronic stress.

The impact of the COVID-19 pandemic on anxiety and academic stress has been widely documented. Brown and Papp (2024) conducted a 4-year longitudinal analysis showing how students' stress and coping mechanisms evolved during the pandemic, significantly impacting their sleep quality and overall mental health. Similarly, Chen et al. (2024) and Moreno et al. (2022) identified a strong link between academic stress and depression during the pandemic, highlighting the importance of addressing these mental health issues in educational settings. Yang and Geng (2024) further examined how COVID-19-related anxiety affects students' engagement and academic resilience, demonstrating that prolonged anxiety can undermine cognitive and behavioral engagement.

If not proactively addressed through emotional education and other coping strategies, academic stress can have severe consequences for students' mental health, including the development of stress-related disorders and an increase in school failure rates (Suárez-Montes et al., 2015; Vélez and Roa, 2005). Mize (2024) explored how the sudden shift to online learning during the Spring 2020 semester due to the pandemic affected students' anxiety and stress, underscoring the need for adaptive coping strategies to mitigate these effects. Additionally, Pang et al. (2024) found that perceived overload and academic anxiety, compounded by social media exhaustion, were significant stressors among international students, suggesting the importance of addressing these external factors. Finally, Sulak and Koklu (2024) utilized the Depression, Anxiety, and Stress Scale (DASS-42) to measure the prevalence of these symptoms, offering a detailed understanding of how academic stress and anxiety manifest in university students.

Stressors and their academic effects. Academic stressors, as Silva-Ramos et al. (2020) well identify, profoundly impact the overall university experience, with a broad spectrum of students experiencing moderate to high levels of stress. Teacher evaluation emerges as a commonly reported stressor. Factors such as socioeconomic and cultural context also play critical roles in academic stress (Vidal-Conti et al., 2018). Family dynamics are also key (Garbanzo, 2007; González-Herrera et al., 2021; Morales and Barraza, 2017).

Students employ a variety of coping strategies to manage academic stress. Zhang et al. (2024) highlight that meaningful work can moderate the adverse effects of hindrance stressors, increasing work engagement and reducing turnover intentions. This concept could be applied to educational settings where students engage more deeply when the academic work feels meaningful. Zhao et al. (2024) also explore how emotional intelligence and an error management culture can enhance students' learning from challenges. This approach could aid in mitigating the effects of stressors by promoting resilience and emotional regulation in academic contexts.

Emotional education and cognitive processes are fundamental for self-regulation and stress management (Ariño-Mateo et al., 2022; Palma-Delgado and Barcia-Briones, 2020; Pérez-Jorge et al., 2021; Pérez-Jorge et al., 2016). López et al. (2021) highlight how these stressors can disturb the body's homeostatic balance, manifesting in physiological alterations such as changes in heart rate and blood pressure. Similarly, Silva-Ramos et al. (2020) point out that fatigue, irritability, and academic performance deterioration are common symptoms in students overwhelmed by stressful situations.

Fruehwirth et al. (2023) discuss how perceived stress during college transitions correlates with mental health symptoms and risky behaviors. They emphasize the need for early interventions to reduce stressors and promote healthy coping mechanisms during this critical period. Similarly, Alhamed (2023) examined how resourcefulness moderates the relationship between academic stress, sleep disturbances, depressive symptoms, and academic performance, particularly among health profession students during the pandemic, illustrating the role of personal coping resources in mitigating stress.

Students are increasingly employing coping strategies such as mindfulness and relaxation techniques to manage the physiological and psychological symptoms of academic stress. Meditation, deep breathing exercises, and mindfulness-based stress reduction have shown promise in reducing anxiety symptoms and improving concentration and focus (Ross et al., 2023; Martínez-Líbano et al., 2023). These strategies help students manage their stress levels and build resilience for future academic and life challenges (Son et al., 2020).

According to Vidal-Conti et al. (2018), work overload and the complexity of academic tasks are among the primary triggers of academic stress. These factors, combined with the fear of evaluations and falling short of expectations, can significantly impact students' mental health. Kubicek et al. (2023) conducted a meta-analysis that differentiated between various challenge stressors, finding that while cognitive demands can foster learning, excessive workload tends to exacerbate stress, which has implications for balancing academic demands. Additional pressures from families and self-criticism are equally relevant in this context (Pinto et al. 2022).

The transition to higher education represents a significant change in students' lives, requiring adaptation to a new environment with different demands. Establishing new interpersonal relationships and adapting to other teaching and evaluation methods are common challenges (Barraza, 2008; Mazo et al., 2013). These changes can be particularly stressful, especially during critical periods like exams and assignment submissions (Vega-Martínez et al., 2022; Llanos, 2016).

Academic stress significantly affects students physically and mentally, with repercussions on their academic performance and other areas of their lives (López et al., 2021; Guarino et al., 2000). From a cognitive perspective, this stress can negatively impact concentration, learning, and memory, leading to diminished academic performance and, in extreme cases, educational failure. Physiologically, it can manifest through symptoms such as weight alterations, sleep pattern disturbances, muscle tension, and hormonal changes (López et al., 2021). During periods of high demand like exams, there is an increase in unhealthy habits, such as intake of processed foods, substance use, and decreased physical activity, contributing to the exacerbation of health problems like depression and dyslipidemia (Llanos, 2016; Hickie et al., 1995).

Kristensen et al. (2023) further explore how academic stress interacts with academic self-efficacy and psychological distress, demonstrating that these factors can mediate students' experiences of stress, highlighting the importance of bolstering self-efficacy in coping strategies. Chaudhry et al. (2024) examine how support from academic institutions, peers, and family significantly contributes to students' psychological well-being, suggesting that these support systems are essential for reducing stress and enhancing academic engagement.

The combination of both problem-focused and emotion-focused coping strategies, mindfulness, and relaxation techniques provides a holistic approach to managing academic stress. As students face various stressors, developing emotional intelligence and leveraging support networks will be critical in reducing the negative impact of stress on their academic performance and overall well-being (Gavurova et al., 2022; Tsantopoulos et al., 2022). Aligning with the Sustainable Development Goals, it is essential to promote an academic environment that fosters well-being and provides students with the tools to effectively manage stress, ensuring academic success and personal development (Restrepo et al., 2020).

This study includes both undergraduate and postgraduate students to provide a comprehensive understanding of academic stress. While prior research often examines these groups separately, analyzing them together offers a broader perspective on how academic demands impact students across educational stages. This inclusive approach allows the study to explore whether these populations' stressors and coping strategies differ, ensuring that the findings can inform more universally applicable interventions.

This study aims to fill that gap by contributing to the existing literature, specifically focusing on how universities can implement and adapt effective stress management strategies for students in the post-pandemic context. It analyzes how stress levels vary according to gender, academic level, employment status, and family responsibilities. It examines whether proactive coping strategies—such as planning and seeking emotional support—are more effective than passive approaches. Based on recent studies, it is anticipated that female students and those balancing academic, work, and family demands will experience higher stress levels, while students employing active coping strategies will report lower stress levels. By identifying these factors, the study offers practical guidelines for universities to design targeted interventions that better support student well-being in the evolving post-pandemic context.

Method

Problem and objectives. Mental health, especially in the academic context, has gained increasing importance in contemporary society. This study aims to analyze the issue of academic stress among university students, which has been a

growing concern given its significant impact on physical and mental health. The COVID-19 pandemic has intensified these challenges, highlighting the need to address and understand this phenomenon more clearly.

Gender, degree program, employment, academic status, and scholarship have been selected due to their well-documented associations with academic stress and student performance (Zhang et al., 2024; Zhao et al., 2024). Gender differences in stress perception (Martínez-Líbano et al., 2023), employment and academic status (Alhamed, 2023), and economic constraints linked to scholarship availability (Fruehwirth et al., 2023) significantly impact students' ability to manage academic workloads. Considering these variables allows for a comprehensive understanding of the multifaceted nature of academic stress, especially in the heightened context of the COVID-19 pandemic.

Specific objectives.

1. To examine the correlation between academic stress and student performance.
2. To identify the leading causes of academic stress and student concerns during their training.
3. To evaluate the impact of academic stress on students' physical and mental health.
4. To explore students' strategies to cope with academic stress.

Methodology. This study employed a mixed-methods approach, combining quantitative and qualitative data to understand academic stress among students better. A standardized questionnaire measured academic stress across a broad sample, comparing variables such as gender and employment status. The reliability of the questionnaire was confirmed using Cronbach's alpha (0.89), indicating good internal consistency.

Additionally, focus groups were conducted to explore students' experiences with stress and coping strategies in greater depth. The discussions were analyzed thematically, complementing the quantitative data and providing a more nuanced understanding of academic stress.

Participants. Undergraduate and postgraduate students were included in this study to capture a broader understanding of academic stress across different educational stages. These two groups were selected because, although they are at different life stages and have varying academic pressures, they both face significant academic demands that contribute to stress. Undergraduate students often experience stress related to adapting to higher education and managing coursework, while postgraduate students frequently deal with the pressures of advanced research, thesis completion, and balancing academic work with professional responsibilities (Dumitrescu and De Caluwé, 2024; Broks et al., 2024).

Including both groups allows us to explore how academic stress manifests differently across educational stages and life circumstances, thus providing a more comprehensive view of the factors contributing to academic stress. While we acknowledge that variability might arise due to these differences, the study aims to compare how each group manages and perceives stress, contributing to a more nuanced understanding of stress in higher education.

The participants were selected using simple random probabilistic sampling. The sample included 256 students from the Faculty of Education of the ULL, encompassing various undergraduate and postgraduate degrees. This number was estimated to achieve a 95% confidence level and a 5% margin of error.

Within the sample, 72.3% were female, 25.4% were male, 2% identified as nonbinary, and 0.4% belonged to other genders.

Table 1 Characteristics and distribution of the sample.			
Age	Between 18 and 22 years old 65.5%		Over 22 years old 34.4%
Gender	Female 72.3%	Male 25.4%	Nonbinary 2% / Other 0.4%
Education	Master degree 18.8%		Undergraduate 81.3%

Regarding age, 65.6% were between 18 and 22, while 34.4% were over 22. A total of 33.2% of the participants combined their studies with work, and 66.8% were exclusively dedicated to studying. 45.7% balanced their studies with family responsibilities, and 54.3% did not have such responsibilities.

Regarding academic status, 81.3% of the participants were enrolled in undergraduate programs and 18.8% in master's programs. Regarding the reception of financial aid, 64.8% of the students had scholarships, while 35.2% did not receive financial support (see Table 1).

The focus group was intentionally selected to ensure diversity of perspectives among the student population. In addition to undergraduate and postgraduate status, other demographic factors, such as academic specialization, age, and prior experience with continuous assessment and stress management strategies, were also considered. The inclusion of 50% of postgraduate students in the focus group, despite 80% of the sample being undergraduates, was intended to capture nuanced differences in stress experiences that may arise from the distinct academic and life stages these groups represent. Table 2 presents a summary of the focus group participants' profiles with the identification code "Sn," where "S" refers to "Subject" and "n" is the participant number.

Tools and techniques
Questionnaire: The Inventory of Academic Stress (SISCO), developed by Arturo Barraza (2007), was selected to assess academic stress in the studied population. This instrument is based on a systemic-cognitive approach and comprehensively assesses academic stress. The questionnaire consists of 31 items designed to capture various dimensions and manifestations of academic stress. The items are presented in a dichotomous format and structured on a Likert-type scale, allowing for a detailed and nuanced evaluation of the student's responses.

Given the specificity of the objectives of this research, pertinent adaptations were made to the original questionnaire. These modifications aimed to clarify certain items to align them more closely with the context of the ULL Faculty of Education and its student body's particularities. Additionally, six items (3, 4, 5, 6, 8, 15) were added to address the research questions directly. These additional questions were designed to delve into specific aspects of academic stress related to the experiences and perceptions of students, their mental and physical well-being, and their coping strategies.

An expert review was undertaken to ensure the validity of the adaptations made to the SISCO Inventory. This process sought to ensure that the changes maintained the integrity of the original instrument while making it more relevant and applicable to the specific study population. The experts' feedback contributed to the accuracy and relevance of the added questions, thus ensuring that the collected data was reliable and meaningful.

Focus group: The focus group aimed to gather qualitative data on students' experiences with academic stress. Specific open-ended

Table 2 Data of the focus group participants.

Participant	Identification (Sn)	Age
Master in Teaching (Specialization in Spanish Language and Literature)	S1	22
Bachelor in Primary Education Teaching (4th Year)	S2	24
Master in Teaching (Specialization in Economics, Business, and Tourism)	S3	28
Bachelor in Pedagogy (3rd Year)	S4	20

questions were developed to encourage participants to share their perceptions and coping strategies. Questions included: "What are the main sources of academic stress you experience?", "How do you manage stress during exam periods?" and "What institutional resources do you find most helpful?" These questions were designed to align with the study's objectives and were developed based on previous research on academic stress (Broks et al., 2024; Zhang et al., 2024).

A focus group was conducted with selected students from the Faculty of Education of the ULL. This qualitative approach delved into the causes of academic stress, coping strategies, resources available at ULL for its management, and its influence on academic performance.

Two of the authors of this study moderated the discussion to ensure a structured exploration of the relevant topics. The focus group transcripts were analyzed using ATLAS.ti software, facilitating a detailed and systematic assessment of the responses. This analysis identified trends and patterns in students' experiences and opinions about academic stress.

Integrating this qualitative analysis with the quantitative findings from the questionnaire provided a holistic and multidimensional view of the impact of academic stress on the student community.

Procedure. Following the guidelines established by Organic Law 3/2018, of December 5, on Personal Data Protection and Guarantee of Digital Rights, all study participants were informed about the confidentiality and anonymity of the data collected. Participants were assured that the information gathered in the questionnaire and the focus group would be used exclusively for research purposes, maintaining their privacy and intimacy at all times.

a. Participant selection: participants were selected from the Faculty of Education and the Doctoral and Postgraduate School of the ULL, specifically from education-related degrees. This selection was intended to include a representative sample of undergraduate and graduate students.

b. Questionnaire administration: before administering the questionnaire, participants were explained the purpose of the study and assured of the protection of their data. The questionnaire was primarily distributed via WhatsApp to students of different degrees and postgraduates, and professors also collaborated to facilitate the completion of the questionnaire in the classroom. Additionally, a QR code was made available to the faculty so that physically present students could participate.

c. Focus group execution: four students from the Faculty of Education were selected for the focus group, ensuring they were current students of both undergraduate and postgraduate programs. To guarantee anonymity, each participant was assigned a unique identification. The discussion was audio-recorded, and this anonymous identification was used throughout the session.

d. Data collection and analysis: data were collected through the online questionnaire and in person. The collected data was analyzed to comprehensively understand academic

Table 3 Relationship between factors and instrument ítems.

Factors	Items
Situations Associated with Stress (F1)	1, 2, 3, 4, 5, 6, 7, 8
Physical Reactions (F2)	9, 10, 11, 12, 13, 14
Psychological Reactions (F3)	15, 16, 17, 18, 19
Behavioral Reactions (F4)	20, 21, 22, 23, 24
Coping Strategies for Academic Stress (F5)	25, 25, 26, 27, 28, 29, 30, 31

stress and its impact on students from the Faculty of Education. The analysis focused on identifying common patterns, concerns, and coping strategies related to academic stress.

Results

Reliability analysis of the adapted version of the SISCO Inventory of Academic Stress by Barraza (2007). The reliability of the adapted version of Barraza's (2007) SISCO Inventory of Academic Stress was assessed using Cronbach's Alpha, yielding a value of 0.897. This indicates a high internal consistency among the 31 items of the questionnaire.

The KMO index was 0.900, and Bartlett's test of sphericity showed a Chi-Squared value of 3047.465 (465 df, $p < 0.000$), indicating significant correlations between the variables. A five-component structure was chosen, aligned with the structure proposed by Barraza (2007), explaining 50.95% of the total variance.

Although the explained variance of the questionnaire was 50.95%, which may be considered somewhat low in specific contexts, this variance is acceptable in studies investigating complex psychological constructs like academic stress. Stress is influenced by numerous factors, many of which may not be fully captured by a single instrument. In line with previous studies on stress and psychological well-being (Chen et al., 2024; Broks et al., 2024), variances of around 50% are common when dealing with multidimensional constructs, as internal and external variables shape these. Thus, while higher variance would be ideal, the results still provide valuable insights into how the measured factors contribute to academic stress.

See Table 3 for the composition of the factors based on the questionnaire items.

The composition of each of the factors, including the weights (structure coefficients), as well as the percentage of variance explained by each and their eigenvalues, are presented in the following tables (Table 4).

Exploratory descriptive analysis of the dimensions of the SISCO Inventory of Academic Stress. Below is a table with the descriptive statistics of the answers provided by the undergraduate and master's degree students of the Faculty of Education of the ULL. See Table 5.

The analysis of the questionnaire administered to the students of the Faculty of Education of the ULL revealed significant aspects

Table 4 Factors, explained variance, and eigenvalues for academic stress responses.

	Explained variance	Eigenvalue
Factor 1. Situations Associated with Stress	22.8	7.07
Factor 2. Physical Reactions	11.95	3.71
Factor 3. Psychological reactions	6.65	2.06
Factor 4. Behavioral reactions	4.87	1.51
Factor 5. Coping strategies for academic stress	4.68	1.450

Table 5 Factors of the SISCO inventory of academic stress.

Factor 1. Situations associated with academic stress		
Situations	Mean	SD
Competitiveness among peers	2.43	1.14
Participation in class	2.96	1.26
Personality and character of faculty	3.14	0.98
Not understanding the course material presented by the faculty	3.39	1.16
Limited time for completion and submission of academic work	3.65	1.16
Assignments requested by the faculty	3.79	1.08
Faculty evaluations	3.96	0.93
Overload of academic tasks and assignments	4.08	0.96
Total	3.42	0.70
Factor 2. Physical reactions		
Physical reactions	Mean	SD
Itching, nail-biting, etc.	2.65	1.445
Diarrhea	2.77	1.301
Sleep disorder (insomnia or nightmares)	3.04	1.179
Headache or migraine	3.09	1.134
Drowsiness or increased need for sleep	3.33	1.222
Chronic fatigue (permanent tiredness)	3.35	1.253
Total	3.04	0.90
Factor 3. Psychological reactions		
Psychological reactions	Mean	SD
Feelings of aggression or increased irritability	2.53	1.194
Feelings of depression and sadness	2.98	1.243
Restlessness (inability to relax)	3.34	1.163
Anxiety, distress, or desperation	3.35	1.199
Concentration problems	3.50	1.144
Total	3.14	0.93
Factor 4. Behavioral reactions		
Behavioral reactions	Mean	SD
Reduced consumption of food	2.17	1.188
Increased conflicts and arguments in our environment	2.54	1.178
Isolation from other people	2.66	1.252
Increased consumption of food	3.10	1.239
Lack of enthusiasm for academic tasks	3.45	1.150
Total	2.78	0.82
Factor 5. Coping strategies for academic stress		
Strategies	Mean	SD
Religiosity	1.64	1.079
Professional help	1.85	1.208
Self-praise	2.54	1.178
Seeking information about the situation	2.63	1.171
Venting and confiding, expressing concerns aloud	3.07	1.154
Assertiveness skills, advocating for our feelings and ideas without offending others	3.32	1.017
Developing a plan for task completion	3.50	1.218
Total	2.65	0.57

of academic stress in several dimensions. The study found that the main situations associated with academic stress, with an overall mean of 3.42, included task and assignment overload ($\bar{x} = 4.08$) and faculty assessments ($\bar{x} = 3.96$). In contrast to these stressors, peer competitiveness ($\bar{x} = 2.43$) and class participation ($\bar{x} = 2.96$) generated less stress.

They had an average score of 3.04 regarding physical reactions to academic stress; chronic fatigue ($\bar{x} = 3.35$) and drowsiness ($\bar{x} = 3.33$) were identified as the most common. On the other hand, reactions such as body itching ($\bar{x} = 2.65$) and digestive problems ($\bar{x} = 2.77$) occurred to a lesser extent.

Psychological reactions also displayed an interesting pattern, with an average score of 3.14. Students primarily experienced difficulties in concentration ($\bar{x} = 3.50$) and feelings of anxiety or despair ($\bar{x} = 3.35$), while reactions of irritability or aggressiveness ($\bar{x} = 2.53$) and feelings of depression and sadness ($\bar{x} = 2.98$) were less common.

Regarding behavioral reactions, with an average score of 2.78, a lack of motivation for academic tasks ($\bar{x} = 3.45$) and increased food consumption ($\bar{x} = 3.10$) emerged as common responses to stress. Less frequent reactions included reduced food consumption ($\bar{x} = 2.17$) and increased conflicts and arguments ($\bar{x} = 2.54$).

Finally, academic stress coping strategies, with an average score of 2.65, were observed to be the most common practice by students, including developing a plan ($\bar{x} = 3.50$) and using assertiveness ($\bar{x} = 3.32$). In contrast, religiosity ($\bar{x} = 1.64$) and seeking professional help ($\bar{x} = 1.85$) were less frequently employed strategies.

Parametric hypothesis testing was conducted to analyze the differences in academic stress according to various independent variables. Specifically, an independent samples t-test was used to compare groups. The independent t-test was applied to gender, employment status, and family responsibilities. Additionally, we have considered incorporating more advanced statistical models, such as ANCOVA, to control for covariates and better explore the impact of each independent variable on academic stress. Although this approach has not been implemented in the current analysis, it may be included in future studies.

Together, these findings provide a comprehensive insight into how students at the Faculty of Education perceive and respond to academic stress. They highlight the primary sources of stress, varied reactions to it, and the coping strategies adopted.

Analysis of differences in academic stress according to independent variables. These are the results of analyzing differences in academic stress based on various independent variables. Factors related to academic stress, such as situations associated with academic stress (F1), physical reactions (F2), psychological reactions (F3), behavioral reactions (F4), and coping strategies for academic stress (F5), were evaluated against the following independent variables: gender, degree program, employment and

academic status, receipt of scholarships, family balance, type of enrollment, level of concern, course stage, and academic average.

To carry out this analysis, parametric hypothesis testing was performed, precisely the independent samples t-test. Below are the highlighted results.

Gender differences. According to the results obtained, significant differences were observed based on gender in terms of situations associated with academic stress (F1) ($\bar{x}_f = 3.52$), physical reactions (F2) ($\bar{x}_f = 3.21$), psychological reactions (F3) ($\bar{x}_f = 3.27$), behavioral reactions (F4) ($\bar{x}_f = 2.86$), and coping strategies for academic stress (F5) ($\bar{x}_f = 2.71$). These results indicate that individuals identified as female experienced more academic stress compared to those identified as male. See Table 6.

Table 6 Differences according to gender.

Gender by factors of academic stress	Results							
	Levene		T-test					
	F	p	t	gl	Levels	N	$\bar{x}$ (SD)	P
(F1)	0.093	0.761	4.005	248	Female	185	3.52 (0.67)	0.000
					Male	65	3.13 (0.72)	
(F2)	1.045	0.308	5.364	248	Female	185	3.21 (0.84)	0.000
					Male	65	2.54 (0.93)	
(F3)	3.597	0.059	3.583	248	Female	185	3.27 (0.88)	0.000
					Male	65	2.79 (1.03)	
(F4)	0.001	0.975	2.322	248	Female	185	2.85 (0.81)	0.021
					Male	65	2.57 (0.84)	
(F5)	0.510	0.475	2.741	248	Female	185	2.71 (0.55)	0.007
					Male	65	0.55 (0.62)	

Table 7 Differences in family balance during studies.

Family conciliation by factors of academic stress	Results							
	Levene		T-test					
	F	p	t	gl	Levels	N	$\bar{x}$ (SD)	P
(F1)	0.001	0.975	−2.993	254	Yes	117	3.28 (0.71)	0.003
					No	139	3.54 (0.68)	
(F2)	3.369	0.068	−2.598	254	Yes	117	2.88 (0.97)	0.010
					No	139	3.17 (0.83)	
(F3)	4.734	0.030	−2.490	254	Yes	117	2.98 (1.01)	0.013
					No	139	3.27 (0.85)	
(F4)	0.025	0.874	−2.147	254	Yes	117	2.66 (0.82)	0.033
					No	139	2.88 (0.81)	

Differences depending on whether you can practice family conciliation during your studies. According to the results obtained, significant differences were observed based on family conciliation during the study in terms of factors related to situations associated with academic stress (F1) ($\bar{x}_{no} = 3.54$), physical reactions (F2) ($\bar{x}_{no} = 3.17$), psychological reactions (F3) ($\bar{x}_{no} = 3.27$), and behavioral reactions (F4) ($\bar{x}_{no} = 2.88$). The results suggest that individuals who did not achieve family conciliation during their studies experienced more stress than those who did. See Table 7.

Differences in concern. Regarding the level of concern expressed by the students, significant differences were observed in terms of factors associated with academic stress (F1) ($\bar{x}_{yes} = 3.55$), physical reactions (F2) ($\bar{x}_{yes} = 3.21$), psychological reactions (F3) ($\bar{x}_{yes} = 3.32$), behavioral reactions (F4) ($\bar{x}_{yes} = 2.9$) and strategies for coping with academic stress (F5) ($\bar{x}_{yes} = 2.69$). Students who felt concern during their studies experienced more stress than those who did not. See Table 8.

Analysis of academic stress coping strategies and their impact on student well-being. This section examines how students employ various coping strategies to manage academic stress and how these strategies influence their physical, psychological, and educational outcomes. The analysis focuses on the relationship between specific coping behaviors and stress responses across the five factors of the SISCO Inventory.

About the times when students feel most stressed, significant differences were observed in terms of factors associated with academic stress (F1) ($\bar{x}_{Ay} = 3.8$), physical reactions (F2) ($\bar{x}_{Ay} = 3.619$), psychological reactions (F3) ($\bar{x}_{Ay} = 3.623$), and behavioral reactions (F4) ($\bar{x}_{Ay} = 3.17$). Most students experienced

more stress throughout the course, not exclusively during exam periods. See Table 9.

Correlation analysis between academic stress and academic performance. A Pearson correlation analysis was conducted further to explore the relationship between academic stress and academic performance. The results revealed a weak negative correlation between students' overall academic stress levels and academic performance ($r = -0.22$, $p < 0.05$). This suggests that as academic stress increases, academic performance slightly decreases. However, this relationship was not strong enough to imply a direct predictive effect. These findings align with prior research (Chen et al., 2024; Kristensen et al., 2023), indicating that while stress may impact performance, other factors—such as coping strategies and institutional support—can mitigate its effects.

Discussion group content analysis.

a. Opinions on the causes of academic stress
   Participants identified various causes of academic stress. They highlighted an excess of educational tasks and ambiguous continuous assessment as significant sources of stress. Concerns were also expressed about the traditional approach to teaching at university and the need for more innovation in content delivery. Self-demand, state financial aid for studies, and the elimination of the September examination session were also mentioned as stress-inducing factors.

b. Opinions on the consequences of academic stress
   Participants reported a range of implications of academic stress. Primarily, they mentioned physical reactions such as

Table 8 Differences in concern during studies.

Concerns about academic stress factors	Results							
	Levene		T-test					
	F	p	t	gl	Levels	N	$\bar{x}$ (SD)	P
(F1)	0.209	0.648	6.407	254	Yes	209	3.55 (0.64)	0.000
					No	47	2.88 (0.68)	
(F2)	0.025	0.874	7.067	254	Yes	209	3.21 (0.82)	0.000
					No	47	2.27 (0.84)	
(F3)	0.015	0.901	7.024	254	Yes	209	3.32 (0.86)	0.000
					No	47	2.35 (0.84)	
(F4)	0.873	0.351	4.824	254	Yes	209	2.9 (0.78)	0.000
					No	47	2.28 (0.82)	
(F5)	0.357	0.551	2.626	254	Yes	209	2.69 (0.56)	0.009
					No	47	2.45 (0.61)	

Table 9 Differences depending on the current moment.

Moments of academic stress factors	Results							
	Levene		T-test					
	F	p	t	gl	Levels	N	$\bar{x}$ (SD)	P
(F1)	0.150	0.698	−3.485	254	All year	35	3.8 (0.64)	0.001
					During exams	221	3.37 (0.69)	
(F2)	0.006	0.936	−4.233	254	All year	35	3.619 (0.91)	0.000
					During exams	221	2.94 (0.87)	
(F3)	0.027	0.870	−3.349	254	All year	35	3.62 (0.94)	0.001
					During exams	221	3.06 (0.91)	
(F4)	0.342	0.559	−3.055	254	All year	35	3.17 (0.91)	0.002
					During exams	221	2.72 (0.79)	

insomnia and digestive issues. However, the impact on mental health was also emphasized, with anxiety being a significant factor. Academic stress affected both the academic trajectory and the social lives of the students

c. Opinions on strategies to cope with academic stress

Participants shared the strategies they used to cope with academic stress. These included disconnecting by engaging in activities they enjoyed, organizing study material in advance, and setting small goals to tackle the workload gradually. These strategies helped them to deal with stressful situations.

Opinions on reducing academic stress among students of the Faculty of Education of the ULL. Participants suggested various measures to reduce academic stress. They stressed the importance of continuous assessment, which includes quality academic work, to avoid an overload of exams. They also called for curricula that are more focused on teaching practical and meaningful knowledge. The reintroduction of the September examination session and feedback from teachers on correcting assignments and exams were proposed to reduce time pressure and improve academic performance.

d. Opinions on resources that ULL could offer to reduce academic stress among students
Students suggested that the university could provide training in study techniques and offer psychological support or assistance in specific subjects for those who need it.
e. Opinions on academic performance influenced by stress

Divergent opinions exist on how academic stress affects academic performance. Some students mentioned that pressure can boost their performance, while others stated that it prevents them from performing adequately. Table 10 presents the literal details and opinions of the participants, providing a more comprehensive view of the issues discussed in the focus groups.

In addition to the qualitative analysis, descriptive statistics were used to quantify the frequency of specific themes that emerged from the interviews. For instance, 80% of participants mentioned stress related to academic workload, while 60% cited exam-related stress as a significant factor. This quantitative approach allowed us to capture the prevalence of key stressors among students and provided a clearer understanding of the most common sources of academic stress.

Discussion

This study comprehensively explores the academic stress experienced by students in the Faculty of Education at ULL, analyzing its impact on academic performance, physical and psychological health, and the strategies students use to manage this stress. The findings align with previous literature, highlighting academic stress's complexity and multifaceted nature.

One of the key insights from this study is that academic stress can positively and negatively affect academic performance. While acute stress can act as a motivator, improving student performance under pressure, chronic stress undermines health and academic outcomes. This dual effect mirrors findings by García-Ros et al. (2012), who suggested that a certain stress level can boost performance. Broks et al. (2024) emphasized that students with strong self-regulated learning strategies can thrive academically despite stress. However, students who rely on maladaptive coping mechanisms, as highlighted by Dumitrescu and De Caluwé (2024), are more likely to experience adverse outcomes, such as

Table 10 Arguments expressed by the participants.

Causes of academic stress	● "Scholarships are also important, so I think that relationship between being able to continue if you fail or not is also relevant." ● "Another cause is self-demand, right? There are people, for example, I sometimes notice that one demands too much of oneself, and it can also be counterproductive in that sense." ● "Continuous assessment, for example. They insist you must pass a final exam despite working from September to July, week after week, in groups, individually… Because if you tell me there is a small quantity of compassion…, but they demand and do not even care…" ● "The methodology, how to carry out the subject." ● "Often the students and the teacher are overloaded because it is not the same to correct 40 tests as to correct 2. Moreover, the assessment tool is the same; it is an average between the two tests and the two practicals or whatever, and that is it, meaning that often it is not just that they are overloaded, but that they overload themselves too." ● "In stress, the "model" teachers also play a role, those who have been there for 30 years teaching the same thing and fail three-quarters of the class, if not more."
Consequences of academic stress	● "Stress has hurt me, especially on my health. This last year, I have had several appointments with the doctor, dermatologists, and gastroenterologists." ● "Pure and simple insomnia, I can not sleep at all at night, and it is always mental punishment." ● "It is like being in a cloud to the point where it seems I am not living in the present due to self-demand."
Strategies to cope with academic stress	● "The day before exams, I do not touch anything; I do nothing but focus on what I might have because it is a way to disconnect." ● "Disconnect and do things you like, not study at the last minute." ● "I listen to ASMR at night because of insomnia. I also go to a psychologist."
Measures to reduce academic stress among students of the Faculty of Education at the XXX	● "Firstly, the so-called continuous assessment should be real. The assessment tools or final products should be limited; as I said, we can not ask for 20 assignments and an exam, which is not a continuous assessment. Why do I do 20 assignments? If I do not get a five on the exam, you do not consider them. I do think it is a perversion in a way and that the products the teacher will assess should be reduced, and if I ask for XXX, I do not do a test. Why? It makes no sense." ● "The dates of the examination session. I have a tragedy with the recovery exams; I would call it after the summer was magnificent, and now you can no longer examine yourself after the summer. I took advantage of exams when I was being examined in September." ● "That teacher feedback is of much demand and then correct when I have time. The last day of records, for example. When the teachers meet the deadlines, we must meet them at the end. Moreover, from the teachers, those who do not meet them should do so." ● "When it is understood that you are juggling so much, I mean, you with work, family life, and so on, it is understood that a master's degree is another range of ages and circumstances, for example. Moreover, the pressure is the same; it is not that I am saying to lower the level, but people's circumstances must be considered." ● "And that the focus of the subject is real and practical. Not to study one thing and then, in practice, find something else. That it has a real dimension because it is unfocused. The study plans are very unfocused from reality, from current needs. The current students, ourselves, were not the same as 20 years ago or ten years ago. Moreover, we continue to teach the same. To contemplate that. I think it is interesting to restructure the plans."
Resources that ULL could offer to facilitate the reduction of academic stress among students	● "The presence of study technique advisors. Those kinds of things, I think, are interesting. Right? Alternatively, there could be a section in some subjects that considers these things in the degree programs. Study techniques, memorisation methods…" ● "Yes, especially for students who, for example, cannot afford that external help, because if, in the end, you can afford it, you will not have a problem if the university does not offer it, but there are low-income people for whom it is more complicated."
Academic performance influenced by stress	● "It depends because sometimes I am one of those who perform under the sword of Damocles; I perform when I feel the pressure." ● "I for sure underperform under pressure. I do not perform under pressure, but this self-demand is often before the exam or the event."

anxiety and poor academic performance. Interestingly, this study found no significant correlation between overall stress levels and grades, challenging the assumption that higher stress necessarily leads to lower academic performance. This suggests that other factors, such as time management and the use of adaptive coping strategies, play a crucial role in moderating the effects of stress, a notion also supported by Mize (2024) during the analysis of student experiences during the COVID-19 pandemic.

Another important finding is that stress among students is not confined to exam periods. Contrary to common belief, stress persists throughout the academic year, likely due to continuous assessment models that involve an ongoing workload of assignments and evaluations. This constant pressure, as supported by Vidal-Conti et al. (2018) and Llanos (2016), creates a stressful environment for students, exacerbated by external factors such as family responsibilities and financial concerns. The continuous uncertainty brought on by the COVID-19 pandemic further heightened this stress, as described by Brown and Papp (2024), who found that students faced elevated stress levels throughout the year, not just during peak academic periods.

The impact of academic stress on physical and psychological health is another significant theme of this study. Students reported various physiological reactions to stress, including sleep disorders, fatigue, and increased anxiety, all of which align with the findings of Silva-Ramos et al. (2020), who documented similar health issues in students under stress. Moreover, the current study identified a strong link between academic stress and psychological problems, such as anxiety and demotivation. This is consistent with Chen et al. (2024), who found that academic stress during the pandemic was closely linked to depression in students, further highlighting the adverse effects of prolonged stress. Additionally, Yang and Geng (2024) identified a connection between COVID-related anxiety and decreased academic engagement and resilience, indicating that the mental health consequences of stress can extend beyond academic performance to affect overall student well-being.

Regarding coping strategies, this study found that students primarily relied on planning and organizing their course materials to manage stress, reflecting the importance of time management in reducing academic pressures. These findings are consistent with previous research on emotional intelligence and coping strategies, as Puigbó et al. (2019) and Nespereira-Campuzanoa, Vázquez-Campo (2017) noted. However, the study also found that students underutilized psychological support services, a significant concern given the high levels of stress reported. This gap points to a need for institutions to promote greater access to mental health resources, especially during periods of heightened academic pressure. Mize (2024) emphasized that students who used structured coping mechanisms and sought psychological support during the pandemic were better able to adapt to the sudden shift to online learning, while those who lacked these strategies faced increased anxiety and disengagement. Moreover, Pang et al. (2024) highlighted that international students experienced additional stressors, such as social media exhaustion and academic anxiety, which impacted their educational attainment, reinforcing the importance of providing targeted support for students with specific stress-related challenges.

Although no significant differences were found between undergraduate and postgraduate students, this finding suggests that common stressors and coping mechanisms may transcend academic levels. This insight highlights the need for stress management programs that address shared challenges across the student population.

One limitation of this study is the small number of participants in the focus group, consisting of only four students (two undergraduates and two postgraduates). While this size aligns with methodological recommendations for focus groups, which suggest small groups of 4–6 participants to facilitate in-depth discussions (Krueger and Casey, 2015), it may limit the generalizability of the qualitative findings. Time constraints and participant availability influenced the group size.

Future research should consider expanding the number of participants to capture a broader range of student experiences and achieve data saturation. This approach would provide comprehensive insights into academic stress and inform more effective intervention strategies.

In summary, this study reinforces that academic stress is a pervasive issue affecting students' lives, from academic performance to mental health. While some students may thrive under certain levels of stress, the negative consequences of chronic stress, mainly when effective coping strategies are absent, underscore the need for more excellent institutional support. As Broks et al. (2024) and Dumitrescu and De Caluwé (2024) suggest, fostering better-coping mechanisms and providing access to psychological resources are essential for mitigating the harmful effects of academic stress and promoting student well-being in higher education.

Conclusions

This study has illuminated the complex phenomenon of academic stress among students at the Faculty of Education of the University of XXX. Through comprehensive analysis, several conclusions and key points have been identified that highlight the importance of addressing this issue in an integrated manner.

Diversity of academic stress. The results of this study have shown that academic stress is a diverse and multifaceted experience. Stressors vary from the overload of assignments and teacher evaluations to concerns related to family conciliation and scholarships. This underscores the need to recognize that academic stress can manifest differently and uniquely affect each student.

Impact on health. Academic stress significantly impacts students' physical and psychological health. Study participants reported a range of adverse effects, such as sleep disorders, anxiety, difficulties concentrating, and demotivation. These findings highlight the importance of academic institutions implementing psychological support measures, reviewing assessment practices, and promoting healthy coping strategies.

Academic performance. Contrary to the common belief that academic stress leads to poor performance, this study did not find a significant correlation between stress levels and grades obtained. This suggests that other factors, such as coping strategies and time management, might be more influential in academic performance.

Gender and stress. The results indicate that females appear more prone to experiencing academic stress than males. This finding aligns with previous research that has identified gender differences in the perception and management of academic stress.

Coping strategies. Students employ various strategies to cope with academic stress, with planning and organization being the most used. Seeking social support and developing emotional intelligence are valuable strategies, though psychological support was identified as a less frequent strategy. This highlights the importance of promoting accessible psychological support resources for students.

Assessment modalities. The continuous assessment modality, which involves a constant workload throughout the academic period, appears to be a significant source of stress for students. This suggests reviewing and adjusting assessment practices to ensure a fair workload distribution and reduce stress levels.

In summary, this study contributes to understanding academic stress in the university context and offers valuable insights into its multiple facets. These findings have important implications for educational institutions, which may consider implementing psychological support measures, reviewing assessment practices, and promoting healthy coping strategies. Furthermore, this study opens the door to future research that explores the interactions between academic stress and other factors influencing student well-being.

While this research offers meaningful insights, addressing certain limitations would significantly enhance its impact. Expanding the sample size, incorporating more variables such as socioeconomic status and mental health conditions, and adopting a longitudinal approach could provide richer insights into academic stress. Future research that tackles these gaps will deepen our understanding and help develop more effective strategies to improve student well-being. The findings presented here underscore the importance of continued investigation into

the multifaceted nature of student stress, particularly in times of academic and societal challenges.

The results of this study underline the urgent need for academic institutions to implement more effective measures to manage academic stress, given its significant impact on student's mental health and performance. Implementing psychological support programs within universities could be a key strategy to mitigate the effects of stress by providing students with accessible resources for emotional management and resilience. Moreover, such initiatives will prepare students and institutions to respond more effectively to future crises that may disrupt the educational environment, enhancing overall adaptability and resilience.

In addition, the findings suggest that it is crucial to review continuous assessment practices, as continuous assessment is a constant source of stress for many students. Educational institutions could consider redistributing workloads and making work deadlines more flexible, allowing students to better manage their academic and personal responsibilities.

From a policy perspective, policymakers need to consider these results when formulating policies that address academic performance and students' overall well-being. Scholarship programs that include counseling and emotional support, as well as increased accessibility to mental health resources, are crucial to ensure that students from diverse socioeconomic backgrounds can meet the challenges of the modern academic environment.

Finally, given the relationship between academic stress and gender, it is suggested that university welfare policies integrate specific approaches to address students' gender-differentiated needs to promote a more equitable university experience.

Limitations and prospects of the study and future lines of work and intervention

This study presented several additional limitations that need to be considered. The results, although valuable, cannot be generalized due to the specific nature of the context and sample. Nevertheless, these findings can serve as a basis for identifying needs and trends within the University of La XXX environment. It was challenging to obtain a larger sample of participants due to the course dates at which the test was administered. For future studies, administering the tests at the beginning of the academic term could improve participation rates.

As the sample was limited to students from the Faculty of Education, students' stress levels and experiences may vary significantly across disciplines. Each faculty may have academic demands and stressors, meaning the results may not represent the broader university population. Future studies should include students from various disciplines to provide a more comprehensive picture of academic stress across the university.

Additionally, key factors such as socioeconomic status, pre-existing mental health conditions, and access to resources were only briefly touched upon. These are crucial in shaping students' stress experiences and should be explored further in future research. Variables like study habits, social support, and academic motivation could also explain why some students manage stress better than others and warrant deeper examination.

Given that academic stress fluctuates throughout the year, a single data collection point may not adequately capture these variations. A longitudinal approach in future research could provide a clearer picture of how stress evolves during critical periods, such as exams.

Understanding teachers' perspectives on academic stress and educational demands could have enriched the analysis. Moreover, the persistence of traditional teaching methods limits understanding the impact of academic stress in the current educational context.

One limitation of this study is relying on self-report measures to assess stress's psychological, physiological, and behavioral manifestations. Self-reported data are subject to various biases, such as social desirability bias, where participants may underreport or overreport their stress experiences to align with perceived social expectations. Additionally, participants may have difficulty accurately recalling specific physiological or behavioral responses to stress, leading to potential inaccuracies in the data. Future research should consider incorporating more objective measures, such as physiological indicators (e.g., cortisol levels or heart rate variability) or observational data, to complement self-reported data and provide a more comprehensive stress assessment.

Finally, academic demands and lack of attention to individual student characteristics can negatively affect mental health, highlighting the need for a more personalized and inclusive educational approach.

Data availability

Due to the sensitive nature of the information collected in our study, which includes personal details and mental health data of the participants, it is not possible to publicly share the data obtained. Following ethical guidelines and data protection policies, participants signed a confidentiality clause that prevents us from disseminating their data to ensure their privacy and confidentiality. For researchers interested in consulting or requesting access to data sets for academic purposes, we will consider such requests, ensuring that the shared data do not breach the ethical obligations set by the consent signed by the participants. These inquiries or requests can be directed to the corresponding author.

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Author contributions

Competing interests

Ethical approval

This study was supervised by the research ethics committee of the University of La Laguna (CEIBA) with registration number CEIBA2021-3101. This committee approved the study on 24 November 2021. This study is part of a more extensive study on the health of university students in Spain and Ecuador. This committee reported on the appropriateness of the procedure followed for the study. This study was conducted following the principles of the Declaration of Helsinki. Confidentiality and anonymity of the collected data were ensured to protect their privacy.

Informed consent

All participants, who were university students of legal age and accepted voluntary participation, were informed about the study before responding to the questionnaire. This included clarifying that participation was voluntary and that they could withdraw without any consequences. Informed consent was obtained by requiring participants to mark a checkbox indicating their consent to participate at the beginning of the questionnaire. The questionnaire was administered between February and March 2023.

Additional information

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7 Longitudinal effects of stress in an academic context on psychological well-being,physiological markers,health behaviors,and academic performance in university students (2025)	BMC Psychology (Article from : BioMed Central Ltd)

Longitudinal effects of stress in an academic context on psychological well-being, physiological markers, health behaviors, and academic performance in university students

Juan Camilo Benítez-Agudelo[1,2]* , Dayana Restrepo[1] , Eduardo Navarro-Jimenez[3] and Vicente Javier Clemente-Suárez[4,5]

Abstract

Background Stress in academic settings arises from the interplay between perceived demands such as exams, deadlines, and academic workload and an individual's coping resources. While academic stress (AS) is frequently examined as a separate construct, the stress encountered in an academic environment encompasses both academic and non-academic stressors that students face throughout their university experience. This study examined the longitudinal associations between stress in an academic context on key psychological, physiological, and behavioral variables in university students.

Methods A longitudinal study was conducted with 115 Colombian psychology students aged 16 to 35 years, evaluated at the beginning and end of an academic semester. Variables were measured using validated psychometric questionnaires, including the Big Five inventory, the Zung Depression Scale, the UCLA Loneliness Scale, the State-Trait Anxiety Inventory (STAI), the Acceptance and Action Questionnaire (AAQ-II), the Perceived Stress Scale-4 (PSS-4). Behavioral data, such as physical activity, sleep patterns, and academic performance, were also recorded. Heart rate variability (HRV), a widely used physiological marker of autonomic nervous system function and stress regulation, was assessed. Paired t-tests were used to compare baseline and final measurements, and multiple linear regression determined predictors of academic performance.

Results Longitudinal analysis revealed significant declines in sleep duration, quality, and heart rate variability (HRV), alongside increased anxiety and depressive symptoms, indicating heightened stress and autonomic dysregulation. Despite these adverse effects, academic performance improved. This pattern suggests a complex association where higher achievement coincided with declining well-being markers. Regression models identified depressive symptoms

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as negative predictors of performance, while greater HRV (SD1, PNN50) and balanced autonomic activity were positively associated with academic performance.

Conclusions This study examines the longitudinal effects of stress within an academic environment on the psychological, physiological, and behavioral outcomes of university students. The findings showed compromised sleep patterns, changes in autonomic regulation, and mental health indicators; nevertheless, an increase in academic performance is also noted. However, this enhancement coincides with heightened levels of anxiety, depressive symptoms, and physiological dysregulation. These results highlight the necessity for targeted interventions aimed at fostering resilience and promoting a holistic sense of well-being.

Keywords Stress, Sleep, Heart rate variability, Psychological flexibility, University students

Introduction

Stress is an adaptive neuroendocrine response to demands perceived as challenging or threatening. It triggers the release of catecholamines (adrenaline, noradrenaline) and glucocorticoids (cortisol), which enhance alertness, energy levels, and concentration [1, 2]. This response allows individuals to maintain focus and perform optimally during demanding tasks, such as examinations, presentations, or athletic competitions [3]. When stress is short-term, perceived as manageable, and within the individual's capacity to address the specific challenge, it can have positive effects. These include supporting emotional and cognitive development, as well as promoting the acquisition of problem-solving skills, adaptability, and resilience. However, when external demands exceed available coping resources, stress can become maladaptive, negatively affecting physical and psychological health [4, 5]. Prolonged exposure to stress is associated with disruptions in essential systems such as the cardiovascular, immune, endocrine, nervous, and gastrointestinal systems, and may impair cognitive functions like executive attention, working memory, and decision-making [6]. Physiological consequences include oxidative stress, chronic low-grade inflammation, metabolic dysregulation, and increased risk of non-communicable diseases (e.g., cardiovascular conditions, metabolic syndrome) [7, 8]. At the psychological level, stress manifests as fatigue, tension headaches, feelings of guilt, emotional exhaustion, and depressive symptoms. Additionally, it is frequently associated with disruptions in sleep architecture, which involve both psychological and physiological mechanisms [9, 10].

In the academic context, stress arises from the interaction between perceived demands (e.g., exams, deadlines, academic workload) and the individual's coping resources [11, 12]. While academic stress (AS) is often studied as a distinct construct, this study focuses on stress experienced in an academic setting, which encompasses both academic and non-academic stressors that students encounter during their university life [13]. This approach allows for a broader understanding of how stress in an educational environment affects students' well-being and performance. Stress in academic settings is particularly intensified before exams and is linked to increased cortisol levels, disrupted sleep homeostasis, and impaired emotional regulation [14, 15]. According to the cognitive-sleep quality model, excessive academic worries generate hyperarousal, affecting the perception of sleep duration and efficiency [9]. Similarly, from the perspective of the transactional stress model, stress arises from the interaction between perceived demands and personal resources, potentially resulting in burnout, cognitive fatigue, and impaired academic performance [16]. However, unlike studies that focus exclusively on academic stress as a construct, this study examines stress in a broader academic context, considering both academic and non-academic factors that contribute to students' stress levels.

University students must autonomously manage academic, social, and personal responsibilities, a challenge that is exacerbated by limited institutional support, increasing stress and reducing the ability to balance competing demands effectively [17]. As the semester progresses, sustained cognitive overload and accumulated stressors lead to chronic hypothalamic-pituitary-adrenal (HPA) axis activation, with prolonged cortisol secretion contributing to neuroimmune alterations and autonomic dysregulation [18]. Chronic stress induces dysregulation of the autonomic nervous system, characterized by a shift toward sympathetic dominance and a reduction in vagal tone, increasing vulnerability to cardiovascular and neurological disorders [19, 20]. Among university students, chronic stress is frequently associated with insufficient sleep, unhealthy dietary habits, reduced physical activity, increased resting heart rate, and alterations in cardiac autonomic balance [21]. On an emotional level, stress in academic settings contributes to anxiety, emotional detachment, irritability, and a diminished sense of self-efficacy, which in turn impact cognitive functions such as sustained attention, working memory, and problem-solving abilities [22, 23].

Despite the growing body of research on stress in educational settings, there is a lack of integration between psychological, physiological, and academic outcomes. Existing studies have largely focused on isolated aspects,

such as the effects of stress on academic performance or the role of sleep in psychological well-being, without considering their interplay [24-26]. Furthermore, physiological markers like heart rate variability, which offer valuable insights into the autonomic nervous system's response to stress, remain underexplored in the context of academic settings. This fragmentation limits our understanding of how these factors evolve over time and are associated with each other. Addressing this gap is essential to develop evidence-based strategies for promoting resilience and academic success among university students.

The primary objective of this study was to analyze the longitudinal effects of stress in an academic context on key psychological, physiological, and behavioral variables in university students. Specifically, we examined how increasing stress in academic settings throughout the semester was associated with sleep quality, psychological flexibility, anxiety, depressive symptoms, physical activity, heart rate variability, and academic performance. This study aimed to provide a global perspective on how stress related to academic demands affects students' mental and physical health, identifying complex associations between psychological well-being and academic performance. We hypothesized that higher levels of stress over the semester would negatively affect sleep quality, psychological flexibility, and heart rate variability while leading to higher levels of anxiety and depressive symptoms. Despite these negative psychological and physiological effects, we expected to observe a moderate improvement in academic performance, suggesting that students prioritize their studies at the expense of their well-being. The results of this research would provide a holistic understanding of the effect of stress in an academic environment, offering actionable insights for educational institutions to support student well-being better and optimize academic outcomes.

Methods

Participants

In the current study, 115 volunteer Colombian university students enrolled in a psychology program, aged between 16 and 35 years (M = 19.7, SD = 3.32), were assessed through an online questionnaire at two points: the beginning (February 2024) and the end (May 2024) of the academic semester. The sample was predominantly female, comprising 79.13% of participants. A non-probabilistic criterion-based sampling method was employed to select participants. The sample size (N = 115) was established based on previous research investigating stress in academic settings and physiological responses in university students, which utilized similar sample sizes to identify significant effects [27]. Participants were selected based on specific inclusion and exclusion criteria to ensure sample homogeneity and minimize potential

confounding factors. The inclusion criteria required students to be actively enrolled in the psychology program at the university, reside in Colombia during the study period, be between 16 and 35 years old, and voluntarily provide informed consent. The exclusion criteria included having a diagnosed medical or psychiatric condition that could affect stress responses, sleep patterns, or physiological measurements; taking medications such as psychotropics or beta-blockers that could interfere with autonomic or cardiovascular function; engaging in high-performance sports or extreme training routines that could significantly alter physiological markers such as HRV; and failing to complete both study assessments at the beginning and end of the semester. To ensure data integrity and prevent duplicate responses, students provided their university ID, which was cross-checked with institutional records. Participation was entirely voluntary, and all students digitally signed an informed consent form outlining the study's objectives and procedures. The study complied with the ethical guidelines of the Helsinki Declaration on Human Research and was approved by the University Ethics Committee (CIPI/2024(611)).

Procedure

To achieve the objectives of this study, a longitudinal design was implemented with two measurement points: at the beginning and at the end of the academic semester (four months later). Data collection was conducted in person on campus and comprised three main components: online self-administered questionnaires, standardized assessments of academic performance, and measures of heart rate variability (HRV), all performed in a supervised classroom setting. Participants accessed the questionnaire using their personal electronic devices, such as laptops, tablets, or smartphones. Prior to the assessments, a trained researcher provided standardized verbal instructions and remained available to clarify any questions, ensuring that responses remained unbiased. To further minimize response bias, several measures were implemented: all participants received uniform instructions, the survey was self-administered to limit interviewer bias, and a controlled classroom environment was maintained to ensure consistency in assessment conditions (See Fig. 1).

Academic performance was assessed using a standardized test, scored on a scale from 1 to 5 (1 = low, 5 = high). This test was administered at three points during the semester and consisted of 16 multiple-choice questions with a single correct answer. The initial score corresponded to the first evaluation conducted at the beginning of the academic period, and not to grades from previous semesters. The format and difficulty level of the exam remained constant in all administrations, which ensured comparability of scores over time; on the other

Fig. 1 Study Phases
Note: PSS-4: Perceived Stress Scale; STAI: State-Trait Anxiety Inventory; Zung: Depression Scale; BIG-FIVE: Big Five Inventory; AAQII: Acceptance and Action Questionnaire II; UCLA: Loneliness Scale; BP: Behavioral patterns (Sleep, Physical activity)

hand, the content of the test varied according to the progression of the curriculum. This avoided the repetition of content and the learning effect. The evaluation was not blinded, as it was part of the regular academic assessment process conducted by instructors. However, since it was a pre-established standardized test, its objectivity and consistency were maintained throughout the study.

A shortened version of the Spanish adaptation of the Big Five Inventory was utilized to assess personality traits, focusing on characteristics such as openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. This abbreviated version comprises 10 items rated on a 5-point Likert scale, where 1 represents strong disagreement and 5 indicates strong agreement [28]. The scale showed good reliability, achieving a Cronbach's α of 0.70, except for the openness to experience factor, which had a value of 0.65 [29]. Trait scores were calculated by summing responses to relevant items, yielding ranges of 2–10 points (2 items × 1–5 Likert scale). Grouped participants into quartiles (Q1–Q4)

based on sample distribution. Quartile cutoffs were: Q1 ≤ 3.0; Q2 = 4–5; Q3 = 6–7; Q4 ≥ 8. These personality traits were included in the study due to their potential influence on stress responses, coping mechanisms, and academic performance. Additionally, the Spanish version of the Zung Depression Scale was employed to evaluate the severity of depressive symptoms as perceived by the individual [30]. This scale demonstrated strong reliability, with a Cronbach's α of 0.85 [31]. Regarding its interpretation, scores ranging from 20 to 49 indicate no or low depression, 50 to 69 indicate moderate depression, and 70 to 80 suggest severe depression. Furthermore, the Spanish version of the UCLA Loneliness Scale was utilized to measure loneliness. This scale assesses perceived loneliness, which refers to the subjective feeling of isolation or social disconnection that an individual may experience; higher scores reflect greater levels of perceived loneliness. In this study, we utilized a condensed version consisting of three items, rated on a three-point

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Likert scale, where 1 signifies "never" and 3 signifies "frequently." The reliability of this test varied between 0.89 and 0.94 [32].

To assess anxiety, a condensed version of the Spanish adaptation of the Spielberger State-Trait Anxiety Inventory was utilized [33], comprising 6 items that measure anxiety on a 4-point Likert scale, where 1 signifies "not at all" and 4 signifies "very much." A score exceeding 19 points indicates significant symptoms of state anxiety. The reliability of this test ranges from 0.85 to 0.93 [34–36]. Additionally, the Spanish version of the Acceptance and Action Questionnaire II was employed to evaluate experiential avoidance or psychological inflexibility through 7 items rated on a 7-point Likert scale, with 0 denoting "never true" and 7 denoting "always true." Typically, average scores for participants without clinical issues fall between 18 and 23 points, while scores for clinical participants are generally above 29 points, indicating that higher scores are linked to greater psychological inflexibility. The reliability of this test is measured at 0.84 [37]. The PSS-4, adapted by Herrero and Meneses, was employed to assess perceived stress. This 4-item scale measures how frequently individuals experience stress, with higher scores reflecting greater perceived stress levels. While Herrero and Meneses utilized a scale ranging from 1 to 5, this study applied Cohen's original 0 to 4 scale, where 0 indicates "never" and 4 signifies "very often." The scale demonstrated solid reliability, achieving a Cronbach's α of 0.72, and accounted for 54% of the variance [38].

Behavioral patterns of participants were evaluated in line with previous studies [39–41]. Sleep duration was assessed using a self-reported measure, where students indicated the number of hours they typically sleep per night. Sleep quality was evaluated with a Likert scale from 1 (very poor quality) to 10 (very good quality), capturing participants' subjective perception of their most recent sleep episode. While validated instruments such as the Pittsburgh Sleep Quality Index (PSQI) provide a more detailed assessment, a single-item scale was chosen for its feasibility in a longitudinal study and to reduce participant burden. Physical activity was assessed through self-reported measures adapted from previous research [42, 43]. To estimate their average daily steps, students were instructed to check the step count recorded on their mobile phones or wearable devices (e.g., smartwatches, fitness bands) and report the weekly average. This approach ensured that the data reflected actual recorded movement rather than subjective estimation. However, as step counts were not collected using standardized research-grade accelerometers, results should be interpreted with caution. Also, the questionnaire included the following items: 'Did you do any physical activity in the last 7 days?', 'If so, indicate the total time (in minutes) spent on cyclic and/or aerobic activities (cycling, treadmill, Zumba) over the past week,' and 'If so, indicate the total time (in minutes) spent on resistance activities (sit-ups, push-ups, squats, or weight training) over the past week.' Although validated tools such as the Global Physical Activity Questionnaire (GPAQ) offer a standardized approach to measuring physical activity, we prioritized a brief self-report method that allowed us to track changes in activity levels over time while maintaining a manageable survey length. This approach aligns with prior studies evaluating physical activity patterns in university students.

Autonomic modulation was assessed through heart rate variability (HRV) analysis. HRV data were collected using the EEG for Everybody mobile device (NoviSad, Serbia), following previously established procedures [44, 45]. Participants remained seated in a quiet room during the recordings to minimize movement and external interferences. A 5-minute segment of continuous electrocardiographic (ECG) data was analyzed, as recommended for short-term HRV assessment. The following HRV parameters were extracted: heart rate (HR), rMSSD (square root of the mean squared differences between successive R–R intervals), PNN50 (percentage of R–R intervals differing by more than 50 ms), standard deviation 1 (SD1), standard deviation 2 (SD2), SD1/SD2 ratio, low frequency (LF), high frequency (HF), LF/HF ratio, low frequency in normalized units (LFnu), and high frequency in normalized units (HFnu).

The assessments took place during the first term of the academic semester. The measurement instruments employed in this study have been thoroughly validated within Spanish-speaking populations and have exhibited strong psychometric properties. Prior to data collection, a pilot test was administered to a small group of students to assess the clarity of the questionnaire items. No significant comprehension challenges were reported, affirming that the chosen instruments were well-suited for the target population.

Statistical analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 24.0 (SPSS Inc., Chicago, IL., USA). Descriptive statistics, including means and standard deviations, were calculated for all variables. Prior to conducting parametric tests, the assumptions of normality and homogeneity of variances were assessed. Normality was evaluated using the Kolmogorov-Smirnov test, which indicated that the data for all variables followed a normal distribution ($p > 0.05$). Homogeneity of variances was confirmed using Levene's test ($p > 0.05$). To address potential outliers, we conducted a boxplot analysis and applied the interquartile range (IQR) method. Data points falling below $Q1 − 1.5 IQR$ *or*

*above Q3 + 1.5*IQR were considered outliers and transformed to reduce their influence on the results. Missing data were handled using listwise deletion, as the percentage of missing values was less than 5% and assumed to be missing completely at random. To examine differences between the first and second measurements across biomedical, psychological, psychophysiological, and academic variables, paired samples *t*-tests were conducted. To control Type I error inflation from multiple testing, we applied the Holm-Bonferroni sequential correction method, adjusting significance thresholds for each comparison based on its rank order ($\alpha_{adj} = 0.05/[k - i + 1]$, where i = rank of the p-value). Effect sizes were calculated using Cohen's *d* [46], with the following classification: negligible effect ($\geq$ -0.15 and < 0.15), small effect ($\geq$ 0.15 and < 0.40), medium effect ($\geq$ 0.40 and < 0.75), large effect ($\geq$ 0.75 and < 1.10), very large effect ($\geq$ 1.10 and < 1.45), and huge effect ($\geq$ 1.45). Two multiple linear regression models were conducted to assess the associations of various predictors with academic performance. The first model examined the association of study variables on academic performance, while the second model evaluated whether these relationships remained consistent over time, using only the second assessment measurements. Sex and age were included as confounding variables in both models. Collinearity was assessed using the variance inflation factor (VIF), with all variables yielding VIF values below 10, indicating no multicollinearity issues. The significance level was set at $p \leq 0.05$ for all analyses.

Results

The findings of this study support the initial hypotheses, indicating that heightened stress within an academic environment throughout the semester led to a reduction in sleep hours, accompanied by an increase in anxiety and depressive symptoms. Additionally, although the changes were not statistically significant, effects on heart rate variability were observed (as indicated by effect sizes). Despite these negative consequences, students demonstrated improvements in their academic performance, suggesting that they may have prioritized their studies at the expense of their overall well-being (see Fig. 2).

Table 1 presents longitudinal changes in sleep duration and quality. Students reported sleeping fewer hours at the end of the semester (M: 6.37; SD: 1.29) compared to baseline (M: 6.78; SD: 1.24), with a statistically significant difference after Holm-Bonferroni correction (t (115) = 3.68, $p < 0.02$, d = 0.32). Sleep quality also declined (M 5.33, SD = 2.11 vs. M 5.92, SD = 2.14), though this difference was not significant after correction (t (115) = 2.60, $p < 0.21$, d = 0.28). These findings support the hypothesis that stress in an academic context contributes to deteriorating sleep patterns. However, it is important

to acknowledge that other external factors, such as work commitments or family responsibilities, may also contribute to these changes in sleep patterns.

Similarly, anxiety levels, assessed with the STAI questionnaire, showed a significant increase (M: 13.50; SD: 4.35 at follow-up vs. M: 12.17; SD: 3.93 at baseline), (t (115) = -3.53, $p < 0.04$, d = 0.32), reinforcing the idea that accumulating academic demands elevate stress responses. Depressive symptoms (ZUNG scale) increased significantly (M: 45.69; SD: 5.68 at baseline vs. M: 48.77; SD: 7.11 at follow-up), (t (115) =-4.65, $p < 0.01$, d = 0.48). This increase in depressive symptoms may be linked to high academic demands, accumulated stress, and a potential decline in activities promoting emotional well-being. In contrast, psychological inflexibility decreased (M: 27.55; SD: 9.75 at baseline vs. M: 25.38; SD: 11.23 at follow-up), but this change was not significant (t (115) = 2.52, $p < 0.21$, d = 0.21); however, it may be an indicator of better adaptability to cognitive and emotional challenges over time. Regarding personality traits (Big Five) showed no significant changes over time (all $p > 0.05$).

Concerning physical activity, no significant changes were observed in overall movement levels; however, a non-significant trend (small effect size) suggested reduction in weight training and abdominal exercises was detected at the end of the semester (M: 403.85; SD: 363.33 at baseline vs. M: 255.38; SD: 172.90 at follow-up), t [13] = 2.12, $p < 0.35$, d = 0.38. This suggests that while students may have maintained general movement (e.g., walking or low-intensity activities), they engaged less in structured strength or resistance training.

Indicators of heart rate variability (HRV) showed non-significant but meaningful effect sizes, which could contribute to the hypothesis that increased stress could be associated with autonomic dysregulation. A decrease was observed in PNN50 (M: 29.50; SD: 22.14 at baseline vs. M: 24.40; SD: 17.45 at follow-up), t (114) = 2.18, $p < 0.21$, d = 0.25, and SD1 (M: 34.53; SD: 19.37 at baseline vs. M: 30.42; SD: 13.96 at follow-up), t (113) = 2.00, $p < 0.28$, d = 0.24, indicating a reduced ability to autonomically regulate heart rate. Conversely, an increase in Hfnu was noted (M: 40.08; SD: 21.33 at baseline vs. M: 46.06; SD: 21.11 at follow-up), t (114)=-2.25, $p < 0.14$, d = 0.28, suggesting an overactivation of parasympathetic activity as a potential compensatory mechanism for stress-induced physiological changes. These findings highlight that prolonged stress in an academic context can be associated with physiological exhaustion, increasing susceptibility to long-term health risks. On the other hand, despite the psychological and physiological toll, academic performance improved significantly. Final grades (M: 4.07; SD: 0.77) were higher than initial ones (M: 3.77; SD: 0.61), t (110) = -3.41, $p < 0.02$, d = 0.43.
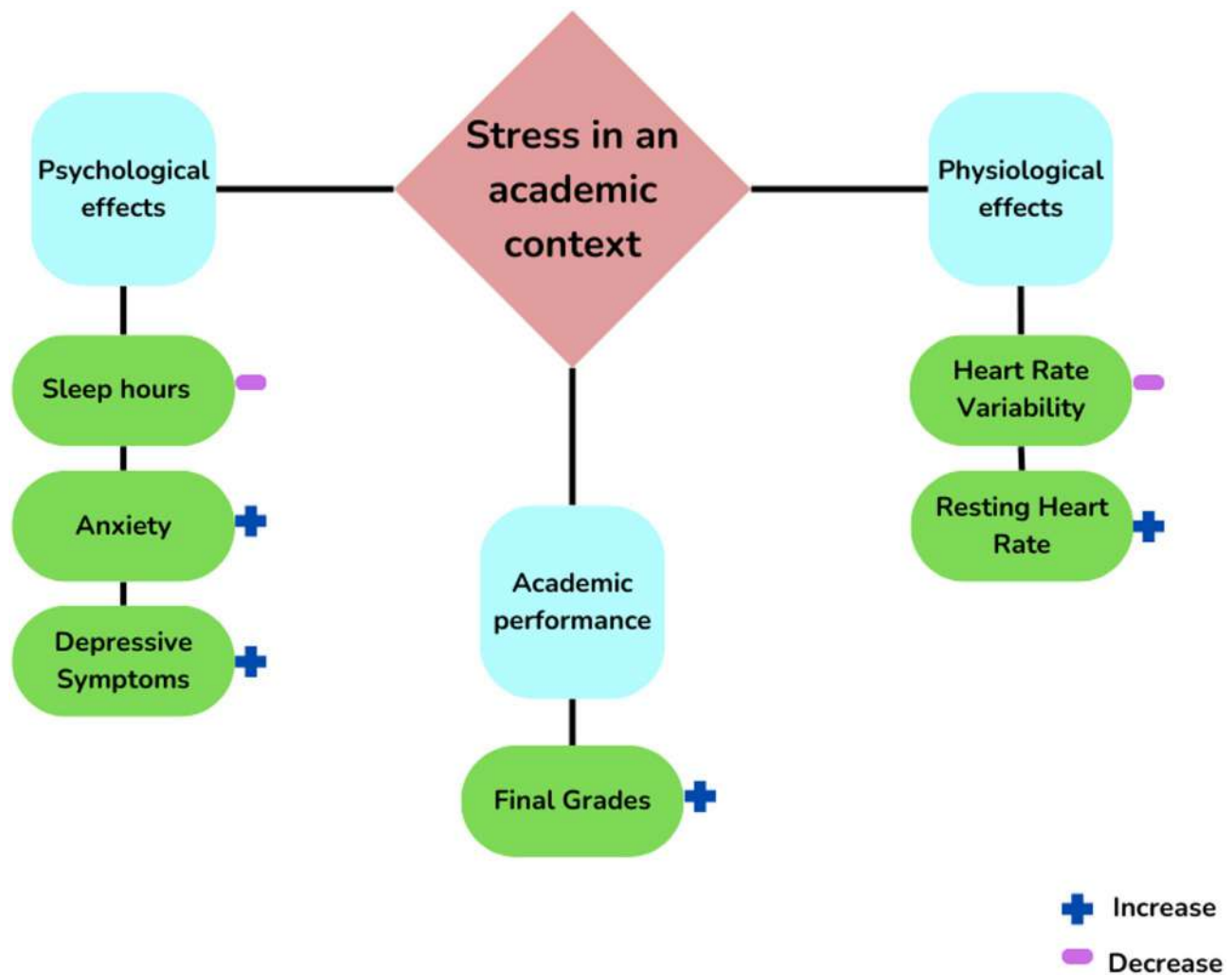
Fig. 2 Effects of Stress on academic context on University Students: A Conceptual Overview

To examine the relationships between variables in more detail, two regression models were conducted (Table 2). The first model analyzed the association of psychological, physiological, and behavioral factors at the beginning of the semester on academic performance. Symptoms of depression emerged as a significant negative predictor (B = -0.03, $p = 0.01$), reinforcing the association between mental health and lower academic achievement. Conversely, greater HRV (SD1) at baseline predicted higher performance (B = 0.01, $p = 0.04$), emphasizing the role of autonomic regulation in cognitive function. This model explained 11% of the variance in academic performance and was statistically significant ($p < 0.02$).

The second model assessed whether these relationships persisted at the semester's end. Higher sleep quality was associated with slightly lower academic performance (B = -0.06, $p = 0.05$), potentially reflecting reduced study time in students who prioritized rest. This could support the second hypothesis, indicating that students enhance their performance over time, potentially at the cost of well-being. Additionally, increased resting heart rate negatively predicted academic performance (B = -0.01, $p = 0.01$), whereas greater HRV (PNN50) was positively associated with academic outcomes (B = 0.02, $p = 0.02$). Lower SD1 values correlated with poorer academic performance (B = -0.03, $p = 0.01$), reinforcing the importance of autonomic flexibility in academic success. This model accounted for 16% of the variance and was statistically significant ($p < 0.01$).

In both regression models, sex was included as a confounding variable. At the first measurement, male students obtained significantly lower academic performance scores compared to female students. This difference was no longer apparent at the second measurement, suggesting a possible adaptation to academic demands across the semester or the influence of other variables that gained relevance over time (Table 2).

Table 1 Descriptive statistics and comparison of variables by measurements

Variables		Measurements	n	M	SD	t-student	P-value	P-adjusted	d
Biomedical	Weight (kg)	1	113	62.61	13.89	-0.19	0.84	1.00	0.01
		2		62.69	13.27				
	Hours of sleep per day	1	115	6.78	1.24	3.68	0.01	0.02	0.32
		2		6.37	1.29				
	Quality of sleep	1	115	5.92	2.14	2.60	0.01	0.21	0.28
		2		5.33	2.11				
Personality	BIG-FIVE Extraversion	1	115	4.83	1.62	-0.50	0.61	1.00	0.06
		2		4.92	1.53				
	BIG-FIVE Agreeableness	1	115	5.91	1.50	-0.56	0.57	1.00	0.05
		2		5.99	1.41				
	BIG-FIVE Conscientiousness	1	115	6.20	1.68	0.56	0.57	1.00	0.06
		2		6.10	1.70				
	BIG-FIVE Neuroticism	1	115	6.63	1.92	-1.23	0.22	1.00	0.11
		2		6.84	1.79				
	Open to Experience	1	115	8.01	1.59	1.58	0.11	0.77	0.15
		2		7.76	1.70				
Anxiety	STAI	1	115	12.17	3.93	-3.53	0.01	0.04	0.32
		2		13.50	4.35				
Psychological Inflexibility	AQQII	1	115	27.55	9.75	2.52	0.01	0.21	0.21
		2		25.38	11.23				
Solitude	Solitude UCLA	1	115	5.32	1.89	1.74	0.84	1.00	0.15
		2		5.04	1.77				
Perceived stress	PSS-4	1	115	6.63	3.33	-1.67	0.09	0.63	0.18
		2		7.20	3.05				
Symptoms of depression	ZUNG Scale	1	115	45.69	5.68	-4.65	0.01	0.01	0.48
		2		48.77	7.11				
Physical activity	Steps	1	41	6458.12	10481.85	0.18	0.85	1.00	0.04
		2		6058.76	8502.75				
	Cyclical/aerobic activity	1	15	174.67	168.47	0.31	0.76	1.00	0.09
		2		157.20	105.85				
	Weight/abs activity	1	13	403.85	363.33	2.12	0.05	0.35	0.38
		2		255.38	172.90				
Heart rate variability	HR	1	114	83.82	15.38	-1.88	0.06	0.42	0.21
		2		86.99	14.32				
	rMSSD	1	114	48.02	23.53	1.89	0.06	0.42	0.23
		2		43.04	19.62				
	PNN50	1	114	29.50	22.14	2.18	0.03	0.21	0.25
		2		24.40	17.45				
	SD1	1	113	34.53	19.37	2.00	0.04	0.28	0.24
		2		30.42	13.96				
	SD2	1	114	48.14	26.26	0.76	0.44	1.00	0.09
		2		45.98	21.57				
	LFNU	1	114	57.56	22.13	1.49	0.13	0.77	0.19
		2		53.38	21.97				
	Hfnu	1	114	40.08	21.33	-2.25	0.02	0.14	0.28
		2		46.06	21.11				
Academic performance	Evaluation grade	1	110	3.77	0.61	-3.41	0.01	0.02	0.43
		2		4.07	0.77				

Note: M: Mean; SD: Standard deviation; Measurement 1: first measurement; Measurement 2: second measurement; STAI: State anxiety questionnaire; AAQII: Acceptance and Action Questionnaire; PSS-4: Perceived Stress Scale 4; HR: Heart rate; rMSSD: square root of average sum of diff squared between normal r-r; PNN50:% of diff between normal R–R intervals greater than 50; SD1: Sensitivity of short-term variability of HRV; SD2: Long-term variability of the HRV spectrum; LFnu: Low frequency; HFnu: High frequency; Height measured in centimeters; Weight measured in kilograms; d: Cohen, effect size; P-adjusted: Holm-Bonferroni correction

Table 2 Results of the linear regression model for academic performance

Measure	Variable	B	Standar Error	Beta	t	*p*-value	IC 95% para B	VIF
First measurement	Constant	2.29	1.31	-	1.74	0.08	[-0.31–4.90]	-
	Age	0.01	0.01	0.01	0.05	0.95	[-0.03–0.03]	1.03
	Sex (Male)	-0.36	0.17	-0.24	-2.11	0.04	[-0.69–0.02]	1.53
	Symptoms of depression	-0.03	0.01	-0.24	-2.54	0.01	[-0.04–0.01]	1.08
	Cardiac Variability (SD1)	0.01	0.01	0.19	2.07	0.04	[0.00–0.01]	1.00
Second measurement	Constant	2.84	1.72	-	1.65	0.10	[-0.58–6.26]	-
	Age	0.02	0.02	0.1	1.14	0.26	[-0.02–0.07]	1.04
	Sex (Male)	0.05	0.21	0.02	0.25	0.79	[-0.36–0.47]	1.53
	Sleep quality	-0.06	0.03	-0.18	-1.97	0.05	[-0.13–0.01]	1.10
	Cardiac Variability (HR)	-0.01	0.01	-0.25	-2.6	0.01	[-0.02–0.01]	1.16
	Cardiac Variability (PNN50)	0.02	0.01	0.51	2.22	0.02	[0.01–0.04]	6.65
	Cardiac Variability (SD1)	-0.03	0.01	-0.63	-2.65	0.01	[-0.06–0.01]	6.89

Note: Dependent variable: Evaluation grade. The variables, age and sex, were included in the model, as they were considered confounding variables. Sex coded as 0 = female, 1 = male. At first measurement, male students showed significantly lower performance compared to females (B = -0.36, *p* = 0.04). No significant difference was found at the second measurement. Symptoms of depression: Zung Scale; SD1: Sensitivity of short-term variability of HRV; HR: Heart rate; PNN50:% of diff between normal R–R intervals greater than 50; VIF: Variance Inflation Factor

Discussion

This study investigated the longitudinal effects of stress in an academic context on psychological, physiological, and behavioral variables, including sleep quality, psychological flexibility, anxiety, depressive symptoms, physical activity, heart rate variability, and academic performance in college students over one semester. The results partially confirm the initial hypotheses, revealing that higher levels of stress over the semester negatively affected sleep quality and heart rate variability, while leading to higher levels of anxiety and depressive symptoms, as hypothesized. Interestingly, despite the adverse psychological and physiological effects, academic performance improved significantly, supporting the hypothesis that students prioritize their studies at the expense of their well-being.

From a physiological perspective, this study provides important insights into the relationship between stress markers and academic performance in university students. The observed decline in sleep quantity and quality over time aligns with the hypothesis that stress in academic settings would negatively affect sleep, consistent with previous research showing that students often sacrifice rest to meet academic demands [47, 48]. However, an unexpected finding emerged: improvements in sleep quality were associated with a slight decrease in academic achievement. This contrasts with the well-established link between better sleep and enhanced cognitive functions, such as memory and attention [49]. Several factors may explain this counterintuitive result. First, it could reflect specific behaviors in our sample, such as nighttime study habits that prioritize academic preparation over sleep, a phenomenon supported by studies showing no significant differences in academic performance between students at risk for sleep disorders and those without sleep disorders [50]. Second, the use of self-reported sleep data introduces potential biases, such

as inaccuracies in perceived sleep quality or higher-performing students reporting greater dissatisfaction due to increased academic pressures [51, 52]. These findings align with recent research on the interplay between stress, health behaviors, and academic performance. For example, one study found that positive thinking, good sleep quality, and higher physical activity levels were associated with improved well-being and/or better performance during high-stakes assessments, such as objective structured clinical examinations (OSCEs) [53]. In contrast, avoidance coping strategies negatively affected both well-being and performance, supporting our observation that students may prioritize academic demands over sleep, potentially adopting maladaptive coping strategies that compromise their well-being.

Interestingly, perceived stress levels, as measured by the PSS-4, did not exhibit a statistically significant change throughout the semester. This stability in perceived stress may suggest that students maintained a consistent perception of their stress levels, possibly due to habituation to academic demands or stable baseline stressors unrelated to academic context. It is also possible that while objective markers (e.g., HRV, sleep) and emotional symptoms (e.g., anxiety, depression) fluctuated, students' subjective appraisal of their stress remained unchanged, highlighting a potential disconnect between perceived and physiological stress responses [7, 26, 54]. This finding aligns with research suggesting that self-reported stress can sometimes remain stable despite underlying changes in emotional or physiological states [55, 56].

Regarding heart rate variability (HRV), the results support the hypothesis that stress may be associated with autonomic dysregulation. At the beginning of the semester, a higher HRV, specifically in the SD1 component (reflecting parasympathetic activity and autonomic recovery), predicted better academic performance.

This finding suggests that students with greater autonomic regulation at the start of the semester were better equipped to handle academic demands, highlighting the crucial role of physiological homeostasis in cognitive function [57]. For instance, higher parasympathetic activity has been linked to greater cognitive flexibility and stress management, which may facilitate more effective academic performance [58]. However, as the semester progressed, the relationship between physiological markers and academic outcomes shifted. Reductions in PNN50 and SD1, along with increases in Hfnu, indicated a diminished autonomic capacity to regulate stress, aligning with existing literature linking chronic stress to autonomic dysfunction [59-63]. Low HRV has been established as a key physiological marker of prolonged stress, reflecting its impact on emotional regulation and cognitive performance [64].

Further analysis revealed that resting HR at the end of the semester was inversely associated with academic performance, suggesting that sustained physiological activation may undermine students' ability to manage academic demands effectively [60, 61]. In addition, the positive association between PNN50 at the end of the semester and academic performance further underscores the importance of parasympathetic activity in maintaining cognitive and emotional resilience. PNN50, which reflects the proportion of successive RR intervals that differ by more than 50 milliseconds, is a marker of vagal tone and autonomic recovery. Higher PNN50 values indicate greater parasympathetic activity, which has been associated with better stress management, enhanced attention, and improved cognitive performance [65, 66]. This finding suggests that students with greater autonomic flexibility and recovery capacity are better equipped to handle academic challenges, supporting the idea that physiological resilience plays a key role in academic success.

These results highlight the dual risks of insufficient physiological arousal and excessive physiological overload, both of which can compromise academic performance. This aligns with previous research showing that moderate autonomic activation is optimal for cognitive functioning, while extreme imbalances, whether due to elevated stress or excessive relaxation, are detrimental to both performance and well-being [67, 68]. The initial protective effect of higher HRV (SD1) at the start of the semester may diminish as academic demands increase, suggesting that chronic stress and fatigue could alter the relationship between autonomic regulation and academic outcomes over time. Despite the adverse effects of chronic stress on physiological well-being, students suggest an improvement in final grades, which may suggest a compensatory mechanism wherein academic performance is prioritized over physical and emotional health,

supporting our study hypothesis. This complex association, previously documented in stress studies [69, 70], raises significant concerns, as it underscores the hidden costs of academic success, particularly the neglect of students' overall well-being; however, unmeasured factors (e.g., study habits) could contribute to this association.

Regarding the connection between psychological indicators of mental health and academic performance, psychological flexibility defined as the ability to manage and respond adaptively to emotional and psychological stressors showed a positive trend throughout the semester, although it was not statistically significant. This finding contrasts with the study's initial hypothesis, which predicted that students would experience a decline in psychological flexibility due to the cumulative effects of academic stress. Instead, the results suggest that students developed a greater capacity to adapt to emotional challenges under sustained stress, a finding consistent with research highlighting the role of psychological flexibility as a protective factor in high-demand environments [71, 72]. For instance, studies have shown that individuals with higher psychological flexibility are better equipped to handle academic pressures and maintain emotional well-being, even in the face of significant stressors [73, 74]. However, despite this improvement in psychological flexibility, students experienced an increase in symptoms of depression and anxiety by the end of the semester, which is consistent with the study's hypotheses. This contrasts with some studies that have found psychological flexibility to be inversely associated with symptoms of depression and anxiety [75]. The discrepancy may be explained by the unique nature of stress in an academic context, which often involves prolonged exposure to high demands and limited recovery time, potentially overwhelming even adaptive coping mechanisms [76]. Conversely, students exhibiting heightened depressive symptoms at the outset of the semester were more likely to experience diminished academic performance, underscoring the lasting impact of mental health on academic outcomes [77]. Although the reported symptoms did not reach clinically significant thresholds, they indicate a discernible psychological decline linked to stress in academic environments [78]. This finding aligns with research suggesting that stress can precipitate subclinical levels of mental health issues, which, despite not fulfilling diagnostic criteria, can still adversely affect well-being and academic achievement [13].

While previous research has shown that personality traits influence stress vulnerability and coping effectiveness [79, 80], our findings did not reveal this. Specifically, none of the personality traits included in our regression models were statistically significant predictors of academic performance. This contrasts with studies suggesting that traits such as neuroticism, extraversion, and

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conscientiousness play a key role in stress responses and academic outcomes [79, 80]. The lack of significant findings in our study may be attributed to several factors, such as the homogeneity of personality traits in our sample or the predominance of contextual factors (e.g., academic workload, institutional support) that overshadowed the relation of personality.

This study highlights the intricate interplay between psychological, physiological, and behavioral factors in predicting academic performance, including variables such as sleep quality, perceived stress, psychological flexibility, and heart rate variability. Academic success appears to emerge from a complex interplay between physiological arousal (stress) and the psychological flexibility to manage it effectively. In academic settings, stress often functions as a positive determinant of performance under specific conditions, which partially coincides with eustress theory, which posits that moderate levels of stress can act as a motivating force that enhances performance [81, 82]. Professional studies present environments that simultaneously generate both beneficial and detrimental forms of stress, offering opportunities for students to develop skills to manage these demands. This underscores the dual nature of stress in higher education, where it can act as both a catalyst for performance and a potential detriment to overall well-being if not properly regulated. Similarly, this study emphasizes the importance of targeted interventions to mitigate the negative effects of stress in academic settings on student well-being. While students may develop adaptive mechanisms, such as increased psychological flexibility, increased symptoms of depression and anxiety illustrate the limitations of these innate coping strategies. Medical students should be offered the opportunity to participate in structured stress management programs that emphasize personalized support and goal setting, as these may help reduce psychological and physiological stress and improve students' coping abilities [83].

The limitations of this study underscore several important areas for consideration. Firstly, the sample was restricted to university psychology students from a single institution and employed a non-probabilistic sampling method, constraining the generalizability and applicability of the findings to other populations, disciplines, or educational settings. However, the physiological and behavioral markers studied (e.g., HRV, sleep) are broadly relevant to stress research in higher education. In addition, as this was an observational study, unmeasured confounding factors may influence the observed relationship, Likewise, the study results do not imply causality between the variables. Furthermore, the data collected was not anonymous, potentially influencing participants' responses due to concerns about privacy or social desirability bias. Secondly, the study relied on self-reported

measures for key variables, such as perceived stress, anxiety, and sleep quality, which are vulnerable to inaccuracies stemming from recall bias, social desirability bias, and individual differences in perception. For instance, students experiencing high stress may overestimate sleep disturbances, while others might underreport them due to the normalization of poor sleep habits. These limitations emphasize the necessity for future research to supplement self-reported data with objective measures, such as actigraphy or polysomnography, to achieve a more comprehensive understanding of the relationship between sleep quality and academic performance. Third, although the study evaluated physical activity levels through self-reported measures, it did not specifically assess sedentary behavior. Future research could benefit from incorporating objective or validated self-report tools to measure sedentary time and explore its potential interaction with stress within an academic context, as well as its impact on student well-being. Additionally, although we controlled learning effects by varying test content, we cannot rule out that general test-taking skills improved over time. Future studies could include parallel test versions to address this. Furthermore, it is important to highlight that this study concentrated on stress in academic settings rather than characterizing academic stress as a distinct construct. While this perspective allowed for a broader understanding of the stressors that students encounter in their academic environments, it may have encompassed factors beyond purely academic demands, such as personal or social stressors. This broader lens might limit the direct comparability of our findings with studies that focus specifically on academic stress as a construct. However, it offers a more comprehensive view of the overall stress experience for university students, which is invaluable for developing holistic interventions. Despite these limitations, the study's findings possess considerable value and practical implications. The insights gained may guide intervention strategies for managing stress among university students, establishing a crucial foundation for future policies related to student welfare and psychological support programs. By focusing on a specific group, the research provides a more nuanced understanding of stress within that academic context, serving as a launching pad for broader comparative studies.

For future research, it would be beneficial to broaden the participant base to encompass a diverse range of institutions and demographics, allowing for the examination of whether similar results emerge across different educational scenarios. Additionally, future studies should explore specific academic stressors (e.g., exams, deadlines, workload) in a more structured manner to better understand their unique impact on student well-being and performance. This could involve developing targeted

assessments or interventions that address these stressors directly. Integrating more objective stress measurement methods, such as analyzing physiological biomarkers or employing neuroimaging techniques, could enhance the study's rigor. Furthermore, investigating targeted interventions designed to alleviate stress in an academic context, with an assessment of their effectiveness through experimental or longitudinal approaches, could greatly contribute to understanding and improving student experiences throughout their academic journeys [83]. Future research should also explore the interplay between personality traits and stress in academic contexts in diverse populations and contexts to better understand their role in student well-being and performance.

The findings of this study underscore the importance of implementing comprehensive strategies to support university students' well-being during periods of heightened stress in an academic context. Educational institutions should consider integrating stress management programs, such as mindfulness training or resilience-building workshops, to mitigate the adverse psychological and physiological effects of stress [83]. Additionally, promoting better sleep hygiene and encouraging regular physical activity could enhance students' capacity to cope with academic demands [84, 85]. Leveraging tools like heart rate variability monitoring can provide personalized feedback to identify students at risk of chronic stress and tailor interventions accordingly. These approaches not only aim to improve academic performance but also prioritize the overall health and sustainability of students' educational journeys.

Conclusion

This study provides a comprehensive analysis of the long-term effects of stress within an academic context on the psychological, physiological, and behavioral outcomes of college students. The findings indicate that academic-related stress is linked to poorer sleep quality, autonomic regulation, and mental health. Notably, while there is an improvement in academic performance, this enhancement is also linked to increased anxiety, depressive symptoms, and physiological dysregulation, highlighting an often-overlooked connection between academic success and student well-being. These results emphasize the need for targeted interventions that address both academic and non-academic stressors, foster physiological resilience, and support holistic well-being. Future research should explore specific academic stressors, utilize objective measures, and evaluate the effectiveness of interventions designed to help students manage stress and achieve sustainable academic success.

Abbreviations
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Publisher's note

ARTICLES FOR UTM SENATE MEMBERS

"Driving student success, well-being, and skills for the future"

TITLE	SOURCE TITLE
8. Study well-being profiles, recovery strategies, and academic performance among university students: a person-oriented approach (2025)	Higher Education (Article from : Springer Science and Business Media B.V.)

Study well-being profiles, recovery strategies, and academic performance among university students: a person-oriented approach

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Abstract

The present study introduces a circumplex model of study well-being as an application of occupational well-being research to a higher education context. Accordingly, the first aim was to identify what kind of study well-being profiles (SWP), representing different levels and combinations of study engagement, burnout, satisfaction, holism, and boredom; there are among university students and how stable the SWPs are during the academic school year. The second aim was to investigate how the identified SWPs are related to students' recovery strategies and perceived academic performance. A total of 812 Finnish university students filled in an e-survey at the end of the fall semester (T1) and 316 of them did it again at the end of the spring semester (T2). Latent transition analysis revealed altogether four SWPs (at T1/T2): Moderate (44/42%), Engaged-Satisfied (26/25%), Engaged-Holists (17/17%) and Bored-Burned out (13/16%). Latent transition analysis showed that the detected SWPs were highly stable: 86% of the participants remained in their SWP across the academic year. However, where transitions occurred from one profile to another, they were mainly from better to worse. Furthermore, the results showed that students from Moderate or Engaged-Satisfied profiles reported more beneficial recovery strategies and experienced better academic performance than students from Engaged-Holists or Bored-Burned out profiles. In conclusion, this study highlights that study engagement and holism can co-exist, particularly in performance-oriented, success-tracking, and evaluative environments such as academia, without necessarily advancing academic performance and posing a threat to recovery from study-related stress.

Keywords University students · Study well-being · Engagement · Burnout · Recovery strategies · Latent transition analysis

Introduction

The declining student well-being within higher education highlights a pressing need for institutions to adopt holistic approaches that support both academic performance and personal growth (e.g., Auerbach et al., 2018). In the present study, we investigate how

university students' well-being experiences relate to their recovery from study distress and their perceived academic performance. More precisely, we investigate a circumplex model of study well-being as an application of occupational well-being research to a higher education context (Bakker & Oerlemans, 2011). That is, we theorize similar mechanisms and processes laying behind study well-being experiences among students in higher education than behind occupational well-being experiences among employees.

Following this line of reasoning, work engagement and burnout have already been studied in a higher education context in the form of study engagement and burnout (e.g., Carmona-Halty et al., 2019; Salmela-Aro & Read, 2017; Schaufeli et al., 2002; Zeijen et al., 2024). However, well-being is not manifested only as burnout and engagement experiences; instead, our work- and study-related well-being experiences cover more versatile variations also, including job/study satisfaction and work/study holism when inspected from the perspective of the *two-dimensional view of work-related subjective well-being* (Bakker & Oerlemans, 2011). Furthermore, it has been presented that this view can be complemented with the construct of job boredom (see, e.g., Harju et al., 2014, p. 912, Fig. 1). Accordingly, student boredom has been recognized as a relevant phenomenon also in higher education context (e.g., Sharp et al., 2016).

From these starting points, this study covers the theory-based key indicators of study-related well-being, investigating *firstly* the existence and stability of study well-being profiles (SWP), representing different levels and combinations of study-related engagement, burnout, satisfaction, holism, and boredom, and *secondly*, how the identified SWPs are related to university students' recovery strategies and perceived academic performance. Both the theoretical background and the results of the present study will also provide a framework for higher education personnel (e.g., guidance counsellors) to understand and contemplate study-related well-being from different perspectives with students confronting challenges with their well-being and/or study advancement, as these challenges are relatively common (Kaggwa et al., 2021).

Study well-being profiles based on two-dimensional view of subjective well-being

In the present study, SWPs are considered to represent different intraindividual levels and combinations of study-related well-being experiences, similar to multifaceted occupational well-being profiles found recently among guidance counsellors (Rantanen et al., 2023). The study was based on the two-dimensional view of work-related subjective well-being that combines the key indicators of employee well-being, namely burnout, work engagement, workaholism, and job satisfaction, into the same model (Bakker & Oerlemans, 2011). Since the theoretical base and empirical measures of study burnout and engagement are rooted in job burnout and work engagement (Salmela-Aro, 2009; Salmela-Aro & Upadyaya, 2012; Schaufeli et al., 2002), it seems plausible to adapt the two-dimensional view of work-related subjective well-being (Bakker & Oerlemans, 2011) to form a circumplex model of study well-being which is presented in Fig. 1.

As illustrated in Fig. 1, based on Bakker and Oerleman's (2011) theorizing, two main dimensions induce different forms of subjective well-being while studying: (1) high vs. low activation and (2) pleasure vs. unpleasure. Accordingly, *study engagement* as a combination of high activation and pleasure has been defined as a positive state of mind in academic work comprising vigor (i.e., high level of energy and mental resilience while studying), dedication (i.e., positive cognitive attitude and interest towards studying), and absorption (i.e., a total concentration and engrossing in academic work) (Salmela-Aro,
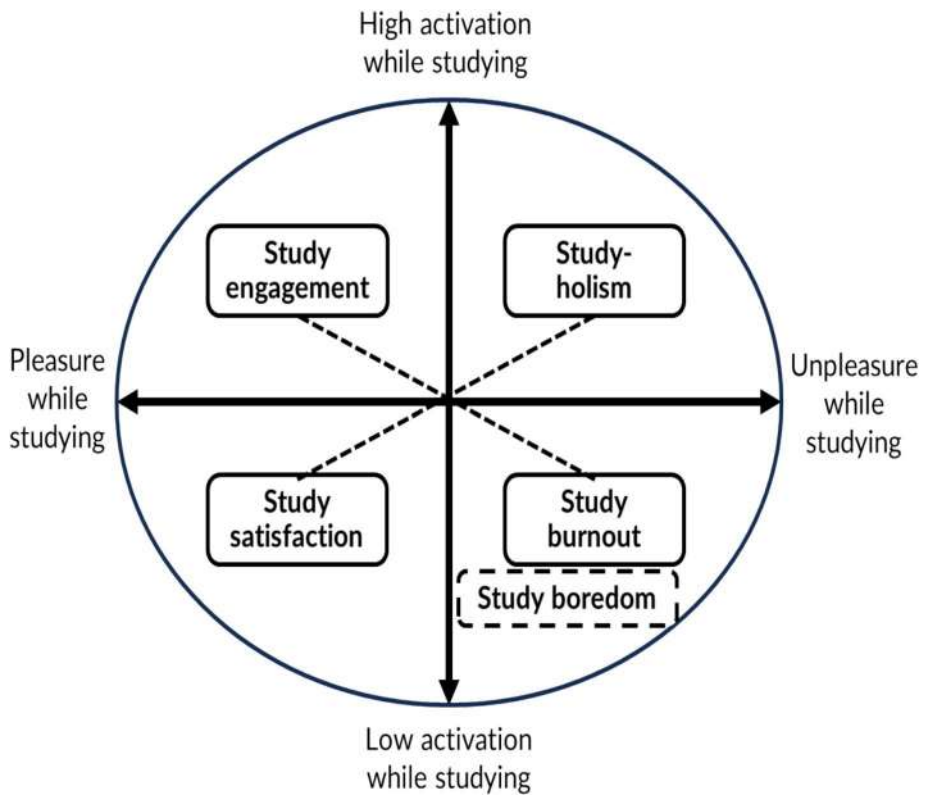
Fig. 1 Circumplex model of study well-being (adapted from the two-dimensional view of work-related subjective well-being; see Bakker and Oerlemans (2011), Fig. 2). Study boredom is depicted with a dotted outline because job boredom as a parallel construct is not included in the view presented by Bakker and Oerlemans

2009; Salmela-Aro & Upadyaya, 2012; Schaufeli et al., 2002). *Study burnout*, in turn, as an opposite to study engagement, manifests itself as a combination of low activation and unpleasure and comprises three separate dimensions: emotional exhaustion (i.e., strain and chronic fatigue caused by study demands), cynicism (i.e., detached attitude toward studies and loss of interest in academic work), and inadequacy (i.e., feelings of incompetence as a higher education student) (Salmela-Aro, 2009; Salmela-Aro & Upadyaya, 2012; Schaufeli et al., 2002).

According to the conceptualization presented in Fig. 1, studyholism shares the element of high activation with study engagement. However, the difference between these experiences is that the primary affect attached to workaholism, and parallelly to studyholism, is not pleasure but displeasure (Schaufeli et al., 2009; Taris et al., 2010). Hence, in the present study, *studyholism* is defined as a strong inner, compulsive drive to study excessively hard instead of studying hard primarily due to the joy and fulfilment of academic work. This definition is congruent with the view that although studyholism can, in some students, co-exist with study engagement, the core of studyholism lies nevertheless in the obsessive–compulsive symptoms (Loscalzo & Giannini, 2022). In turn, *study satisfaction* as an opposite experience of studyholism reflects pleasure

and low activation. It is defined here as a student's global positive feelings toward studies and academic work following the definition of job satisfaction (Spector, 1997).

Finally, based on earlier scholars' work, *study boredom* can be defined as a state of unwell-being that is characterized by low activation and arousal combined with unpleasure, discontentment, and difficulties in concentration due to lack of interest-evoking external stimulus and/or inner motivation toward one's academic work (Harju et al., 2014; Reijseger et al., 2013; Vîrgă et al., 2022). Hence, it is suggested that as a part of the circumplex model of study well-being, study boredom represents another counterpart to study engagement, along with study burnout. However, study boredom does not mean as detrimental loss of mental energy, resources, and self-competence as study burnout because "boredom is more strongly related to the activation–deactivation axis, whereas burnout also strongly relates to the pleasure–displeasure axis" (Harju et al., 2014, p. 912).

The present study investigates study engagement, burnout, satisfaction, holism, and boredom by applying a person-oriented approach and methods (Hofmans et al., 2020). This approach is chosen because individuals, and here particularly university students, are likely to differ from each other in how the different indicators of subjective study well-being are linked to each other. Students may also differ in terms of stability and change of their subjective well-being and, in some students, ill-being may accumulate (Parviainen et al., 2020; Salmela-Aro & Read, 2017; Tuominen-Soini & Salmela-Aro, 2014).

However, study engagement, burnout, satisfaction, holism, and boredom have rarely been examined simultaneously and with a person-centered approach to find out how these well-being experiences combine to form different kinds of SWPs. In one existing study among higher education students utilizing this kind of study design, four SWPs among Finnish higher education students were detected: 44% of the students experienced particularly high study engagement and 7% suffered from very severe study burnout, while 30% of the students were identified as simultaneously exhausted and engaged, and 19% experienced inadequacy in their studies (Salmela-Aro & Read, 2017). In addition, among general upper secondary students, there were four different SWPs as well: engaged (44%), engaged-exhausted (28%), cynical (14%), and burned out (14%), and the results indicated that it was typical for engaged students to stay in the engaged group and for engaged–exhausted students to move into a more disengaged group (Tuominen-Soini & Salmela-Aro, 2014). Furthermore, a more recent study showed that upper secondary students could be divided into three groups according to their engagement, burnout, and studyholism: engaged (34%), stressed (47%), and burned out (19%) (Salmela-Aro & Upadyaya, 2020). Also, Cano et al. (2024) found three SWPs among undergraduate psychology students: engaged, moderately engaged, and burned-out. An explicit limitation of these previous studies is that they have mainly focused only on study engagement and study burnout without simultaneously considering all dimensions of the circumplex model of study well-being (see Fig. 1), which would provide a more comprehensive view of higher education students' well-being in the form of SWPs. In general, previous research shows that burnout and engagement are rather stable constructs over differing time intervals (e.g., Mäkikangas & Kinnunen, 2016; Salmela‑Aro et al., 2021). However, to our knowledge, there is a lack of research about the temporal stability and possible transitions between SWPs during higher education studies either in short-term, that is within the same academic year as in the present study design, or in long-term such as across several academic years.

Study well-being, recovery strategies, and academic performance

Our novel aim is to investigate whether students belonging to different SWPs differ from each other in recovery strategies and perceived academic performance. This question holds significance as students must allocate their energy and other resources effectively to perform well in their studies. This resource consumption is typically recuperated during leisure time. Generally, the recovery process contrasts with the strain process, where strain reactions are mitigated (Geurts & Sonnentag, 2006; Meijman & Mulder, 1998). However, in student life, factors such as blurred boundaries between studies and free time, demanding academic workload, and pressure from graduation deadlines may impede recovery. Due to these strain factors, exploring whether students can recover from study-related stress and how this relates to their well-being is crucial.

This study examines study-related stress recovery through psychological detachment from academic work and relaxation (Sonnentag & Fritz, 2007). *Psychological detachment* refers to mentally disengaging from work-related thoughts. At the same time, *relaxation* is associated with a low activation level and a positive mood, typically resulting from low physical and mental effort. Secondly, Sonnentag and Fritz (2007) present two other recovery strategies—control and mastery experiences—that contribute to recovery. *Control* pertains to individuals' ability to decide how they spend their time outside of work, facilitating perceptions of personal agency. *Mastery experiences* involve feelings of competency resulting from learning or positive achievement experiences during leisure time.

The above-defined recovery strategies are all very beneficial for employees (see, e.g., Mäkikangas et al., 2014; Sianoja et al., 2018), but detachment and relaxation stand out as particularly crucial leisure recovery experiences in terms of well-being (for review, see Sonnentag et al., 2017). Here, the significance of these recovery strategies is studied among university students, and we suppose that they also play a crucial role in their subjective well-being. The previous research on higher education students' recovery and its relations to well-being and academic performance is scarce and has mainly focused on psychological detachment instead of all four recovery strategies. Prior research shows that successful detachment from studies is related to lower anxiety, burnout, and depression (Isoard-Gautheur et al., 2023), as well as study engagement and well-being in life (Chu et al., 2021). Also, a few other studies suggest that leisure activities that help psychologically detach from academic work (Luta et al., 2021) and require sustained and committed involvement (Donald et al., 2024) benefit university students' performance and well-being.

Our final aim is to examine whether students in different SWPs perceive their academic performance differently. Academic performance is defined here as students' perceived study progress and study success when compared with their own expectations. Previous research shows that, in general, student well-being is positively but relatively weakly related to academic performance (Bücker et al., 2018). This association may result from the fact that students are not a homogenous group, and it matters how the different indicators of subjective study well-being are linked. Supporting this notion, Ketonen et al. (2016) found that engaged and motivated university students were likelier to achieve good grades and earn the target amount of study credits. Correspondingly, the results by Klinkenberg et al. (2023) indicated that the engagement-exhaustion combination is typical among highly achieving students. In contrast, the disengagement-exhaustion combination increases the likelihood of lower academic results and delays in

studies. In addition to differences in the pleasure vs. unpleasure axis, differences in the high vs. low activation axis (cf. Figure 1) can be particularly interesting. Namely, boredom has been found to be harmful to academic performance and learning (Ghensi et al., 2021; Vilhunen et al., 2022).

The current study

This study addresses three gaps in the current literature on university students' well-being: (1) The previous research on student well-being mainly focuses only on study engagement and burnout. Instead, this study applies the circumplex model of study well-being to simultaneously consider all constructs of the proposed model (see Fig. 1) via latent profile analysis. (2) There is a lack of research on SWPs using longitudinal study designs. This study employs a latent transition analysis to also investigate the stability of the SWPs. (3) To our knowledge, no previous research has considered the relation between SWPs and students' recovery strategies and perceived academic performance.

The research questions are as follows:

RQ1: What kind of study well-being profiles (SWP) can be identified among university students based on study engagement, burnout, satisfaction, holism, and boredom, and how stable are these SWPs across an academic year?

RQ2: How are the SWPs related to recovery strategies (i.e., psychological detachment, relaxation, mastery, and control) and academic performance (i.e., study success and study progress)?

In this study, no specific hypotheses are tested. However, based on the previous literature, we expect to find several different SWPs among university students, demonstrating different combinations of well-being dimensions (e.g., Cano et al., 2024; Salmela-Aro & Read, 2017). Also, the SWPs are expected to show rather high stability over time (e.g., Mäkikangas & Kinnunen, 2016; Salmela‑Aro et al., 2021; Tuominen-Soini & Salmela-Aro, 2014). Furthermore, we expect that better study well-being relates positively to the beneficial recovery strategies as well as better perceived academic performance (e.g., Chu et al., 2021; Klinkenberg et al., 2023).

Methods

Finnish higher education context

Finnish universities are quite autonomous in how they organize well-being support for their students. In the university of the present study, a three-step support model is used. Basic support is available to all students and consists of courses, online self-help programs, and events to support well-being and learning ability. Supplementary support consists of low threshold individual and group counselling and guidance conducted both in the department and faculty but also at the whole university level. Most students benefit from these first two steps, but also more individualized support, provided by experts specializing in supporting student well-being and learning ability, is available through a referral from student health care services.

However, based on results by Finnish Student Health and Wellbeing Survey (THL, 2024), 29% of higher education students experienced psychological distress (i.e., anxiety,

depression, lower levels of happiness). Moreover, according to the survey, 60% of women and 68% of men feel that they have received inadequate mental health services from the student healthcare services for higher education students. Similar results regarding the increase in mental health problems among students have also been found in international studies (e.g., Auerbach et al., 2018).

Participants and procedure

The longitudinal data with two time points was collected in 2016 (T1, $n=812$) and 2017 (T2, $n=316$) at a middle-sized university in central Finland (ca 14,500 students and 2500 staff members). Participation was voluntary, and informed consent was required from all participants.

First, an email invitation to an e-survey was sent at the end of the fall semester 2016 (T1) to all second- and fourth-year students ($N=3185$), of which 990 responded (32% response rate). The respondents represented this university's students reasonably well according to gender and faculty distribution [authors anonymized]. In this study, those 812 participants who had given answers to the key measures of the present study were included. Next, those who gave their consent at T1 for follow-up got an email invitation to participate in the T2 e-survey at the end of the spring semester of 2017, about 6 months after the first wave. Altogether, 316 students (38% response rate) responded to the key measures of the present study. In the subsequent data analyses, those 812 who participated in T1 were included in the cross-sectional analyses regarding the first time point. In contrast, those 316 university students who participated in both T1 and T2 were included in the longitudinal analysis.

The attrition analyses conducted prior to the main analyses showed that there was no difference between the students who participated both at T1 and T2 vs. those who participated only at T1 in age [t-value$=-0.22$, $p=0.82$], study-year [$\chi2\ (1)=1.99$, $p=0.16$], faculty distribution [$\chi2\ (5)=8.13$, $p=0.15$], full-time vs. other study schedule [$\chi2\ (3)=5.24$, $p=0.16$], or weekly study hours [t-value$=1.08$, $p=0.28$]. However, women participated more often at both time points than men [$\chi2\ (2)=8.81$, $p=0.01$]. Accordingly, at T1, 75% of the participants were women, whereas at T2, this count was 80%. Based on T1 data, the average age of the participants was 26 years (range 19–60; $SD=7.27$). Fifty-six percent were second-year, and 44% were fourth-year students. Most were full-time students (89%), and they studied approximately 31 h per week (range 0–105; $SD=14.80$). In addition, the faculty distribution of the sample was as follows: 31% humanities and social sciences, 23% education and psychology, 13% mathematics and science, 13% sport and health sciences, 12% information technology, and 8% business and economics.

Measures

Based on our RQ1, study engagement, burnout, satisfaction, holism, and boredom were measured at T1 and T2 as we were interested in the stability vs. change in the SWPs based on these indicators. Based on our RQ2, recovery strategies and academic performance were measured at T2 as we were interested in how the detected SWPs were related to these two phenomena at the end of the academic year when presumably the subjective well-being is at lowest, and performance can be self-estimated by the respondents reliably based on the actual course of the academic year in their situation.

Study well-being at Time 1 and Time 2

As the present study relies on the two-dimensional view of subjective well-being illustrated in Fig. 1, the study well-being construct were examined at their overall rather than on their sub-dimension level. This approach was supported by the preliminary first-, second-, and third-order confirmatory factor structure analyses (CFA) conducted for each of the study well-being indicators, the main results of which are reported in the Appendix 1. The scales for study engagement, burnout, satisfaction, holism, and boredom were all rated on a 6-point Likert-type scale ranging from 1 (*completely disagree*) to 6 (*strongly agree*). The attrition analyses showed that there was no difference between the students who participated both at T1 and T2 vs. those who participated only at T1 in any of the study well-being variables (*t* value range 1.14–1.57 with respective *p* value range 0.26–0.12).

Study engagement was measured with nine items based on a Finnish study engagement inventory (Salmela-Aro & Read, 2017) covering experiences of vigor (e.g., "When I study, I feel that I am bursting with energy"), dedication (e.g., "I find studying full of meaning and purpose"), and absorption (e.g., "Time flies when I'm studying") related to one's studies. The formed average sum scores for study engagement showed good internal consistencies both at T1 ($\alpha = 0.92$) and T2 ($\alpha = 0.93$).

Study burnout was measured with nine items based on a Finnish Study Burnout Inventory (Salmela-Aro & Read, 2017; Salmela-Aro et al., 2009) covering experiences of exhaustion from studying (e.g., "I feel overwhelmed by studying"), cynicism toward the meaningfulness of studying (e.g., "'m continually wondering whether my studies have any meaning"), and sense of inadequacy as a student (e.g., "I often have feelings of inadequacy in my studies"). The formed average sum scores for study burnout showed good internal consistencies both at T1 ($\alpha = 0.88$) and T2 ($\alpha = 0.88$).

Study satisfaction was measured with four items developed by the authors based on the assessment of general job satisfaction (Spector, 1997) and applied to the present context. These items were as follows: "In general, I am satisfied when I study," "At the moment, I find studying nice," "At the moment, studying is pleasant and easy for me," and "I am not particularly bothered or disturbed by anything in studying." The formed average sum scores for study satisfaction showed good internal consistencies at T1 ($\alpha = 0.85$) and T2 ($\alpha = 0.88$).

Studyholism was measured with nine items based on DUWAS-10 (Schaufeli et al., 2009; see validation into the Finnish context and language in Rantanen et al., 2015). The present study's authors modified the Finnish DUWAS-10 items to fit the higher education context when needed. Later, item one was discarded because of its psychometrical weakness. The nine item studyholism scale still covered experiences of studying (1) frantically ("While studying, I seem to be in a hurry and racing against the clock" and "I stay busy and keep many irons in the fire"), (2) long hours ("I find myself using more time to studying than my student fellows" and "I spend more time studying than on socializing with friends, on hobbies, or on leisure activities"), (3) with obsessive drive ("It's important to me to study hard even when I don't enjoy what I'm doing," "I feel that there's something inside me that drives me to study hard" and "I feel obliged to study hard, even when it's not enjoyable"), and (4) unease if not studying ("I feel guilty when I take time off/a break from studies" and "It is hard for me to relax when I'm not studying"). Of these four experiences, the first two combines into studying excessively and latter two studying compulsively that further form the overall experience of

studyholism (cf. Rantanen et al., 2015, concerning the parallel, fine-grained hierarchical structure of workaholism). The formed average sum scores for studyholism showed good internal consistencies both at T1 (α = 0.82) and T2 (α = 0.80).

Study boredom was measured with five items developed by the authors based on the Dutch [Job] Boredom Scale (Reijseger et al., 2013; see validation into the Finnish context and language in Harju et al., 2014). This scale and items were modified by the present study's authors into the higher education context. The items were as follows: "When I study, time passes very slowly," "I often feel bored when I study," "My interest often fades when I study," "When I study, I get bored and often hope that the book or lecture would soon end," and "My studies only seldom challenge my competence or motivate my interest." The formed average sum scores for study boredom showed good internal consistencies at T1 (α = 0.87) and T2 (α = 0.87).

Recovery strategies at Time 2

Students' recovery strategies were measured with 12 items from the Recovery Experience Questionnaire developed by Sonnentag and Fritz (2007; see validation into the Finnish context and language in Kinnunen et al., 2011) to work context. The present study's authors modified those 12 items to fit the higher education context if needed. The instruction for the respondent was "Next, we describe some thoughts and activities possibly related to free time. Evaluate how much they apply to your free time generally (not only at weekends and on holidays)," and the response scale ranged from 1 (*I do not agree at all*) to 5 (*I fully agree).*

From the 12 items, three measured *psychological detachment* from studies (and work as some students also work alongside studies) ("I forget about work and studies," "I distance myself from my work and studies" and "I get a break from the demands of work and studies"), three *relaxation* ("I do relaxing things," "I use the time to relax," and "I take time for leisure"), three *control* ("I feel like I can decide for myself what to do," "I decide my own schedule," and "I take care of things the way that I want them done"), and three *mastery experiences* ("I learn new things," "I seek out intellectual challenges," and "I do things that challenge me"). CFA confirmed the intended four-factor structure in the present data: both model fit [$\chi2$ (48) = 103.01, p = 0.000, RMSEA = 0.06, CFI = 0.95, TLI = 0.94] and factor loadings (range 0.69–0.86) were good except for one factor loading that was only 0.51. Hence, average sum scores for psychological detachment (α = 0.81), relaxation (α = 0.81), control (α = 0.72), and mastery experiences (α = 0.79) were formed with good internal consistencies.

Academic performance at Time 2

Academic performance was evaluated by students' perceptions about their study success and study progress. Study success was measured with a single item, "Compared to your expectations, during this semester, has your study success been…" with the response options "better than expected," "as expected," and "worse than expected." Similarly, study progress was measured using a single item, "Compared to your expectations, during this semester, has your study progress been…" with the response options "faster than expected," "as expected," and "slower than expected." In formulating the items, we utilized the study success item format from a national panel survey (Kunttu et al., 2016), which we supplemented with study progress item used previously in our university panel surveys.

Analyses

To answer RQ1, the sum score means of the five study well-being indicators (study engagement, burnout, satisfaction, holism, and boredom) were analyzed with latent profile analysis (LPA) and latent transition analysis (LTA) using Mplus version 8.9 (Muthén & Muthén, 2017). The parameters of the models were estimated using the maximum likelihood robust (MLR) estimator, which is robust to the nonnormality of the observed variables. First, a latent profile analysis (LPA) was conducted to determine the number of latent SWPs. Six criteria were used to compare the models of different well-being profile groups: (a) log-likelihood, (b) Bayesian information criteria (BIC), (c) the bootstrapped likelihood ratio test (BLRT), (d) the Vuong–Lo–Mendell–Rubin (VLMR) test of fit, (e) entropy values, and (f) the clarity and interpretability of the classes. The best-fitting model is considered to have a low log-likelihood value, low BIC value, significant (< 0.05) BLRT and VLMR p values, and a high entropy value. The profile solution also should be theoretically consistent and interpretable. Second, a latent transition analysis (LTA) was conducted to investigate the stability of the latent SWPs and the transitions between these profiles.

To answer RQ2, the Welch ANOVA, with the Games-Howell post hoc test for pairwise profile comparisons, was conducted to examine if the students' reported levels of recovery strategies differed significantly between the different SWPs in T2. Furthermore, non-parametric Kruskall-Wallis H tests with Bonferroni corrected pairwise profile comparisons were conducted to examine if the reported levels of perceived study success and study progress differed significantly between the latent SWPs in T2.

Results

Table 1 shows the descriptive statistics for the five study well-being indicators (the bivariate correlations of the study variables are shown in the Appendix 2, Table 5 and Table 6). Confirming our presumption, paired sample *t*-test comparisons showed that participants experienced more study burnout, holism, and boredom at the end of the spring semester, whereas study satisfaction was experienced more at the end of the fall semester. Interestingly, there was no time effect on study engagement.

Table 1 Means (*M*) and standard deviations (*SD*) of the five study well-being indicators and paired sample *t*-test for mean differences

	T1 (n = 812)		T2 (n = 316)		Paired sample *t*-test between T1 and T2 (n = 316)	
	M	*SD*	*M*	*SD*	*t*	*p*
Well-being						
Study engagement	3.89	0.82	3.93	0.87	0.06	0.952
Study burnout	2.90	0.96	3.09	1.00	−4.12	<0.001
Study satisfaction	3.86	0.92	3.77	1.01	2.52	0.012
Studyholism	3.52	0.84	3.65	0.83	−2.12	0.035
Study boredom	3.09	0.91	3.19	0.93	−4.31	<0.001

Note. All study well-being indicators had response scale from 1 (completely disagree) to 6 (strongly agree)

Study well-being profiles among university students

The first aim of the present study was to examine what kind of latent SWPs there exist among university students at the end of the fall semester (T1) and at the end of the spring semester (T2), as well as the stability vs. change concerning belonging to a particular SWP across time.

To identify distinctive SWPs, we conducted LPA separately for both T1 and T2. A four-class solution fitted the data best at both time points when considering all the statistical criteria (Table 2) and the interpretability of the different class solutions simultaneously. Although the *p* values for VLMR and the entropy values indicated that a three-profile solution might provide a slightly better model fit, a four-profile solution was chosen based on its lower log-likelihood and BIC values and because it was theoretically more interpretable and meaningful than the three-profile solution. This decision followed the recommendation to give equal importance to the theoretical interpretability and soundness of the latent profile solutions rather than relying only on statistical criteria (Morin et al., 2016). Accordingly, whereas the three-class solution yielded profiles with roughly low, high, and medium study well-being, the four-class solution detected a group of students from the data simultaneously experiencing high study engagement and studyholism levels. Furthermore, the average individual posterior probabilities in T1 ($n=812$) for being assigned to a specific latent profile in the four-profile model were 0.87, 0.89, 0.85, and 0.91, which indicates a clear classification for interpretation of the profiles.

According to LTA, with four latent profiles identified in LPA, the SWPs were found to be relatively stable (see Table 3 for transition probabilities). Hence, students mainly stayed in the same SWP across the academic year from fall to spring. The "Moderate" profile (T1 43.7%; T2 42.4%) was characterized by close to average means in all study well-being indicators. The "Engaged-Satisfied" profile (T1 25.9%; T2 24.7%) was characterized by high study engagement and satisfaction. The "Engaged-Holists" profile (T1 17.1%; T2 16.8%) was characterized by relatively high study engagement, holism, and burnout. The "Bored-Burned out" profile (T1 13.3%; T2 16.1%) was characterized by high study boredom and burnout. The time-invariant means of the four SWPs for all five study well-being indicators are illustrated in Fig. 2. Where transitions from one latent SWP to another happened, they

Table 2 Fit indices and class proportions for the T1 ($n=812$) and T2 ($n=316$) latent profile analyses
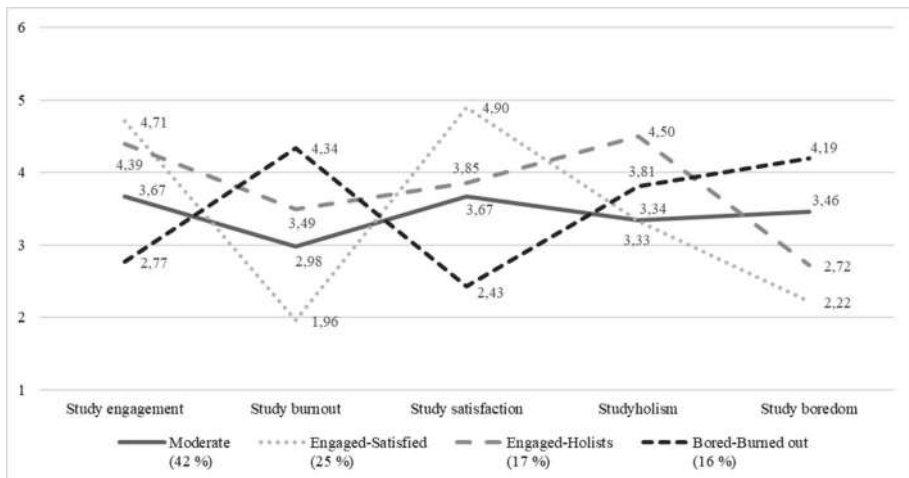
Number of profiles	Log likelihood	BIC	BLRT	VLMR	Entropy	Class proportions
T1						
2	−4799.87	9706.94	0.00	0.00	0.77	418/394
3	−4582.96	9313.32	0.00	0.00	0.83	248/107/457
4	−4510.24	9208.07	0.00	0.13	0.79	101/346/288/77
5	−4428.90	9085.58	0.00	0.28	0.77	47/210/250/148/157
T2						
2	−1895.76	3883.62	0.00	0.00	0.79	164/152
3	−1777.43	3681.49	0.00	0.01	0.87	39/183/94
4	−1739.32	3639.81	0.00	0.20	0.81	88/27/133/68
5	−1706.46	3608.61	0.00	0.31	0.82	86/105/58/39/28

Note. BIC Bayesian information criterion, *VLMR* Vuong-Lo-Mendell-Rubin test

Table 3 Latent transition probabilities, probability of profile membership from T1 to T2, and the number (*n*) of students in each profile based on the four-profile model

	T2				
	Moderate	Engaged-Satisfied	Engaged-Holists	Bored-Burned out	Total
T1					
Moderate	**0.84 (118)**	0.07 (9)	0.00 (0)	0.09 (11)	(138)
Engaged-Satisfied	0.14 (11)	**0.77 (67)**	0.08 (4)	0.00 (0)	(82)
Engaged-Holists	0.00 (0)	0.05 (2)	**0.89 (49)**	0.06 (3)	(54)
Bored-Burned out	0.12 (5)	0.00 (0)	0.00 (0)	**0.88 (37)**	(42)
Total	(134)	(78)	(53)	(51)	

Note. Bold values indicate the probability of remaining in that group at both times and counts in parentheses refer to the number of students in each profile or transition

Fig. 2 Time-invariant mean values from the LTA of the study well-being indicators in four latent SWPs and the proportions of the profiles (%) in T2

were mainly from better well-being to worse: The two most probable transitions were from Engaged-Satisfied to Moderate and from Moderate to Bored-Burned out.

Study well-being profiles and their relation to recovery strategies and academic performance

According to Welch ANOVA, the SWPs were significantly related to all four recovery strategies, namely psychological detachment, relaxation, control, and mastery experiences, reported by the students. Furthermore, based on the post hoc analyses, there were also several statistically significant pairwise differences between the SWPs, as shown in Table 4.

A Kruskal–Wallis H test showed that the SWPs were significantly related to both indicators of academic performance, that is, study success [$\chi2$ (3) $= 14.00$, $p < 0.003$, $\varepsilon^2 = 0.04$] and study progress [$\chi2$ (3) $= 18.68$, $p < 0.001$, $\varepsilon^2 = 0.06$]. Engaged-Satisfied students

Table 4 Welch ANOVA, with means (*M*) and standard deviations (*SD*), examining the differences in recovery strategies at T2 between the four study well-being profiles

	1 Moderate	2 Engaged-Satisfied	3 Engaged-Holists	4 Bored-Burned out	Welch's *F*	*p*	ω^2	Pairwise comparisons
	M(SD)							
Psychological detachment	3.55 (0.83)	3.59 (0.86)	2.88 (0.83)	2.77 (0.79)	18.83	<0.001	0.14	1.2> 3.4
Relaxation	3.94 (0.72)	3.85 (0.79)	3.47 (0.84)	3.46 (0.81)	7.18	<0.001	0.06	1 > 3.4; 2>4
Control	4.06 (0.55)	4.17 (0.66)	3.84 (0.69)	3.52 (0.82)	9.00	<0.001	0.10	1 >4; 2> 3.4
Mastery experiences	3.16 (0.78)	3.42 (0.80)	3.35 (0.84)	2.84 (0.94)	5.19	0.002	0.05	2.3 >4

experienced the best study success, whereas Bored-Burned out students experienced the worst success: the mean ranks from highest to lowest were 182.71 ($n = 78$) for Engaged-Satisfied, 155.87 ($n = 134$) for Moderate, 151.93 ($n = 53$) for Engaged-Holists, and 135.21 ($n = 51$) for Bored-Burned out. Also, in terms of study progress, the Engaged-Satisfied students experienced the best progress, whereas Bored-Burned out students experienced the worst study progress: The mean ranks from highest to lowest were 178.42 ($n = 78$) for Engaged-Satisfied, 167.43 ($n = 134$) for Moderate, 137.10 ($n = 53$) for Engaged-Holists, and 126.79 ($n = 51$) for Bored-Burned out.

A post hoc pairwise comparison showed that Engaged-Satisfied students experienced significantly better study success than Bored-Burned out students ($p < 0.002$). Similarly, Engaged-Satisfied students experienced significantly better study progress than Bored-Burned out students ($p < 0.002$) and Engaged-Holists students ($p = 0.020$). Also, students with Moderate well-being experienced significantly better study progress than Bored-Burned out students ($p < 0.011$).

Discussion

The present study found four distinct, relatively stable study well-being profiles (SWPs) among university students. In general, students belonging to engaged-satisfied and moderate profiles reported higher levels of beneficial recovery strategies and better academic performance regarding study success and progress than students belonging to engaged-holists and bored-burned profiles.

The study well-being profiles among university students show high stability

Study well-being was considered a multidimensional phenomenon with its equivalence in occupational well-being (Bakker & Oerlemans, 2011). According to person-oriented analyses applied in this study, four different SWPs based on study engagement, burnout, satisfaction, holism, and boredom could be identified among university students. In this study, almost half of students were described as having Moderate study well-being, that is, having mediocre activation and pleasure while studying. In addition, a quarter of students were described as Engaged-Satisfied and almost a fifth as engaged-holists. Although students in these latter two SWPs experienced high engagement and activation while studying, Engaged-Satisfied students experienced studying to be highly pleasant and satisfying. By contrast, among Engaged-Holists students, high activation and engagement were linked to a compulsive drive to study excessively hard and, thus, to mediocre study burnout, which was very low among Engaged-Satisfied students. Finally, 13.3% (T1) to 16.1% (T2) of students belonged to the Bored-Burned out profile, showing high exhaustion, cynicism, and inadequacy and low activation, apathy, and satisfaction in their studies.

The above-presented results both extend and align with previous studies with a similar focus to SWPs but with a somewhat narrower range of study well-being indicators. Also, Salmela-Aro and Read (2017) and Tuominen-Soini and Salmela-Aro (2014) have found that about a third of students experience simultaneously study engagement and exhaustion, which resembles, to some extent, the Engaged-Holists profile identified in the current study. Similarly, the same profile was identified in the educational sector, where about a third of guidance counsellors belonged to the Workaholic-Engaged

profile (Rantanen et al., 2023). Hence, together the present and previous findings seem to suggest that in academic contexts, both among students and staff, a well-being profile exists that complements the circumplex models of well-being (cf. Figure 1 here and see Bakker and Oerlemans (2011) Fig. 2). Supporting also Loscalzo and Giannini's (2022) distinction between disengaged vs. engaged studyholism, we conclude that study/work engagement and holism are not isolated experiences but can co-exist, perhaps particularly in performance-oriented, success-tracking, and evaluative environments such as schools and academia.

Furthermore, the present longitudinal study design results showed that the identified SWPs were relatively stable within an academic year during university studies. However, where transitions occurred from one profile to another, they were mainly from better to worse. These findings are in line with previous literature suggesting that well-being related profiles are typically rather stable, and in educational contexts, the transitions tend to demonstrate decreasing well-being (e.g., Mäkikangas & Kinnunen, 2016; Salmela‑Aro et al., 2021; Tuominen-Soini & Salmela-Aro, 2014). In the current study, the transitions from better to worse well-being may indicate increasing demands and stress as the academic year proceeds, which was also seen at the whole sample level as study burnout and holism increased from the end of the fall to the end of the spring semester. However, previous review studies show that burnout and engagement seem to be relatively enduring states showing high stability over time, regardless of the interval between measurements (Mäkikangas & Kinnunen, 2016; Salmela‑Aro et al., 2021).

Recovery strategies are important to study well-being

In general, students belonging to Engaged-Satisfied and Moderate profiles reported higher use of strategies enhancing psychological recovery from study-related stress than Engaged-Holists and Bored-Burned out students. High psychological detachment from studies, relaxation during, and control over one's leisure time were all characteristics for students in both Engaged-Satisfied and Moderate profiles. In addition, Engaged-Satisfied and Engaged-Holists sought mastery experiences more than Bored-Burned out students. However, despite high mastery experiences, students in the Engaged-Holists profile reported as low psychological detachment, relaxation, and control during their leisure time as students in the Bored-Burned out profile. The finding suggests that the Engaged-Holists may tend to over-schedule and plan also their free time which can then make it hard for them to properly relax and detach from studies or work (e.g., Tonietto & Malkoc, 2016). Also, the findings are in line with the research on recovery experiences conducted in work context (e.g., Mäkikangas et al., 2014; Sonnentag et al., 2017).

These results, together with other recent studies (e.g., Isoard‑Gautheur et al., 2023; Donald et al., 2024), emphasize that investing in leisure time in multiple ways, that is, using more than just one recovery strategy (e.g., mastery experiences), can be particularly beneficial for well-being. This is especially important in stress-evoking and demanding student life, where the boundaries between studies and free time are often blurred. However, even though recovery-enhancing processes are known to have potential to protect well-being (Sonnentag et al., 2017), previous research has also shown that the recovery processes are often impaired if the stressors are high and well-being declined (Sonnentag, 2018). This so-called recovery paradox implies that students who

need recovery the most often lack the vigor and energy to engage in recovery-enhancing activities.

Both high and average study well-being relate to good perceived academic performance

In the present study, Engaged-Satisfied students experienced better academic performance than Engaged-Holists and Bored-Burned out students. This finding is plausible and lends support to the few earlier studies on this issue (e.g., Ghensi et al., 2021; Ketonen et al., 2016; Klinkenberg et al., 2023; Vilhunen et al., 2022). More interestingly, however, the present results also showed that students with Moderate well-being experienced almost as good academic performance as Engaged-Satisfied students. The weakest academic performance was perceived among Bored-Burned out students.

This pattern of results emphasizes first that in terms of perceived study success and progress, it matters how different indicators of subjective study well-being are linked to each other and, second, that the highest engagement is not necessarily needed for a positive experience on academic performance. Furthermore, the compulsive drive to study excessively hard, that is, studyholism, even when combined with study engagement, was related to lower perceived academic performance. Hence, even though study engagement appears to be something to pursue, it does not necessarily relate to good academic performance if accompanied by studyholism. In the latter case, it is possible that high study engagement, especially when related to perfectionist personality traits (Molnar et al., 2023), may cause students to experience inadequacy of not fulfilling their expectations.

Limitations and future considerations

First, all the data was gathered in one Finnish university, which may limit the generalizability of the results and conclusions. More versatile samples with higher education students from different educational institutions and geographical areas and with different ethnic backgrounds are recommendable. Also, as usual in longitudinal research, some of the participants dropped out of the study over time. Thus, our final study sample was relatively small, a limitation that we urge to be overcome in future studies with larger longitudinal sample sizes to obtain possibly yet more reliable and generalizable results.

Second, the study success and progress were measured only as self-reports and as related to students' own expectations. Thus, no conclusions about the actual grades or study credit allocation can be made. Previous research shows that engaged and exhausted students may experience more pressure to succeed than others (Klinkenberg et al., 2023) and personality traits, such as perfectionism, may affect the self-evaluation of performance (Molnar et al., 2023) or even moderate the relationship between well-being and performance. Thus, the finding of the current study that students in the Engaged-Holists profile did not experience as good performance as some other students,

seems rational and suggests that student well-being may influence their subjective perception of their academic performance. On the other hand, investigating students' perceptions and expectations of academic performance may be even more relevant than mere grades, especially regarding well-being.

Third, this study focused on the well-being of second- and fourth-year university students during one academic year. In the future, we recognize the need for longer-term longitudinal studies to investigate the individual trajectories of well-being profiles over the transition from education to work life and the antecedents and outcomes of these trajectories. Also, for clarity and coherence, the well-being dimensions were studied here as unidimensional constructs. However, some of these dimensions (e.g., study burnout, studyholism) could also be studied with a multidimensional approach, which can and is recommendable to be addressed in future research. The longer-term longitudinal and multidimensional approaches would enable more targeted well-being interventions and career crafting (e.g., Akkermans & Tims, 2017).

Practical implications

The findings of this study have several implications considering higher education personnel (e.g., guidance counsellors) working to enhance student well-being. The theoretical circumplex model of study well-being (see Fig. 1) and the present results provide a framework for these professionals to understand and contemplate study-related well-being and recovery from study distress from different perspectives with their students, both preventatively and restoratively. Due to the recovery paradox phenomenon described earlier, professionals should emphasize versatile interventions in their practice and not solely rely on verbal instruction and support in the form of psychoeducation. Also, from a student perspective, the current findings emphasize the importance of using versatile recovery strategies and investing in leisure time in multiple ways to enhance one's well-being.

According to the findings, about third of the higher education students experience study burnout, holism, or boredom. However, it should be noted that data of the present study was collected before the COVID-19 pandemic. Based on a recent literature review by Abraham et al. (2024), the prevalence of burnout increased among higher education students during the pandemic, in some studies even from one-third to two-third of students. There are significant implications for these findings, as higher education students are entering the workforce, and burnout symptoms may have longitudinal consequences for their careers. Thus, serious measures should be undertaken to ensure the well-being of higher education students suffering from study burnout, holism, boredom, or all of these, as their risk for delays in study progress or dropping out of studies may be heightened. For example, maintaining the high quality of teaching and adequate availability of study guidance, fostering social relationships within academia, or providing psychoeducational courses on study well-being and study distress recovery strategies as well as more concrete and practise-oriented preventive and restorative interventions may increase engagement and satisfaction in higher education contexts (e.g., Hobbs et al., 2024; Trowler et al., 2022; Wong & Chapman, 2023).

Appendix 1. The preliminary first-, second- and third-order confirmatory factor structure analyses (CFA) conducted for each of the study well-being indicators

In the confirmatory factor analyses (CFA) reported below, the same procedure was applied for each study well-being indicator: (a) Eithin T1 and T2 all observed items were set to load on their intended factors, and all lower-order factors were set to load on their intended higher-order factors, (b) between T1 and T2 all parallel observed item factor loadings and lower-order factor loadings on their intended higher-order factors were constraint equal, and (c) between T1 and T2 all parallel observed item covariances along with all highest-order factor correlations were allowed to be freely estimated.

CFA for study engagement confirmed the intended second-order factor structure, that is, three first-order factors of (1) vigor, (2) dedication, and (3) absorption forming second-order factor, that is, overall study engagement: both model fit [$\chi 2$ (127) = 291.26, $p = 0.000$, RMSEA = 0.04, CFI = 0.97, TLI = 0.97] and single item factor loadings (range 0.70–0.88) were good. In addition, vigor, dedication, and absorption as first-order factors loaded highly to overall study engagement (loading range 0.92–0.98). Hence, CFA showed that study engagement could be investigated as a unidimensional well-being indicator in the present data when one is interested about the overall study engagement experience as discussed by others as well (Salmela-Aro & Read, 2017; Salmela-Aro & Upadyaya, 2012).

CFA for study burnout confirmed the intended second-order factor, that is, three first-order factors of (1) exhaustion, (2) cynicism, and (3) inadequacy forming second-order factor, that is, overall burnout: Both model fit [$\chi 2$ (127) = 343.40, $p = 0.000$, RMSEA = 0.05, CFI = 0.95, TLI = 0.94] and single item factor loadings (range 0.63–0.88) were good. In addition, exhaustion, cynicism, and inadequacy as first-order factors loaded highly to overall burnout (loading range 0.78–1.04). Hence, CFA showed that study burnout could be investigated as a unidimensional well-being indicator in the present data when one is interested about the overall study burnout experience as discussed by others as well (Salmela-Aro et al., 2009).

CFA for study satisfaction confirmed the intended one-factor structure in the present data: Both model fit [$\chi 2$ (18) = 57.61, $p = 0.000$, RMSEA = 0.05, CFI = 0.97, TLI = 0.96] and factor loadings (range 0.65–0.87) were good.

CFA for studyholism confirmed the intended third-order factor structure in the present data, that is, four first-order factors of studying (1) frantically, (2) long hours, (3) with obsessive drive, and (4) unease if not studying forming two second-order factors of studying (1) excessively and (2) compulsively forming third-order factor, that is overall studyholism: both model fit [$\chi 2(121) = 495.71$, $p = 0.000$, RMSEA = 0.06, CFI = 0.88, TLI = 0.85] and single item factor loadings (range 0.53–0.82) were for the most part sufficient. In addition, the afore listed first- and second-order factors loaded mostly highly to overall studyholism (loading range 0.67–1.08). Hence, CFA showed that studyholism could be investigated as a unidimensional well-being indicator in the present data when one is interested about the overall studyholism experience as discussed by others as well in terms of workaholism (Rantanen et al., 2015).

CFA for study boredom confirmed the intended one-factor structure in the present data: both model fit [$\chi 2$ (45) = 44.54, $p = 0.087$, RMSEA = 0.02, CFI = 1.00, TLI = 0.99] and factor loadings (range 0.60–0.87) were good.

Appendix 2. The correlation tables of the study variables

Table 5 Pearson correlations between the study well-being variables in T1 and T2

	1	2	3	4	5	6	7	8	9
1. Study engagement (T1)									
2. Study burn-out (T1)	-0.50***								
3. Study satisfaction (T1)	0.71***	-0.72***							
4. Studyholism (T1)	0.15***	0.40***	-0.15***						
5. Study boredom (T1)	-0.71***	0.51***	-0.59***	-0.02					
6. Study engagement (T2)	0.73***	-0.48***	0.60***	0.16**	-0.59***				
7. Study burn-out (T2)	-0.44***	0.74***	-0.60***	0.29***	0.48***	-0.59***			
8. Study satisfaction (T2)	0.56***	-0.57***	0.66***	-0.05	-0.51***	0.77***	-0.73***		
9. Studyholism (T2)	0.12*	0.28***	-0.09	0.68***	-0.04	0.10	0.44***	-0.15**	
10. Study boredom (T2)	-0.62***	0.47***	-0.54***	-0.06	0.76***	-0.73***	0.58***	-0.65***	0.00

Note. $n_{T1} = 812$, $n_{T2} = 316$; $*p < 0.05$; $**p < 0.01$; $***p < 0.001$

Table 6 Pearson correlations between the study well-being, recovery strategy, and performance variables in T2

	1	2	3	4	5	6	7	8	9	10
1. Study engagement										
2. Study burnout	-0.59***									
3. Study satisfaction	0.77***	-0.73***								
4. Studyholism	0.11	0.44***	-0.15**							
5. Study boredom	-0.76***	0.56***	-0.66***	-0.04						
6. Psychological detachment	0.15**	-0.39***	0.25***	-0.41***	-0.10					
7. Relaxation	0.08	-0.28***	0.12*	-0.34***	0.04	0.55***				
8. Control	0.21***	-0.35***	0.30***	-0.25***	-0.14*	0.40***	0.61***			
9. Mastery experiences	0.28***	-0.19***	0.28***	-0.06	-0.28***	0.13*	0.18**	0.30***		
10. Study success	0.14*	-0.28***	0.26***	-0.09	-0.10	0.06	0.10	0.14*	-0.04	
11. Study progress	0.13*	-0.32***	0.27***	-0.05	-0.10	0.08	0.07	0.16**	-0.05	0.34***

Note. $n_{T2} = 316$; $*p < 0.05$; $**p < 0.01$; $***p < 0.001$

Declarations

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Bridging theoretical gaps to improve students' academic success in higher education in the digital era: A systematic literature review

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ABSTRACT

Academic success is the main goal of higher education systems because it is closely associated with later personal and professional success. This study sought to identify the current theoretical gaps in academic success between the foundational academic success theories: Tinto's institutional departure theory, Bean's students' attrition model, Austin's involvement theory, and self-determination theory, and the emerging academic success frameworks focused on technological integration in higher education. We employed a systematic review methodology to synthesize the findings from 21 empirical studies on current practices to identify academic success theoretical gaps. We used keywords to search three databases: ScienceDirect, Scopus, and Web of Science, to identify relevant studies. The analysis found that the 21 empirical studies did not generally reference the foundational academic success theories, but employed theoretical frameworks tailored to their specific purposes to examine their dynamic interaction between variables such as technology, affective factors, facilities, and academic achievement. These recent studies identified the positive and negative effects of technology on academic success in higher education. Emerging digital tools, such as artificial intelligence and ChatGPT, were found to significantly improve learning performance. Overall, the findings imply that there is a 'generation gap' between the early academic success theories and the emerging technology-based frameworks in higher education. It is recommended that researchers, institutions, and practitioners seek to bridge these academic success theoretical gaps using appropriate theoretical design interventions that closely examine the impacts of integrating technology into higher education.

1. Introduction

Academic success is a pillar of the advancement of students, educational institutions, and the broader community. Because academic success is associated with personal and professional post-study success (Milovanska-Farrington, 2020). Academic success is also a vital indicator of an educational institution's performance (Alyahyan & Düştegör, 2020).

However, academic success and associated success indicators have been defined differently by different scholars and administrators because of the frameworks and theories used (Liz-Domínguez et al., 2019).Kuh et al., (2006), York et al. (2015) broadly defined academic success as *inclusive of academic achievement, attainment of learning objectives, acquisition of desired skills and competencies, satisfaction, persistence, and post-college performance*. Other studies conceptualize academic

success in terms of academic achievement, which is commonly measured with course marks, grades, and grade point average(GPA) (Alyahyan & Düştegör, 2020).

Because of the large investments being made in higher education to cater for higher student numbers and higher costs, greater student success and reduced student attrition are major concerns in the sector (Burkholder & Holland, 2014; Kinzie et al., 2022). Kinzie and Kuh (2017) suggested that there was a need for a comprehensive framework to better understand student success, the reasons students drop out of college, and the factors influencing a decision to persist (Burke, 2019). To do this, a deeper examination is needed of the current theoretical models and gaps associated with the new higher education digital learning environment.

There have been many theoretical persistence models developed (Burkholder & Holland, 2014), with many emerging in the 1970s.

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Grounded by sociological theories, Spady (1970, 1971), Tinto (1975, 1993), and Bean (1980, 1982) emphasized the importance of the relationship between the individual and the institution (Burke, 2019). Later, Kuh et al. (2006) synthesized the five major perspectives in the foundational academic success theories: sociological, organizational, psychological, cultural, and economic, to better understand student success in higher education institutions. Berger, Blanco Ramírez, & Lyon, 2012 then categorized the theoretical frameworks for developmental retention trends into nine eras. More recently, Bowman and Garvey (2023) described the theories of academic success as having two waves, with the *first wave* comprising the foundational theories of student success, and the *second wave* including student success theories that emphasize historically marginalized or unrepresented student populations. While these studies have contributed valuable insights, the debate continues regarding the most suitable framework for explaining academic success across time, especially the emerging needs of learners in contemporary higher education.

The fundamental theories of student persistence have also changed over time. Spady (1970, 1971) first applied a sociological student persistence model that emphasized normative congruence and academic integration, after which Tinto (1975, 1993) proposed a longitudinal model of institutional departure, which hypothesized that persistence is shaped by background factors, goal commitment, and organizational commitment. Bean (1980, 1982) developed a student attrition model that included four main variables that have direct or indirect effects on the intent to drop out: background variables, organizational variables, environmental variables, and attitudinal and outcome variables. Astin's (1984, 1993) theory of student involvement, which includes student characteristics and institutional factors, argues that student involvement determines their decision to persist or drop out. Museus (2014) introduced a more inclusive model, the culturally engaging campus environments (CECE) model, which comprises nine factors that foster success in racially diverse student groups. Museus and Shiroma (2022) tested the CECE model and demonstrated its positive effect on academic motivation and belonging. However, no empirical studies have tested these foundational theories on digital learning platforms.

Explanations of academic success and persistence tend to be context-based (Milovanska-Farrington, 2020). Several factors, such as academic, personal, social, and demographic, can impact students' performance in universities, colleges, and technical institutions (Al-Tameemi et al., 2023). Self-Determination Theory (SDT) assumes that students are more motivated and successful when they experience autonomy, competence, and relatedness (Deci & Ryan, 1985). Bean and Eaton (2001) also highlighted the psychological influences on retention decisions. Jama et al. (2009), however, criticized existing student success frameworks because they are generally unable to address the uniqueness of individual students, cultures, and institutions. Similarly, Tinto (2017) argued that prevailing retention theories focus more on institutional actions than on student perspectives, particularly when examining persistence. Kinzie and Kuh (2017) outlined various approaches for achieving student success, including the implementation process, concluding that a more comprehensive framework was needed. Overall, however, the fundamental academic success theories fail to fully consider the impacts of technology on academic performance in higher education.

Academic success in the digital age presents different challenges and opportunities. Recent studies highlight the need to prioritize the integration of technology at higher education institutions (Tareke et al., 2024), though accompanied by challenges and opportunities (García-López et al., 2025; Vázquez-Cano et al., 2022). These findings claim that digital learning can enhance learner motivation and access to knowledge. However, they also recognized that excessive use, technology integration, personalization, data quality, and ethics are major concerns. Nevertheless, no foundational theories or emerging technology-oriented frameworks have been developed to bridge these discrepancies and find solutions to the existing theoretical limitations.

Therefore, our review synthesizes the findings from empirical studies on the prevailing theoretical frameworks, observed gaps, impacts, and challenges when integrating technology into higher education. The review identifies the theoretical gaps between the foundational academic success theories and the emerging theoretical frameworks to explain academic success at higher education in the digital era. Our study contributes scientific insights to inform the development of comprehensive, inclusive approaches to enhance academic success in contemporary higher education.

1.1. Research questions

To better explain academic success in higher education settings, our systematic literature review sought to identify the current trends and reveal the gaps between the traditional and emerging technology-oriented frameworks. The literature synthesis was driven by the following research questions:

RQ1. What theoretical models are currently employed to explain the relationship between technology and academic success?
RQ2. What gaps are there in the early academic success theories to explain academic achievement in higher education in the digital era?
RQ3. Do technology-related factors affect academic achievement in digital learning environments of higher education?
RQ4. What challenges are there when integrating technology to enhance academic success in higher education?

1.2. Conceptual framework of the study

This study proposes an integrative conceptual framework (Fig. 1) to bridge the gaps between the foundational academic success theories and the emerging technology-based models. The framework recognizes that academic success, which comprises GPA, course performance, persistence, and retention, can be influenced by many interconnected factors. The broad circle represents the broad contextual and global influences on higher education, and the two primary blocks represent (1) foundational academic success theories and associated concepts and factors, and (2) the newly emerging technology-based academic achievement frameworks.

While each block shown can independently impact academic success, the integration provides a more comprehensive and dynamic perspective. The need to bridge the generational gaps between traditional theories and contemporary technology-driven models is highlighted by the upper arrow (3) above the two blocks, which suggests these gaps must be addressed to include the evolving higher education needs. While valuable, foundational theories are unable to fully capture the complexities of modern academic success in digitally mediated environments. Bitar and Davidovich's (2024) recent cultural–technological integration framework (CTIF) demonstrates the mutual reinforcement and dynamic interactions between technological acceptance, pedagogical content knowledge, networked learning capacity, and cultural compatibility, emphasizing their mutual reinforcement. This model highlights the critical roles that cultural mediation and alignment play in ensuring effective digital learning environments.

Therefore, our proposed framework seeks to contextually align the foundational theories with the emerging technology-based frameworks. This integrated approach provides a more holistic understanding of academic success (4) and offers actionable insights for the enhancement of educational outcomes in diverse contemporary higher education contexts.

2. Methodology

Our study focuses on synthesizing findings that identify the gaps between the foundational and emerging technology-oriented frameworks, focusing on academic success in higher education in the digital
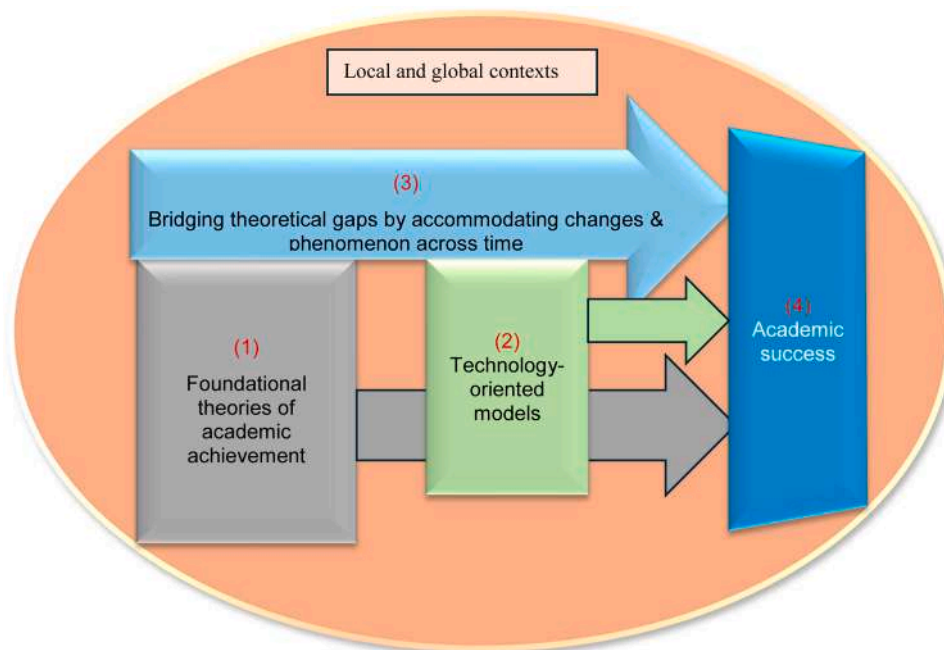
Fig. 1. Conceptual framework.

age. To ensure transparency and reputability, the systematic review was based on the 2020 guideline of the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) (Page et al., 2021). Twenty-one empirical studies from recognized databases were included in the final synthesis.

2.1. Search strategy and data sources

A comprehensive and systematic search of empirical studies was conducted in three electronic databases: ScienceDirect, Scopus, and Web of Science. To ensure the most up-to-date empirical findings, the search was limited to peer-reviewed journal articles published between January 1, 2015, and August 31, 2024. The search string was developed using the keywords derived from the key study constructs and Boolean operators (AND, OR). The following search strings were applied to each database to ensure search consistency: *("theories of success" OR "models") AND ("academic success") AND ("technology integration") AND ("higher education")*. No special qualifiers or limiters were applied during the initial searches to maximize initial record identification.

We followed the rigorous multi-stage process shown in the PRISMA flow diagram (Fig. 2) for article identification, screening, and selection. The initial search across the three databases identified 13,223 possible articles. Using system automation for date, language, and publication type, 10,836 articles were substantially eliminated. The remaining 2387 articles were then filtered based on their titles and abstracts, with a further 2264 articles being removed that did not meet our inclusion criteria: not educational studies, duplicates, not in English, review articles, and conference proceedings. The refined screening process resulted in 123 full-text articles, which were then retrieved and further evaluated for eligibility. All authors independently screened the full texts of these 123 retrieved articles against the predefined inclusion and exclusion criteria. Following this, we conducted a comprehensive screening and evaluation of the titles, abstracts, frameworks, methods, key findings, settings, and variable type using ratings based on the included-excluded criteria, from which 21 articles were maintained for the final analysis. The other 102 were rejected based on our inclusion-exclusion criteria and author discussions. Specifically, these were excluded because the sample was not undergraduate students, technology and achievement were not the study targets, or they were secondary

sources, such as reviews and policy documents.

2.2. Eligibility criteria

The exclusion and inclusion criteria were directly related to the research purposes, with specific criteria being developed based on the PRISMA flow (Page et al., 2021). The inclusion criteria used were: published in a peer-reviewed journal, published between January 1, 2015, and August 31, 2024, focused on college and university students or higher education, had quantitative, qualitative or mixed research method designs, and explicitly focused on academic success and technology. The exclusion criteria were: studies using secondary sources such as reviewed articles, reports, and proceeding papers, not open access, lacking sufficient information about academic success, no academic or education focus, targeting non-undergraduate programs, conducted at secondary or lower levels, and not published in English.

2.3. Quality assessment

To assure methodological quality and transparency and to reduce the risk of bias, we applied a specific quality assessment checklist tailored to the research objectives. The checklist has seven criteria that were rated using a Likert-type scale ranging from not applicable (0) to best match (5). These checklist criteria aligned with both the inclusion and exclusion criteria and the study objectives. The analysis checklist matches the objectives/research questions; that is, each article was assessed based on clearly stated methods, empirical article type, clarity of findings, higher education setting, included theoretical frameworks, and overall article match. The authors all used the same codes for the screening, quality assessment, and final selection procedures. We provided ratings based on the checklist for the 123 studies, after which the average score was calculated. Articles with the highest ratings from all authors were included, with those with low ratings and those that did not match the inclusion criteria excluded. Any discrepancies were resolved through discussions until a unanimous decision was reached. The inter-rater reliability among three authors was calculated using the K-Alpha calculator, and the *Krippendorff's Alpha* value is acceptable ($\alpha = 0.80$) (Marzi et al., 2024). This quality assessment process ensured that the article selection process indicated a reliable rating through which the 21
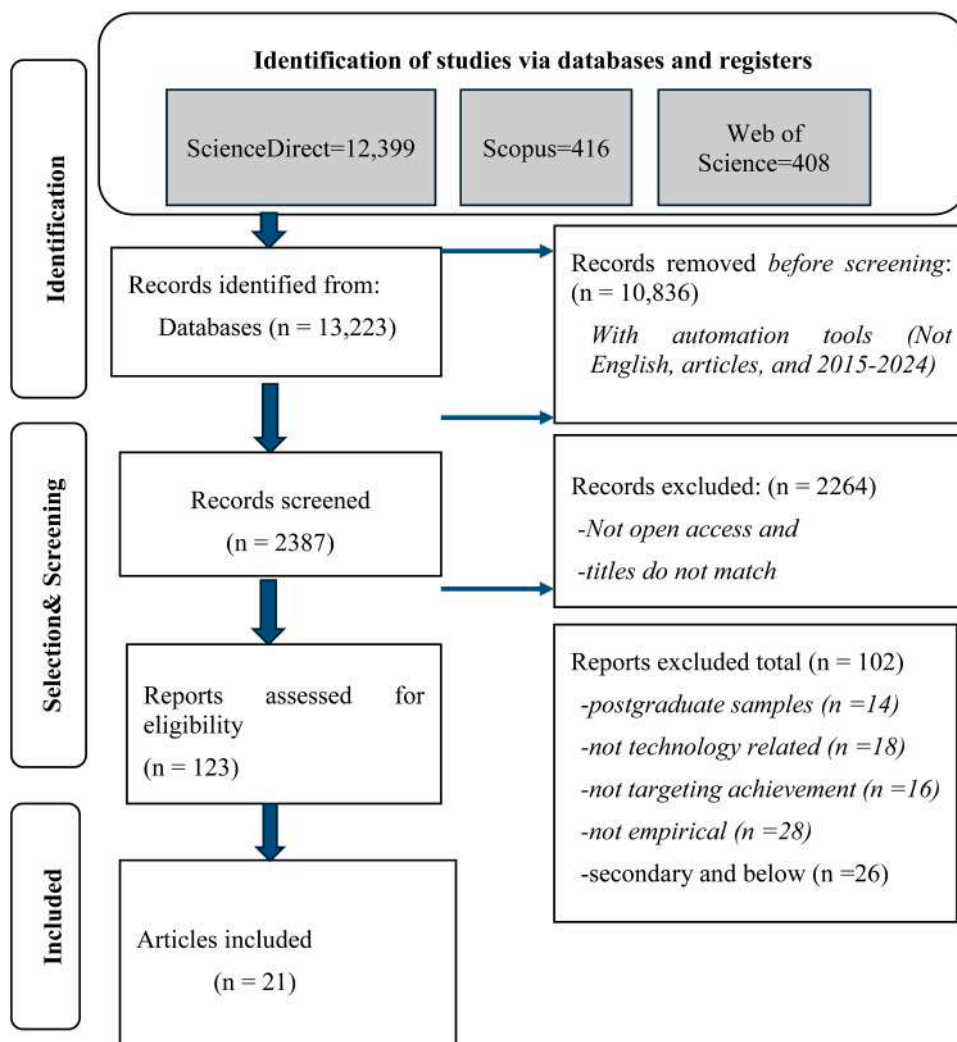
Fig. 2. PRISMA flow diagram.

best-matched studies were identified for the study.

3. Results

This section presents the data, descriptions, and evidence interpretation from the selected articles. The qualitative analysis, described below, consists of findings organized as themes and sub-themes based on the research questions.

3.1. Background of the selected studies

The selected studies were from 18 countries. Most countries contributed one study, with China, Saudi Arabia, and Turkey having two studies. The sample sizes varied from 20 to 4697. Unlike previous reviews, the study articles targeted academic success and technology in higher education. Most employed quantitative methods and a few used qualitative and experimental approaches to examine the dynamic interaction between technology and academic success in higher education (see Table 1).

3.2. Theoretical frameworks employed in technology-oriented studies

The study explored several specific theoretical frameworks that have been used to explain the integration of technology in higher education. These specific frameworks were synthesized with broad themes to ensure clarity and to provide structured knowledge. The specific theoretical frameworks employed in the studies were categorized based on their conceptual matches with each theme. The key themes identified were the technology acceptance model (TAM), motivation and self-regulated learning theory, engagement, digital apps, and technostress (see Table 2).

The first framework was TAM or e-Learning, which comprised five specific technology-related frameworks. The studies claimed that the perceived ease of use and usefulness were essential for the acceptance of e-learning systems (Fülöp et al., 2023). Beyond general acceptance, the task-technology fit (TTF) theory states that a good fit between technology and the task influences academic achievement (Al-Rahmi et al., 2023). Information quality, service quality, and system quality were also deemed necessary for effective task-technology fit, which in turn can influence students' satisfaction and performance in the online system (Mohammed et al., 2024). The media naturalness theory was also tested to compare the effects of face-to-face versus synchronous e-learning on learning outcomes (Blau et al., 2017). Generally, these studies suggest that technology acceptance and technology-task fit can significantly affect student satisfaction and learning outcomes.

The second theme was associated with self-regulated learning (SRL) theory, which is a prominent theoretical lens for the assessment of blended and online learning. SRL theory takes a broad social cognitive perspective and utilizes self-determination theories. The studies employing these frameworks examined the role of affective factors in the

Table 1
Summary of the study key findings.

Study	Study focus	Core theoretical framework used	Research Method	Country & sample size	Key Findings
(Alamri, 2021)	How blended project-based learning (BPBL) affects behavior intention and academic achievement	BPBL Approach	Quantitative	Saudi Arabia 80	BPBL positively influences students' academic achievement through perceived self-efficacy, enjoyment, and usefulness, and behavioral intention. It stimulates cognitive skills, such as self-control, critical thought, and creative thinking.
(Alamri, 2023)	Test a model that integrates achievement motivation, academic achievement, and e-learning	Social cognitive perspective of motivation in e-learning	Quantitative	Saudi Arabia 248	Online learning enhances university students' motivation for success. Tasks, responsibilities, instructor viewpoint, ability, efforts, and perseverance positively impact students' achievement motivation.
(Al-Rahmi et al., 2023)	Integrate communication theory and task–technology fit (TTF) to explain digital media adoption in learning	TTF theory	Quantitative survey	Malaysia 1330	Factors such as technological, task-related, and social characteristics, when combined with TTF, affect academic accomplishment. The study validated communication and TTF theories for using digital media.
(Blau et al., 2017)	The effects of medium naturalness and learners' personality traits on learning outcomes	Media Naturalness Theory	Controlled Experimental study	Israel 76	No significant effect of medium naturalness, but face-to-face yielded slightly more literal knowledge than one-way videoconferencing. Face-to-face led to more enjoyment than online conditions.
(Cigdem & Oncu, 2024)	The impact of self-regulated learning (SRL) on academic success in blended vocational education	Self-regulated learning theory	Quantitative	Turkey 203	SRL has a significant negative influence on ICT Course achievement. Students' perceptions of the interactivity in the learning environment and their perceived self-efficacy had a positive and significant impact on their perceived satisfaction.
Essel et al., 2021)	Technology-induced stress, sociodemographic, academic achievement, and academic productivity	Emergency remote teaching (ERT)	Descriptive correlational study	Ghana 525	Technology dependence has a significant positive effect on technostress. Digital literacy has a significant negative effect on technostress. Technostress has an inverse effect on student academic achievement.
(Feraco et al., 2020)	The role of mobile-based student response systems in teaching to improve academic outcomes.	mobile-based student response systems	Experimental	Italy 294	Both out-of-class activities and quiz activities show a significant effect on exam performance. Exam performance significantly correlated with self-regulated strategies.
(Fülöp et al., 2023)	Analyze the factors that stimulate university students' acceptance of technology.	E-Learning /Technology Acceptance Model (TAM)	Survey	Romania 1875	Clear learning goals, active and focused effort, and consistent course attendance contribute significantly to student achievement. Technological factors are effective but lower than traditional methods in improving student performance.
(Goode et al., 2022)	Investigate the impact of interactive modules and synchronous attendance on student achievement in immersive online delivery	immersive scheduling delivery models vs Cognitive load theory	mixed methods (quantitative and qualitative data)	Australia 120	Behavioral engagement with online learning modules has a positive effect on academic success and is a significant predictor of a higher final score. Students appear to be associated with engagement and deeper learning in the immersive model, such as interactivity, media richness, constructive alignment, flexibility, and responsiveness.
(Hanaysha et al., 2023)	The impact of classroom environment, teacher competency, and information and communication technology (ICT) resources on academic performance and engagement	Self-Determination Theory, Campus-Class-Technology (CCT) theory	Quantitative approach	United Arab Emirates 314	Teacher competency and ICT resources have positive effects on academic performance and student engagement. Classroom environment and university facilities were found as significant predictors of academic performance and engagement.
(Lemay et al., 2019)	Examines the links between self-determination, loneliness, fear of missing out (FoMO), and academic Performance.	Fear of Missing out (FoMO); Self-determination theory	Partial least squares (PLS) approach	Canada 102	Moderate negative relationships between perceived Autonomy and FoMO (Fear of Missing Out), and perceived autonomy and academic performance. A strong positive relationship exists between the perceived need for relatedness and loneliness.

Table 1 (*continued*)

Study	Study focus	Core theoretical framework used	Research Method	Country & sample size	Key Findings
(Liang et al., 2024)	Examine the University's adoption of tech-enhanced learning and its effects on performance, satisfaction, and motivation.	Person-environment fit theory; Technostress	quantitative approach	United Kingdom 332	Person-Environment misfit positively influences technostress. Higher perceived misfit in adopting TEL leads to poorer academic performance, lower satisfaction, and decreased motivation.
(Mohammed et al., 2024)	Investigate factors affecting academic performance via online learning systems	Task-Technology fit (TTF) theory, Online learning	Quantitative	Jordan 846	Information quality, service quality, and system quality indicate positive and significant relationships with the task technology fit. Both task technology fit, and students' satisfaction have a significant effect on learning performance
(Raihan et al., 2024)	AI-Driven Analysis of Students' Class Lecture Activity for Improved Learning Outcomes	Artificial Intelligence (AI) Models	Experimental study	Bangladesh 20	The factors, including stress, attention span, and mental health, significantly affect student concentration and class participation. AI is found to be a strong tool for evaluating classroom activity and reveals undiscovered aspects of student behavior
(Rezai et al., 2024)	How ChatGPT facilitates L2(second language) development	ChatGPT is a large language model (LLM)	Phenomenological method	Iran 21	ChatGPT yielded four improvements as enhanced language proficiency, interactive language practice, personalized learning experience, and enriched learning environments
(Sense et al., 2021)	Predict exam performance using a model-based adaptive fact-learning system	Learning analytics and adaptive learning systems	Quantitative (app-model)	285	Forgetting measured by the system(app) was predictive of learners' exam performance. Students who used SlimStampen (a learning system) obtained higher grades than those who did not.
(Torres-Díaz et al., 2016)	Examine the influence of internet use on the academic success of university students	Application of Technology	Quantitative	Ecuador 4697	Students who perform digital interactive activities tend to have more academic success than those who only seek information. The lack of access to the internet has an even greater negative impact than bad practices or habits in technology use.
(Weerarathna et al., 2023)	The effect of e-learning on the academic success of undergraduates	Information & Communication Technology (ICT)	Quantitative	Sri Lanka 318	E-learning directly impacts academic success. Student satisfaction significantly moderates the relationship and improves academic success
(Whelan et al., 2022)	How and when social network sites (SNS) are used damages student academic achievement and psychological well-being?	Social network sites (SNS) technostress	Partial least squares approach	Ireland 450	SNS stressors inhibit achievement and well-being outcomes because of lower self-control over SNS use. The high use of SNS for academic purposes enhances the effect of SNS stressors on deficient SNS self-control.
(Yavuzalp & Bahcivan, 2021)	The relationships of readiness for e-learning with self-regulation skills, satisfaction, and academic achievement	Readiness for e-learning; Self-regulation	cross-sectional Approach	Turkey 749	Students' readiness for e-learning was significantly predicted by their self-regulation skills, satisfaction, and academic achievement. Students' self-regulated learning skills had a positive effect on their satisfaction with the distance learning
(Ye et al., 2022)	Patterns of self-regulated behavior among online learners	Zimmerman's self-regulation theory model	Experimental design	China 69	The group with average behavior frequency tends to solve online tasks actively. The group with more active behavior frequency tends to improve in the process of trial and error. The group with the lowest behavior frequency tends to passively complete the learning task.

connection between technology and academic success. For instance, analysis of online learners' behaviors reveals SRL patterns that correlate with varying academic performance (Ye et al., 2022). Social cognitive theory also suggests that online learning enhances achievement motivation (Alamri, 2023). Adaptive learning systems were designed to leverage SRL to predict exam performance (Sense et al., 2021). This thematic analysis revealed the dynamic interactions between affective factors, technology, and higher education learner achievement.

The third theme was an engagement model or framework that described the role of student engagement in determining academic success in e-learning contexts. It was found that behavioral engagement with online learning modules positively influences academic success and is a significant predictor of higher final exam performance (Goode et al., 2022). To improve engagement and academic performance, the

Table 2

Summary of the comparison between foundational and emerging theoretical frameworks.

Foundational or Early theories and their focus	Emerging technology-based theoretical Frameworks		Overlaps between the two frameworks	Gaps or distinctions between the two frameworks
	Major Themes of Theoretical Frameworks	Specific framework/s used (see Table 1)		
Spady's undergraduate dropout process model (1970, 1971) assumes that students operate in academic systems and social systems; it links attrition with intellectual development, social integration, satisfaction, and institutional commitment	Technology acceptance model (TAM)	(Alamri, 2021; Al-Rahmi et al., 2023; Mohammed et al., 2024; Fülöp et al., 2023; Weerarathna et al., 2023; Blau et al., 2017; Essel et al., 2021)	Identified different spectrums of academic achievement, grades	Spady's model does not consider the digital learning environments and technology integration in colleges and universities
Bean's student attrition model (1980, 1982) states that students' decision to persist depends on institutional structure, commitment, grade, satisfaction, and life engagements.	Motivation; Self-regulated learning theory; Self-determination theory	(Alamri, 2023; Lemay et al., 2019; Cigdem & Oncu, 2024; Ye et al., 2022; Sense et al., 2021)	Role of Psychological attributes for success	Bean's model lacks specifics on how e-learning environments or digital interactions specifically shape motivation or attitude
Astin's theory of student involvement (1984, 1993) _ underlines the student involvement and its impact on overall development.	Engagement	(Yavuzalp & Bahcivan 2021; Hanaysha et al., 2023; Goode et al., 2022)	Continuum, measurable features, student-related factors	Astin's framework does not detail the specific attributes of digital learning environments (e.g., media richness, responsiveness) or their direct impact on engagement.
Tinto's institutional departure model (1975, 1993)- well tested in diverse institutions- claims that the decision to leave the institution is due to academic and social systems and students' commitment.	General digital apps (AI)	(Raihan et al., 2024; Rezai et al., 2024; Feraco et al., 2020)	Adaptability	Tinto's model does not specify the role of information quality or system quality in digital learning, nor does it account for the specific fit between tasks and technology.
Culturally-engaging campus environment (CECE) (Museus, 2014)_ relies on cultural responsiveness for the diverse needs of marginalized students	Person-environment fit theory and technostress	(Torres-Díaz et al., 2016; Liang et al., 2024)	Equity, matching demands, and inclusivity	CECE responds to the diverse needs of learners,
				But limited to being examined explicitly in the digital environment.

immersive scheduling delivery model highlighted the role of technology integration in learning and managing cognitive demands using interactive learning mechanisms. These frameworks examined the role of technology in enhancing engagement and learning outcomes.

The fourth model was digital applications, mainly Artificial Intelligence (AI) for analyses of psychological behaviors and ChatGPT's role in language development. Integrated AI models were used to analyze student stress levels, which indicated the growing use of AI in monitoring student well-being (Raihan et al., 2024). Large language models (LLMs), such as ChatGPT, were examined to assess their role in developing a second language, enhancing language proficiency, providing interactive practice, and offering personalized learning experiences (Rezai et al., 2024). Mobile-based student response systems were found to positively affect performance in final exams and out-of-class activities (Feraco et al., 2020). These theoretical frameworks revealed the growing application of digital tools in higher education.

The fifth model was technostress, which integrates technology, wellness, and academic success. Both technostress and person-environment fit theories explain the impact of poor fit on student well-being and academic challenges. Studies showed that technological dependence that induces increased technostress inversely affects student academic achievement (Essel et al., 2021; Liang et al., 2024). Similarly, the use of social network sites (SNS) was found to introduce stressors that can inhibit academic achievement by diminishing self-control over SNS use (Whelan et al., 2022). This model consists of unique features and applications of technology to assess learner behavior while delivering instruction in the modern classroom. It also underlined the negative impacts of technology on learner performance if not regulated effectively.

To ensure a more concrete analysis, the synthesis addressed specific theoretical frameworks to assess the interactive effects of technological integration on academic success in higher education over ten years. These frameworks include various factors to enhance student success in higher education, such as technology integration, psychological states,

academic motivation, and the effectiveness of digital tools and instructions. The analysis showed that specific technology-oriented frameworks are commonly used in the prevailing studies.

The review studies also showed that the growing demand for the use of technology in higher education has both challenges and opportunities. Some studies highlight the growing emphasis on the potential negatives of technology use, specifically "technostress" (Essel et al., 2021; Liang et al., 2024; Whelan et al., 2022), while others focus on the positive impacts on learning outcomes (Feraco et al., 2020; Raihan et al., 2024; Rezai et al., 2024); and engagement (Goode et al., 2022). The development of AI models for behavioral analysis, language development, and learning outcome prediction is a new asset for the modern higher education system.

Our review found that there was an application shift from the fundamental academic success theories to specific technology-based models. Previous academic success theories, such as those of Spady, Bean, Astin, and Tinto, were primarily interested in overall institutional attributes, social integration, academic integration, and student characteristics. As shown in Table 2, these foundational academic success theories rarely accommodate the digital focus of the modern education system. Bridging the gaps between these theories across generations is a key focus of our study. While SRL theories, self-determination theory, and social cognitive theory of motivation were also utilized as frameworks, they were included in only a few review articles. This finding should encourage future researchers to embrace those foundational academic success theories to explain the variables in the current digital context. While the foundational academic success frameworks seek to provide macro-level explanations or a broad spectrum for student departure, social integration, retention, and persistence, the theoretical focus in many of the review articles was technology-specific and examined areas such as user interfaces, specific digital tools, and specific psychological responses to technology. This refocusing implies that there is a research shift from broad institutional-level analyses to more micro-level investigations of the direct impact of technology on learning

and achievement.

3.3. The impact of technology on learning outcomes

Our review extracted the empirical findings on the interaction of technology on academic achievement. Apart from examining the theoretical applications and identifying the gaps, we sought to assess the positive and negative technological impacts on academic success in higher education. The findings are presented in the following subsections: *E-learning, technology fit, and achievement; technology, motivation, and achievement; emerging applications (ChatGPT, AI), learning, and achievement; internet use, communication media, and achievement; and technostress and academic achievement.*

3.3.1. E-learning, technology fit, and achievement

Digital learning environments can improve learning outcomes. First, because e-learning systems offer diverse learner opportunities, they can assist learners in monitoring their progress and utilizing effective strategies (Sense et al., 2021), both of which can positively impact academic success (Weerarathna et al., 2023). Integrating technology into teaching can also have a positive effect on exam performance (Feraco et al., 2020). However, other studies (Blau et al., 2017) found that a high level of medium naturalness, that is, face-to-face learning, can be more beneficial than online learning. Well-designed e-learning systems and associated learning tasks have been found to significantly improve achievement motivation and academic performance (Alamri, 2023; Fülöp et al., 2023). Liang et al. (2024) concluded that a proper alignment between technology and educational tasks is crucial when determining online learning effectiveness. A well-integrated technology system can significantly enhance students' satisfaction and academic performance, with factors such as system quality, prompt technical support, technology fit, and positive students-instructor interaction contributing to better academic performance (Mohammed et al., 2024).

For e-learning to be effective, technologies need to fit the diverse student needs. Lemay et al. (2019) noted that individual factors, such as motivation, can also influence academic performance in digital learning environments. However, technology and the student learning preference mismatches, as illustrated by studies on Person-Environment (P-E) misfit, can lead to stress and hinder performance (Liang et al., 2024). Therefore, future e-learning systems should consider learning styles, motivations, and diversity to optimize educational outcomes (Alamri, 2021, 2023).

It has been argued that interactive instructions and SLR strategies, especially in blended learning environments, can enhance students' academic success (Alamri, 2023; Cigdem & Once, 2024). When students effectively use learning management systems (LMS) that have interactive features that promote self-regulation, there are improved academic outcomes. Goode et al. (2022) found that an immersive delivery model was more beneficial than traditional approaches to university teaching and learning, as it could deliver lasting and sustainable benefits for learners, educators, institutions, and ultimately the communities they serve (Goode et al., 2022).

3.3.2. Technology, motivation, and achievement

Motivation plays a crucial role in student engagement with digital learning tools and academic achievement. Studies indicate that motivated students tend to perform better in online environments (Alamri, 2023; Liang et al., 2024). Technologies that provide engagement, enjoyment, and deeper learning are interactive and media-rich, and are relevant, constructively aligned, flexible, and responsive, contribute positively to student motivation and enhance academic success (Goode et al., 2022). Hanaysha et al. (2023) also emphasized the role of teacher competence and the availability of ICT resources in fostering student motivation and engagement. The evidence suggests that well-designed digital learning environments that consider student motivation contribute to higher academic achievements.

Intrinsic motivation, self-regulation skills, and teacher support are also key factors in fostering student engagement and improving academic performance (Yavuzalp & Bahcivan, 2021). Student personality traits were found to be as significant as their ability to adjust to, succeed in, and engage in learning or work interactions in different environments (Blau et al., 2017). Students with higher self-regulation skills tend to report greater satisfaction with online learning and subsequent enhanced academic outcomes (Weerarathna et al., 2023). This suggests that to optimize educational outcomes, the diverse student learning styles and motivations should be considered when integrating educational technologies (Alamri, 2021, 2023).

3.3.3. Emerging applications (ChatGPT, AI), learning, and achievement

The rapid adoption of artificial intelligence (AI) tools such as ChatGPT has provided possible new opportunities for the enhancement of student learning. AI-powered applications can provide personalized learning experiences and foster greater student engagement and academic success (Rezai et al., 2024). Introducing AI to the education setting can allow educators to evaluate classroom activity data and identify undiscovered aspects of student behavior (Raihan et al., 2024). Mobile learning using small independent learning progress was also found to improve engagement (Fülöp et al., 2023). In general, AI tools can assist students in areas such as language proficiency, real-time feedback on assignments, and collaborative learning, all of which can contribute to improved academic outcomes. Studies indicate that AI-enhanced learning environments can increase motivation and academic performance by offering personalized feedback and fostering self-directed learning (Goode et al., 2022).

AI integration into learning platforms can also track student learning behaviors and provide tailored support, which can enhance the learning process and contribute to academic achievement (Raihan et al., 2024). For example, ChatGPT can create a facilitative English learning environment that enhances student motivation, confidence, and learning enjoyment (Rezai et al., 2024). Therefore, further studies should explore the impact of these AI types on the development of personalized learning pathways and student achievement (Alamri, 2023).

3.3.4. Internet use, communication media, and achievement

The internet and communication media are essential for fostering academic success in the digital age. Studies indicate that students who engage with online communication tools and access educational content through the internet tend to perform better academically (Torres-Díaz et al., 2016). Platforms that enable peer interaction and communication with instructors are particularly beneficial as they provide engaging learning environments (Al-Rahmi et al., 2023; Fülöp et al., 2023).

The effective use of digital communication tools, such as online discussion forums and video conferencing, can significantly contribute to greater student engagement and learning outcomes (Cigdem & Oncu, 2024). Internet-based communication positively impacts interactive and motivating learning environments (Hanaysha et al., 2023). However, students must balance academic internet use with other online activities to avoid distractions and negative academic performance from excessive media and internet use.

3.3.5. Technostress and academic achievement

While technology offers significant advantages for student learning, there are still limitations. For instance, if a student perceives misfitted in the university learning environment, being overwhelmed by using many technological tools for learning could cause technostress (Liang et al., 2024). Technostress, which is the stress resulting from both technology dependence and technology characteristics, can negatively affect academic performance (Essel et al., 2021; Liang et al., 2024), and excessive dependence on technology can reduce student focus and productivity. Specifically, when students have higher technostress, their satisfaction and motivation are getting down, which in general results in poorer academic performance (Liang et al., 2024).

The higher the perceived student misfit when adopting technology-enhanced learning (TEL), the poorer the academic performance, satisfaction, and motivation (Liang et al., 2024). Technostress can also act as a mediator between students' perceived misfit between technology/learning tasks misfit (P-E misfit) and academic performance (Whelan et al., 2022). The findings suggest that to mitigate technostress, educational institutions must offer adequate technical support, digital literacy training, and strategies that promote a healthy balance between technology use and traditional learning methods.

3.4. Challenges to integrating technology in higher education

While technology has been found to improve academic success in higher education, there remain many challenges, such as unfair access, a lack of facilities, and poor infrastructure. Research highlights the digital divide, where students from resource-poor regions or those lacking access to advanced digital tools face significant barriers to effective learning (Fülöp et al., 2023; Hanaysha et al., 2023). Limited access to technology can undermine the benefits of e-learning, particularly in developing regions (Mohammed et al., 2024). Weerarathna et al. (2023) also found that student satisfaction with e-learning systems was related to access to reliable technology and support services, with any lack of adequate technical support and infrastructure preventing students from fully benefiting from e-learning platforms (Alamri, 2021). These results highlight the importance of ensuring equal access to digital resources in higher education institutions.

To mitigate these challenges and harness the full advantages of higher education digitalization, there were several viable recommendations. For instance, Hanaysha et al. (2023) suggested that higher education institutions invest in better ICT resources and university facilities, provide teachers training to improve competencies, adopt the latest technologies, and redesign classrooms to optimize learning environments and provide the best student learning experiences. It has also been suggested that including text, video content, and sound sequences could enhance e-learning attention (Fülöp et al., 2023). LMS administrators could focus on long-term student success by creating useful, interactive environments for students and teaching newly enrolled students how to use the LMS to improve their perceived self-efficacy and application skills (Cigdem & Oncu, 2024). Therefore, to enhance academic success and ensure all students have access to high-quality technology, policies are needed to narrow the digital divide.

4. Discussion

This study synthesized the findings from 21 empirical articles to identify the theoretical gaps between the foundational academic success theories and emerging technological integration frameworks. We also examined the impact of technology on academic achievement in higher education. The synthesized findings from the reviewed articles answered our basic research question, each of which is discussed in the following.

RQ1&RQ2. What theoretical models are currently employed to explain the relationship between technology and academic success, and what gaps are there in the early academic success theories to explain academic achievement in higher education in the digital era?

The empirical studies included in this analysis employed a variety of frameworks to explain the dynamic interactions between technology and education, which we systematically categorized into five broad educational models: the technology acceptance model (TAM), self-regulated learning (SRL) theory, engagement theories, digital apps (AI), and technostress. This broad classification offers a comprehensive view for both researchers and practitioners to understand the dynamic relationship between technology and academic success. It also provides a comprehensive picture of the role of technology in education, the challenges encountered, and possible intervention designs that could enhance academic success in higher education contexts.

The study findings revealed that several specific variable-oriented frameworks have been utilized to explain the various facets of technology integration. Notable examples include e-learning (Fülöp et al., 2023; Weerarathna et al., 2023), task-technology fit (TTF) theory (Al-Rahmi et al., 2023; Mohammed et al., 2024), emergency remote teaching (ERT) (Essel et al., 2021), media naturalness theory (Blau et al., 2017), campus-class-technology (CCT) theory (Hanaysha et al., 2023), AI-driven analysis of psychological behavior (Raihan et al., 2024), ChatGPT's role in second-language learning (Rezai et al. (2024), mobile-based student response systems (SRS) (Feraco et al., 2020), social network sites (SNS) technostress (Whelan et al., 2022), and person-environment fit (Liang et al., 2024). These frameworks predominantly emphasize specific technological factors in relation to personal factors and academic achievement.

Essentially, our close analysis revealed a significant theoretical gap. Foundational theories of students' success, such as Spady's (1970) sociological model, Bean's (1980, 1982) attrition model, Astin's (1993) involvement model, Tinto's (1975, 1993) institutional departure theory, and Museus's (2014) CECE, were not included in the analyzed empirical studies. This key finding implies a "generational gap" between the established theories of academic success and emerging technology-based models. While earlier theories emphasized macro-level factors related to institutional characteristics, social integration, and student attributes to explain student retention, dropout and persistence, the prevailing technology-based frameworks emphasized micro-level factors such as technology, instruction and academic achievement.

Even if the foundational theories of persistence remain unaddressed, only a few studies referred to psychoeducation theories, such as self-determination theory (Lemay et al., 2019), the social cognitive perspective of motivation in e-learning (Alamri, 2023), SRL theory (Cigdem & Oncu, 2024; Sense et al., 2021), or Zimmerman's self-regulation theory (Ye et al., 2022). These frameworks explain the interactions between affective factors such as intrinsic and extrinsic motivation, psychological needs (autonomy, competence, and relatedness), goal setting, and SRL when technology is included in the assessment of academic achievement, and provide broader perspectives to develop a comprehensive understanding of the dynamics between the target variables and enhanced academic success.

However, the unexpected omission of the fundamental academic success theories in the reviewed technology-targeted empirical studies raises a critical concern about their applicability in explaining the role of technology integration. It also suggests that there is a significant conceptual divide between traditional theories of academic success and contemporary technology-driven models of academic success. Therefore, we observed a significant gap between the traditional academic success theories and emerging technology-targeted academic success frameworks.

RQ3. Do technology-related factors affect academic achievement in digital learning environments of higher education?

Our examination of the technological contributions to improved academic success revealed that technology can enhance academic achievement. For instance, when e-learning approaches are matched with specific learning tasks, student performance and motivation can be significantly enhanced (Al-Rahmi et al., 2023; Liang et al., 2024). Task-technology fits (TTF) (Mohammed et al., 2024) and interactive, SRL strategies in LMS promote active learning environments and enhanced academic success (Alamri, 2023; Cigdem & Oncu, 2024). Alamri (2023) also found that BPBL enhanced cognitive skills, specifically self-control, critical thought, and creative thinking. These studies revealed that individual factors such as motivation, personality, learning styles, self-efficacy, and self-regulation can interact with technology to influence learning outcomes.

Applying technology-related tools, such as AI, was found to be an emerging issue in higher education, because of the increased use of artificial intelligence Apps like ChatGPT and mobile learning systems in

modern education. These new tools are revolutionizing the education landscape by enabling independent learning, providing personalized feedback, and fostering self-directed learning (Rezai et al., 2024). AI applications also provide educators with the ability to evaluate classroom activity data and uncover previously unknown aspects of student behavior (Raihan et al., 2024). The technological impacts, such as improved cognitive skills, critical thinking, and creative problem-solving, are higher when technology is integrated with traditional learning approaches (Goode et al., 2022). However, understanding the long-term impacts of technological tools (AI) in diverse learning contexts requires greater study.

The advantages of technology in education depend on its alignment with students' needs. For example, Blau et al. (2017) found that face-to-face learning outweighs e-learning in certain contexts due to its high "medium naturalness". Personal factors, such as intrinsic motivation, self-determination, self-efficacy, personality, and SRLwere found to significantly improve the success of digital learning approaches (Lemay et al., 2019; Alamri, 2023). But a misfit between technology and student demands was associated with lower academic performances (Liang et al., 2024).

RQ4. What challenges are there when integrating technology to enhance academic success in higher education?

Despite the invaluable advantages of technology, its integration into higher education faces several challenges, particularly limited access and infrastructure support. The findings highlight the digital divide as a key critical challenge in the world of the digital age, specifically for students who have poor facilities, such as a lack of access to advanced tools and reliable internet, which limit any e-learning benefits (Fülöp et al., 2023; Hanaysha et al., 2023). This disparity emphasizes the need for greater institutional investments in ICT resources and infrastructure to bridge the gap and promote inclusivity (Mohammed et al., 2024).

Another challenge is the technostress on academic performance, which is the student distress resulting from an inappropriate use of the internet, such as technology dependence and technology type used (Essel et al., 2021; Liang et al., 2024). Excessive technological dependence, which is caused by inappropriate digital platforms, the overwhelming demands of technology, or an inability to effectively engage with digital learning environments, can deter student focus and productivity (Liang et al., 2024). Higher levels of technostress are associated with lower academic performance, satisfaction, and motivation (Essel et al., 2021). Institutional factors such as teacher competence and resource availability can also impact successful technology integration.

These challenges highlight the need to develop appropriate mitigation strategies. Providing educators with training on new technologies and redesigning classrooms for optimal digital interactions are vital steps to overcoming these challenges (Hanaysha et al., 2023). To effectively address these issues, higher education institutions need to prioritize technical support, digital literacy training, and a balanced approach to technological integration (Whelan et al., 2022). Interactive, multimedia-rich, technically supported LMS platforms can improve student engagement and self-efficacy and contribute to long-term student success (Cigdem & Oncu, 2024). To date, higher education curricula, policies, institutional factors, educational factors, cultural contexts, and personal characteristics have not been fully researched to assess the effectiveness of higher education technology integration in enhancing academic success. Generally, the emerging technology-based theoretical frameworks address the advantages and challenges of integrating technology into higher education; however, they have, so far, had limited scope. These studies did not refer to the foundational academic success theories when seeking to explain the dynamic interaction between technology and education from a wider perspective.

4.1. Future directions

This study highlights the contributions of technology in higher education to enhance academic success. The studies we examined included

various frameworks to assess the impact of technology on higher education learning outcomes. However, as the fundamental academic success theories were inadequately examined, future studies should examine ways to extend these theories to include the contributions of technology to contemporary higher education academic success.

Researchers need to balance the broader theoretical frameworks with variable-specific frameworks and bridge the "generational gaps" through theoretical development or reevaluating the foundational academic success theories in the digital context. Those well-established theories, which extensively explain the reasons for student retention, dropout, and persistence, should be tested in the digital learning environments. Our analysis also revealed that even though there has been a growth in the number of variable-specific academic successes, these are limited to wider examinations of the dynamics between technology and education. Therefore, further investigations are needed using diverse methodologies and theoretical frameworks to more deeply examine the dynamic between technology, education, and academic success.

Higher education practitioners can improve academic success through the effective integration of technology and education. Educators and educational leaders, and administrators must address the digital divide to ensure a match between technology-learning tasks and student characteristics, improve the student self-control and their ability to use technology properly, and reduce technostress. Institutionally, attention needs to be paid to capacity building and instructional approaches to ensure that technology use meets the digital demands of higher education learners.

Policy makers should seek to mitigate the digital divide in contemporary higher education systems by developing workable policies focused on inclusive designs, e-learning platforms, and technology literacy programs. Essentially, when implementing fair and equitable educational policies, policymakers must provide adequate financing, infrastructure, and programming.

Indeed, in today's world, not embracing technology is impossible. By addressing these gaps, providing concrete guidance and support to practitioners, and implementing proactive policies, educational institutions can better match technology with learner demands to enhance academic success through inclusivity and adaptability.

4.2. Limitations

This study sought to provide some valuable insights into the effectiveness of technology in higher education and its impact on academic success. While we followed a comprehensive sifting procedure to identify 21 empirical studies, this was a small number compared to the initial search result ($n = 13{,}223$). These potential constraints may have been because the keywords and search strings used broad concepts to retrieve as large an initial sample as possible. Our strict inclusion and exclusion and quality assessment checklist criteria rejected many of the initial studies. However, this could also indicate that the integration of technology with higher education achievement has not yet attracted significant research.

The study was also limited to empirical studies published only for the last 10 years, which may have excluded several studies from the initial search. Consequently, this may have restricted the breadth and generalizability of the findings and the conclusions drawn. Future systematic review studies should consider appropriate targeted keywords, adjust the inclusion and exclusion criteria, broaden the searching databases, and extend the publication date and nature.

5. Conclusion

Our study focused on 21 empirical studies, which employed quantitative, qualitative, and mixed research approaches focused on examining the interaction of technology and psychoeducational factors in higher education and the effects on academic success. Rather than referring to the well-established foundational academic success theories,

selected studies used technology-specific frameworks to explain their target variables. A few further studies referenced early psychoeducational academic success approaches, such as self-determination theory, SRL theory, and social cognitive theory. Interestingly, this study found some newly emerging frameworks, notably technostress, that connect technology, well-being, and academic success in higher education.

However, the fundamental academic success theories that previous empirical studies have tested were not mentioned in the analyzed studies, which suggests that there is a "generational gap" between established academic success theories and emerging technology-based models. While the foundational academic success theories provide macro-level explanations, the new technology-based frameworks emphasize micro-level academic success factors. This also implies a shift from basing academic success research on the foundational theoretical frameworks to explaining academic success in higher education using emerging technology-oriented theories.

We found that there were challenges and opportunities in the contemporary technology-related education system. Some empirical studies found that new technologies such as AI and ChatGPT improve cognitive skills and language learning skills. It also indirectly impacts academic achievement through motivation, engagement, and satisfaction. Most findings underlined the positive impacts of technology on academic achievement in higher education in both face-to-face and online platforms. In contrast, some studies revealed that poor facilities, excessive internet use, technostress, lack of self-monitoring, and educator competency could critically affect technology effectiveness. We conclude that to exploit its advantage, education technology should be designed to match learner needs and their diverse backgrounds.

The digital divide remains a serious challenge for educators, researchers, and policymakers. The identified theoretical gaps could be bridged by developing new frameworks or reevaluating the well-established foundational theoretical academic success models to fit with a technology accessible higher education system. Importantly, institutions and educational stakeholders must overcome the barriers to successful technological integration to enhance higher education academic success.

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TITLE	SOURCE TITLE
10. Study Demands-Resources Theory: Understanding Student Well-Being in Higher Education (2025)	Administrative Sciences (Article from : Multidisciplinary Digital Publishing Institute (MDPI)

REVIEW ARTICLE

Study Demands–Resources Theory: Understanding Student Well-Being in Higher Education

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Abstract

This article reviews the literature on student well-being (burnout and engagement) and their relationships with study demands and resources, student behaviors (proactive and self-undermining study behaviors), and student outcomes in higher education. Building on research that used Job Demands–Resources and Study Demands–Resources models to investigate student well-being, we develop the Study Demands–Resources (SD–R) theory to delineate the various processes, mechanisms, and behaviors involved in student burnout and engagement. Study demands and resources have unique and combined effects on higher education students' well-being. In addition, students can influence their own well-being and study-related outcomes by either proactively optimizing their study demands and resources or displaying self-undermining behaviors that can adversely affect their study environment. We discuss several avenues for future research, including (a) rigorous tests of SD–R propositions; (b) trait versus state effects in SD–R theory; (c) the impact of the higher education climate and lecturer influence; and (d) an expanded SD–R theory.

Higher education students are confronted with a range of demands, such as coursework deadlines, group assignments, financial problems, and exams. Such demands necessitate time management, coordination, and focused attention. Over time, study demands require considerable cognitive, emotional, and physical effort, which may

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drain psychological resources and lead to study anxiety, fatigue, and even burnout (Gusy et al., 2016; Madigan & Curran, 2021; Salmela-Aro & Upadyaya, 2014). However, students may also encounter various resources while studying, including support and constructive feedback from lecturers, social support from family and friends, and development opportunities (Bakker et al., 2015). Such resources help students manage their demands, facilitate student engagement (Gusy et al., 2016), and guide goal-oriented behaviors. Resources are inherently motivating because they satisfy basic psychological needs, such as the needs for autonomy, relatedness, and competence (Vansteenkiste et al., 2009).

To better understand the factors influencing student well-being, educational psychologists have adopted the Job Demands–Resources (JD–R) model (Demerouti et al., 2001) that originated in an organizational context. JD–R theory is a comprehensive, well-established, and widely utilized theory to measure and explain well-being in organizational contexts empirically (Bakker, Demerouti, & Sanz-Vergel, 2023; Bakker, Hetland, et al., 2023; Bakker, Xanthopoulou, & Demerouti, 2023), offers insights from both positive and negative well-being perspectives, and integrates various job stress and motivational perspectives (Bakker, Demerouti, & Sanz-Vergel, 2023; Demerouti et al., 2001). The JD–R model categorizes characteristics of the work environment into demands (facets of work that cost effort and instigate a health impairment process) and resources (facets of work that help cope with demands, give meaning, and fuel a motivational process) (Bakker & Demerouti, 2007; Schaufeli & Bakker, 2004).

Over the past 15 years, numerous studies have provided evidence that the university environment can similarly be organized into study demands and resources, which evoke parallel health impairment and motivational processes among students (e.g., Calderwood & Gabriel, 2017; Cho et al., 2023; Clements & Kamau, 2018; Salanova et al., 2010; Wilson & Sheetz, 2010; Wolff et al., 2014). Thus, building on the JD–R framework, several scholars have proposed and tested Study Demands–Resources (SD–R) models tailored to the higher education context (e.g., Gusy et al., 2016; Jagodics & Szabó, 2023; Lesener et al., 2020; Martin & Collie, 2022; Mokgele & Rothmann, 2014; Salmela-Aro et al., 2022).

In this position paper, we rely on recent formulations of JD–R theory (Bakker et al., 2014; Bakker & Demerouti, 2024; Bakker, Demerouti, & Sanz-Vergel, 2023; Demerouti & Bakker, 2023) to systematically delineate the various processes, mechanisms, and study behaviors (proactive behaviors and self-undermining) associated with student burnout and engagement. We build on and strengthen existing SD–R models and review literature on higher education students' demands and resources. In addition, we discuss how study demands and resources impact student well-being and achievement and the implications for optimizing the university experience.

Although the experiences of students in the higher education environment are not exactly the same as those of employees, there are several similarities between studying and working. Like employees, students need to engage in organized, structured, and compulsory activities, like attending classes, working on group assignments, and studying for exams. In addition, like work activities, study activities are goal-oriented and evaluated, and have important implications for one's career (Salanova et al., 2010). We align empirical evidence for the Study Demands–Resources

(SD–R) model with new developments in JD–R theory that build on and strengthen existing research (Gusy et al., 2016; Jagodics & Szabó, 2023; Lesener et al., 2020; Salmela-Aro et al., 2022) and focus on the higher education context, although SD–R theory may also be relevant for other educational contexts (e.g., primary school and high school) (Salmela-Aro & Upadyaya, 2014).

We aim to make the following contributions to the educational psychology literature. We systematically integrate JD–R principles and propositions based on the existing student well-being literature and build on and strengthen current SD–R models to inform a sound, holistic SD–R theory for the higher education context. First, we integrate the various causes and consequences of two types of student well-being: burnout and engagement. Second, we explain the roles of study demands and resources. Why, how, and when do study demands result in strain and burnout? What is the function of study resources such as autonomy, recognition, and social support? How do study demands and resources have a combined impact on student well-being? We integrate the buffer and boost hypotheses in SD–R theory. Third, we look at the role of personal resources, such as self-efficacy, optimism, and resiliency. How do such beliefs and cognitions influence student burnout and engagement? We explain how personal resources may result in new study resources, and how personal resources statistically interact with study demands and resources. Fourth, we discuss proactive self-enhancing study behaviors such as study crafting and playful study design, as well as reactive self-undermining behaviors. We describe how these behaviors may result in gain and loss spirals of study events and experiences, respectively. Fifth, we discuss the underlying psychological processes linking study demands and resources and student burnout and engagement to individual and higher education outcomes. Specifically, we show how student burnout and engagement mediate the relationship between antecedents and outcomes. Finally, we make several recommendations for future research and practice.

Study Demands–Resources Theory

An important building block of SD–R theory is that the features of the study environment can be categorized as either a demand or a resource. Following this logic and the findings of previous JD–R and SD–R models, SD–R theory proposes that higher education students' experiences can be categorized as being demanding or resourceful. Study demands require effort and may, therefore, consume considerable physical, emotional, and cognitive energy and capacity. These demands encompass challenges that facilitate learning (e.g., intricate assignments) as well as hindrances that thwart progress (e.g., ambiguous tasks that create uncertainty) (Salmela-Aro et al., 2022). In contrast, study resources play a functional role in helping students achieve their academic goals and are instrumental in helping the student studying, regulating study demands, and motivating students to grow, learn, and progress while studying. These resources frequently comprise multilayered factors that assist students' learning and engagement (Salmela-Aro et al., 2022). In our review, we will examine two distinct processes outlined in JD–R and SD–R models (Demerouti et al., 2001; Lesener et al., 2020; Salmela-Aro et al., 2022; Schaufeli & Bakker,

2004): the health impairment process and the motivational process. In the organizational context, these processes have demonstrated notable and disparate negative and positive impacts on well-being. The health impairment process is associated with adverse health outcomes, while the motivational process is linked to positive outcomes (Bakker, Demerouti, & Sanz-Vergel, 2023).

A second building block of SD–R theory is student well-being with the opposing states of student burnout and engagement. Here, as with JD–R theory, SD–R theory outlines that students may either feel exhausted and be cynical about their studies or rather the opposite, i.e., feel vigorous and enthusiastic. The third building block concerns student behaviors. SD–R theory proposes that certain study environments trigger reactive and maladaptive study behaviors that can undermine effective studying, whereas other study environments trigger proactive and adaptive study behaviors that facilitate effective studying. The proposed SD–R theory also includes feedback loops and is graphically depicted in Fig. 1. In what follows, we discuss each of these building blocks in more detail while reviewing the available evidence in the educational literature. We start with discussing student well-being.

Student Well-Being

During the past two decades, student well-being has received considerable attention (for meta-analyses, see Bücker et al., 2018; Kaya & Erdem, 2021). However, since
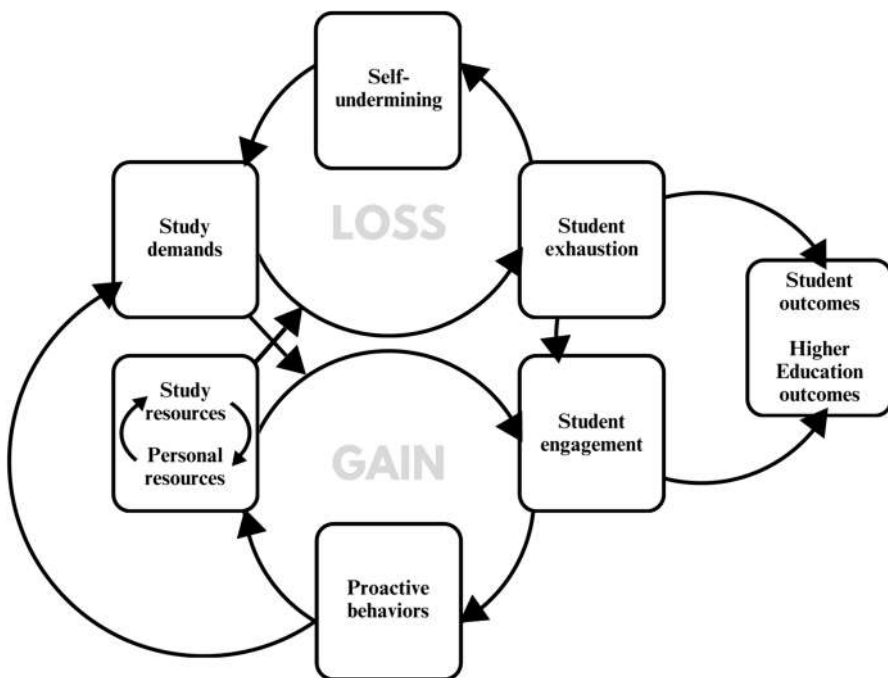

Fig. 1 The Study Demands–Resources model

scholars have used a wide range of student well-being definitions and indicators, it is challenging to get a good overview of the potential predictors and outcomes of student well-being. In the present paper, we focus on two specific types of student well-being: student burnout and student engagement.

Student Burnout

Student burnout refers to feeling exhausted because of study demands, expressing a cynical, detached attitude toward one's studies, and feeling incompetent as a student (Schaufeli et al., 2002). Burned-out students experience chronic mental, emotional, or physical exhaustion due to the many demands they face while studying. They often feel disconnected or cynical about their classes and suffer from reduced academic efficacy, may skip classes, or may not complete assignments. Student burnout has been linked to several unfavorable outcomes, including depressive symptoms (Cheng et al., 2020), increased use of substances such as alcohol and cannabis (Allen et al., 2022), suicidal ideation (Dyrbye et al., 2008), class absenteeism (Seibert et al., 2017), and dropping out (Bumbacco & Scharfe, 2023). Consequently, burnout is a predictor of impaired academic achievement (Madigan & Curran, 2021).

Student Engagement

Student engagement is defined as a positive, fulfilling, study-related psychological state characterized by vigor, dedication, and absorption (Salmela-Aro & Read, 2017; Schaufeli et al., 2002). Engaged students display mental resilience while studying and perseverance in the face of challenges and difficulties (Finn & Zimmer, 2012; Hu, 2010). In addition, they exhibit a strong commitment to their studies, experiencing a sense of excitement, enthusiasm, and focus (Pekrun & Linnenbrink-Garcia, 2012; Schaufeli et al., 2002). Engaged students show active learning behaviors and receive better grades (Bakker et al., 2015; Schaufeli et al., 2002), and low levels of academic withdrawal (Tuominen-Soini & Salmela-Aro, 2014). In addition, student engagement predicts various long-term positive outcomes, such as persistence in educational pathways (Öz & Boyacı, 2021) and better job possibilities (Ma & Bennett, 2021). Engaged students are also more likely to start an entrepreneurial career (e.g., Liu, Gorgievski, et al., 2023). Moreover, both student burnout and engagement are the consequence of a unique combination of study demands and resources, which are discussed next.

Study Demands and Resources

Higher education institutions serve as a transformative space where students develop invaluable skills and can gain life-changing opportunities. Engaging in tertiary education means gaining new experiences, meeting new people, and learning a passion for your subject. On days with lectures and tutorial meetings, there are opportunities to learn new things and have interesting conversations with professors and fellow students. The days students prepare for an exam

may demand focused reading, intensive information processing, and dealing with interruptions. Moreover, in some countries, students may encounter various other demands, including transportation problems, limited access to technology, poor housing, unsafe living conditions, financial struggles, and difficulty adjusting to the higher education environment (Haverila et al., 2020; Martin et al., 2023; Martin & Collie, 2022).

Studying is also a social activity. Students may be asked to collaborate with their peers when writing papers, preparing presentations, or creating podcasts — which provides an opportunity for an enjoyable and fulfilling experience. However, collaborating may also mean dealing with interpersonal conflicts, for example, when finding out that a group member engages in social loafing and exerts little effort to contribute to the group task. As a final example, students may enhance their academic experience by participating in extracurricular activities, joining study associations, planning study visits to organizations, or inviting experts to give interesting talks.

Research indicates that students from higher social classes typically have access to more resources such as academic materials, financial support, family assistance, and developmental opportunities than their peers from lower social classes (Munir et al., 2023; Van Zyl, 2016). These resources may enable them to better navigate and manage their demands and reduce study stress, facilitating engagement and study success. In contrast, students from lower social classes often face a larger range of demands, including academic unpreparedness for higher education, difficulties in commuting to campus, challenges in adapting to new social circles (resulting in lower levels of peer support), and being enrolled in courses that were not their preferred choice (Van Zyl, 2016). These demands may intensify the perceived academic workload and stress levels, making it more difficult to succeed.

The activities and events students encounter in their study life seem countless and manifold. Following JD–R theory and previous SD–R models (e.g., Lesener et al., 2020; Salmela-Aro et al., 2022; Salmela-Aro & Upadyaya, 2014), SD–R theory proposes that the characteristics of study life can be distinguished into two categories, namely study demands and resources. We define study demands as all the facets of studying that cost effort and, therefore, expend physical, emotional, and mental energy (cf. Bakker, Demerouti, & Sanz-Vergel, 2023). Study demands may manifest in diverse forms, such as a high pace and volume of study work and cognitive challenges (Cilliers et al., 2018). Students may also face time constraints (Lesener et al., 2020), conflicting deadlines (Martin et al., 2023), and learning obstacles (Martin et al., 2021).

In contrast, study resources are defined as all the aspects of studying that have motivating potential, can buffer the impact of study demands, and facilitate growth and learning (cf. Demerouti et al., 2001; Demerouti & Bakker, 2023). Specifically, resources tailored to studying can manifest as study resources (e.g., having competent lecturers, access to books and study materials, study facilitators, and mentors) and university resources (e.g., classrooms, library and computer facilities, good infrastructure, and an atmosphere creating a sense of belonging). Resources specific to studying may include learning support (Martin et al., 2021), autonomy and sense of control (Collie et al., 2015), family and friend support (Cilliers et al., 2018), developmental and growth opportunities (Cilliers et al., 2018; Lesener et al.,

2020), lecturer support (Cilliers et al., 2018; Kulikowski et al., 2019), and role clarity (Lesener et al., 2020) among others.

Proposition 1: Study characteristics can be modeled using two distinctive categories, namely study demands and study resources.

Another central proposition in SD–R theory is that study demands and resources have unique effects on student burnout and engagement. Research on such effects within the work context has provided consistent evidence for two processes: (a) a health impairment process triggered by excessive job demands and (b) a motivational process triggered by job resources (Lesener et al., 2019). The health impairment process refers to the impact of demands on physical health complaints through fatigue, anxiety, and other strains. In contrast, the motivational process refers to the impact of resources on creativity and task performance through the experience of engagement (vigor, dedication, absorption) (Bakker, Demerouti, & Sanz-Vergel, 2023; Schaufeli & Bakker, 2004).

Research among students has also provided evidence for these dual processes. For instance, study demands have been shown to deplete students' energy levels (Cilliers et al., 2018; Jagodics & Szabó, 2023) and negatively affect their physical and psychological well-being (Gusy et al., 2016; Mokgele & Rothmann, 2014). Kaggwa et al. (2021) recently highlighted that the demands prevalent in the higher education context can potentially lead to burnout symptoms, ultimately resulting in negative student outcomes such as procrastination, decreased life and study satisfaction, and intention to drop out (Turhan et al., 2022). Research has also demonstrated a clear link between escalated levels of student burnout and mental health disorders (e.g., depression; Jackson et al., 2016) as well as reduced academic performance (Madigan & Curran, 2021). Thus, consistent with the health impairment process proposed by JD–R theory (Bakker, Demerouti, & Sanz-Vergel, 2023), study demands are de-energizing to students, and lead to health problems and unfavorable study outcomes.

While study demands are positively associated with strain and student burnout, study resources are more clearly positively associated with positive aspects of student well-being, including student engagement (Gusy et al., 2016; Robins et al., 2015). Indeed, several studies underscore the importance of study resources in shaping student motivation and performance. Resources like support from lecturers and peers have been demonstrated to enhance aspects of student well-being such as life satisfaction and engagement (Mokgele & Rothmann, 2014). Bellini et al. (2022) further suggest that a resourceful study environment facilitates students' learning goals. When students perceived an abundance of study resources, their engagement and motivation to study were significantly heightened (Liu, Gorgievski, et al., 2023).

Bakker et al. (2015) followed students for three consecutive weeks in which they attended six tutorial group meetings. They found that in the weeks that students had access to more study resources (autonomy, social support, opportunities to learn about new topics, and positive feedback), they were more energized and enthusiastic about their studies (i.e., more engaged). During these weeks, students exhibited increased engagement in tutorial meetings, actively participating in problem-solving brainstorms and posing critical questions. In contrast to study demands, study resources, therefore, have the potential to trigger the motivational process in students (Bakker, Demerouti, & Sanz-Vergel, 2023). Lesener et al.

(2020) found support for the health impairment and motivational processes in a sample of 5660 university students. Their findings showed that study demands were positively associated with student burnout and that student burnout mediated the link between study demands and students' life satisfaction. They also found support for the motivational process, where study resources were positively related to life satisfaction through student engagement.

Proposition 2: Study demands and resources instigate two different processes, a health impairment process, and a motivational process.

The third proposition in SD–R theory is that study demands and resources have a combined impact on student well-being and outcomes. According to Bakker, Demerouti, and Sanz-Vergel (2023), there are two ways in which demands and resources interact and have an impact on well-being. The *buffer* hypothesis states that study resources such as social support and constructive feedback alleviate or buffer the positive influence of study demands on strain. Thus, buffer effects refer to the protective role of resources in alleviating the adverse consequences of high study demands. For example, when students face demanding coursework and interpersonal conflicts, certain study resources, such as time control and support from fellow students, can act as buffers to diminish the negative impact on their well-being. Aloia and McTigue (2019) found evidence for a buffer effect in their study among college students in the USA. Specifically, they found that the impact of study demands (e.g., workload, and pressures to perform) on psychological well-being was weakened when students had access to an abundance of study resources (supportive informational and emotional communication). In addition, research by Naylor (2022) suggested that a study environment rich in resources (e.g., teacher autonomy support and interesting coursework) can compensate for study demands such as study load and financial stress. They also showed that students who had access to more study resources reported lower levels of burnout, anxiety, and depression in the face of high study demands.

The *boost* hypothesis states that challenging study demands can amplify or boost the positive impact of study resources on engagement and performance (cf. Bakker et al., 2014). Particularly when students are confronted with complex study tasks and deadlines, they will benefit most from lecturer support and constructive feedback. Hospel and Galand (2016) found evidence for a boost effect by showing that students were more emotionally engaged (e.g., curious, interested, enthusiastic) in the lessons when teachers combined high study demands (i.e., high expectations, strong guidance) with study resources in the form of autonomy and support. When students had numerous opportunities to take initiative and when their perspectives and feelings were well acknowledged, study demands positively influenced positive emotional engagement and negatively influenced negative emotional engagement. However, the demands × resources interaction term showed only marginal, mainly nonsignificant, effects on cognitive and behavioral engagement. We refer to Salmela-Aro et al. (2022) for a further review of synergistic relationships among study demands and resources in the SD–R model.

Proposition 3: Study demands and resources have a multiplicative, combined impact on student well-being.

The Role of Personal Resources

Personal resources refer to individuals' beliefs in their ability to control and impact their environment successfully (Hobfoll et al., 2018; Xanthopoulou et al., 2009). Examples are self-efficacy, optimism, hope, and resiliency (also referred to as psychological capital; Luthans et al., 2013). In the organizational context, several studies have demonstrated the importance of personal resources for employee outcomes (e.g., Bakker & Van Wingerden, 2021; Knight et al., 2017). Moreover, research suggests that individuals who have more personal resources also have access to more environmental resources (e.g., Xanthopoulou et al., 2009). These findings suggest that when individuals believe they can influence their environment successfully, they are more likely to gain more environmental resources (e.g., autonomy, social support, feedback), which helps them feel engaged and perform well (Bakker, Demerouti, & Sanz-Vergel, 2023).

Over the past decade, research suggests that personal resources are also important for student well-being and learning outcomes. Spanish and Portuguese students who reported many personal resources (optimism, self-efficacy, resilience, hope) were more engaged in their studies and demonstrated a higher grade point average than students with few personal resources (Martínez et al., 2019). Similarly, Vietnamese business students with higher personal resources reported greater happiness and higher quality of university life (Tho, 2023). Personal resources such as hope and self-efficacy were most important for students who had only limited access to social and organizational resources and vice versa (Junça Silva et al., 2022). This suggests that personal resources can compensate for a lack of study resources. Finally, a scoping review of Theron (2022) showed that personal resources (e.g., self-confidence, self-efficacy) and personal skills (e.g., talent for learning, time management skills) help students navigate challenges, achieving goals, and enhancing their well-being.

Is there any evidence that students with more personal resources also gain more study resources over time? Even though Bakker et al. (2015) did not test the causal relationship between personal and study resources, they did find that on the days students had access to more personal resources, they reported more study resources, and vice versa. Robayo-Tamayo et al. (2020) investigated the influence of early-day personal resources on end-of-day student engagement through study resources. They used a 5-day quantitative diary study and showed that on the days students felt more self-efficacious and curious, they mobilized more social support from their professors and peers, increasing their engagement.

Lee et al. (2022) argued that social support from peers and teachers (study resources) and self-compassion (i.e., being mindful and kind to oneself — a personal resource) would be reciprocally related. Although the design of their study could not test (reversed) causal effects, they did find a positive link between social support and self-compassion. In addition, both resources were positively related to academic engagement and negatively related to academic burnout. Finally, it can be argued that students who believe in themselves and think they have control over their study environment are more likely to proactively *ask* for resources from others. Indeed, Tho (2023) showed that students with more personal resources (hope, optimism, self-efficacy, and resilience) were more likely to engage in study crafting,

i.e., they took the personal initiative to increase their social and structural study resources.

Proposition 4: Personal resources such as optimism, self-efficacy, hope, and resilience have a reciprocal relationship with study resources.

SD–R theory further proposes that, like study resources, personal resources can moderate the negative impact of study demands on student well-being. In the organizational context, several studies have shown that personal resources alleviate the impact of job demands on well-being (e.g., Bakker & Sanz-Vergel, 2013; Demirović Bajrami et al., 2022). However, in the context of higher education, most research has focused on mediating effects, with limited literature available that provides evidence for a moderating effect of personal resources.

In one of the few studies available, 't Mannetje et al. (2021) used interviews to explore the personal resources high-achieving honors students rely on to perform well in a demanding academic environment. This study across three Dutch universities showed that several personal resources, including self-direction, inquiry-mindedness, and perseverance, were crucial for achieving academic success and helped students cope with the demands they faced. Further, a recent study by Martin et al. (2023) investigated the roles of self-perceived adaptability and fluid reasoning, which both can be classified as personal resources in an educational setting. The authors hypothesized that students with higher levels of adaptability and fluid reasoning would be less prone to experiencing the adverse effects of a mandated lockdown, which was considered a study demand. Results showed that fluid reasoning (but not adaptability) buffered the unfavorable effects of the lockdown on self-efficacy. In line with JD–R and SD–R models, a boost effect was also observed, indicating that fluid reasoning was a more important resource with a stronger impact on self-efficacy when the demands were high rather than low (Martin et al., 2023).

Proposition 5: Similar to study resources, personal resources moderate the impact of study demands on student well-being.

Proactive Self-Enhancing Study Behaviors Producing Gain Spirals

The previous section has shown that study demands and resources have unique as well as multiplicative effects on student well-being. A critical insight in JD–R theory is that individuals do not merely respond to the characteristics of their environment, but rather may take initiative to actively influence this environment (Bakker, 2017; Demerouti & Bakker, 2024). Accordingly, engaged individuals are motivated to proactively shape the design of their tasks and social environment. This phenomenon is called crafting — the proactive adjustments individuals make in their tasks and social relationships (Wrzesniewski & Dutton, 2001) or more broadly in their demands and resources (Tims & Bakker, 2010) to enhance the meaning of their activities and to create a better fit between their personal abilities, preferences, and the situation. Several reviews and meta-analyses have shown that job crafting has a range of positive consequences in the organizational context, including increased engagement, meaningfulness, task performance, and prosocial behavior (Demerouti & Bakker, 2024; Lazazzara et al., 2020; Rudolph et al., 2017). Thus, individuals

who proactively increase their challenging demands (e.g., start a new project), reduce their hindrance demands (e.g., reduce workload and negative interactions with others), and/or actively increase their resources (e.g., ask for feedback, seek support) are more likely to feel energized and enthusiastic about their work, and consequently perform better (Demerouti & Bakker, 2024), creating a positive and upward spiral.

In SD–R theory, we propose that students may also engage in proactive self-enhancing behaviors (e.g., study crafting), to optimize their study environment, engagement, and performance. They are more likely to do so when they feel well and are enthusiastic about their studies (see Fig. 1). By taking the personal initiative to influence their study environment, students can sustain their engagement and create an upward spiral of resources, engagement, and study performance (Llorens et al., 2007). Bindl and Parker (2011) have defined such proactive behavior as "self-initiated, anticipatory action aimed at changing either the situation or oneself." (p. 567). Examples in the study context include taking the initiative to set clear study goals, proactive problem-solving, and proactively using one's strengths and improving one's deficits. Students who proactively build a network during their studies are more likely to approach each other for help when needed, and adapt to university life (Brouwer & Engels, 2022). Moreover, students' characteristics and behaviors influence other students' academic performance and social outcomes — known as peer effects (Cao et al., 2024; Yeung & Nguyen-Hoang, 2016).

Recent research has shown that students engage in feedback-seeking behaviors, study crafting, and playful study design and that such behaviors can have favorable consequences for student engagement and outcomes. Using a weekly diary design, Körner et al. (2021) investigated study crafting among higher education students. Findings showed that weekly study resources (decision latitude, social support from lecturers, and support from fellow students) were positively related to weekly study crafting via weekly student engagement. Thus, study resources fostered energy and enthusiasm in students, which, in turn, made them more likely to proactively increase their study challenges, try to learn new things, and ask lecturers for feedback about their performance.

Tho (2023) investigated the consequences of study crafting (asking for feedback, taking on extra study tasks) among a large sample of Vietnamese undergraduate business students. Results of this study showed that study crafting was an important determinant of satisfaction with study life, when students believed that they had control over their study environment. Particularly when students' personal resources (e.g., hope, optimism) were high, study crafting was positively related to indicators of happiness and satisfaction with study life. In a similar vein, Mülder et al. (2022) conducted a study among almost 3000 German university students and found that study crafting was positively related to well-being. Students who proactively improved their study demands and resources were more engaged with their studies, were less exhausted, and reported higher overall well-being (e.g., quality of life, satisfaction with health and personal relationships).

Luu and Vo (2020) conducted a study among medical students and their teachers. They used observations and video recordings of medical teachers' authentic leadership (e.g., observations of self-awareness and relational transparency) and

student reports of study crafting. The results showed that teacher authentic leadership was positively related to student crafting behaviors. Thus, when teachers were more authentic, students were more likely to proactively seek study challenges and resources. Postema et al. (2022) conducted a study among Dutch student-athletes and investigated possible spillover effects of study crafting to the sports domain. Consistent with an enrichment perspective, results showed that on the days students engaged in study crafting (increasing challenges, increasing resources, and cognitive crafting), they experienced higher levels of activated positive affect (e.g., feeling inspired, excited, alert) and increased student engagement. Positive affect also had a spillover effect on the sports domain: students who experienced more positive emotions because of study crafting showed better training performance as evident from self- and coach-ratings.

Körner et al. (2023) evaluated a study crafting intervention's effectiveness by randomly assigning students to a training or control group. Study crafting and student engagement and exhaustion were assessed before and after the intervention. Results showed that students learned to optimize their study demands and resources (i.e., study crafting), and this increased their levels of student engagement and decreased their levels of exhaustion.

Liu, Zhang, et al. (2023) investigated another proactive study behavior called playful study design — a cognitive-behavioral approach to study tasks through which tasks and/or activities are redesigned to be more fun and more challenging (Scharp et al., 2023). They used a day reconstruction method and collected data from university students across five consecutive days. The results showed that playful study design fostered the daily experiences of flow and flourishing, particularly under difficult conditions (when students often ruminated about COVID-19). In another study, Wang et al. (2023) investigated the impact of weekly playful study design on student engagement and goal attainment. This study showed that students were highly engaged and successful in achieving their goals when they redesigned their study tasks to be more playful. For example, by guessing the hypothesized outcomes, segmenting tasks to increase the challenge of studying, or by using cognitive mind maps for summarizing the literature, students increased their own engagement and performed better. The effects were strongest for students who were high (vs. low) in proactive personality — they benefitted most from using playful study design. These findings are consistent with JD–R theory and previous findings in the work context showing that job crafting and playful work design have favorable effects on engagement, creativity, and performance (Bakker, Demerouti, & Sanz-Vergel, 2023; Bakker & Scharp, 2024; Oprea et al., 2019).

Proposition 6: Students proactively optimize their own study demands and resources through study crafting and playful study design.

Proposition 7: Student engagement can instigate a gain spiral of proactive, self-enhancing study behaviors, (study and personal) resources, and optimal study demands.

Reactive Self-Undermining Study Behaviors Producing Loss Spirals

Whereas proactive study behaviors play an important role in the gain spiral of SD–R theory, self-undermining behaviors play an important role in the loss spiral (see Fig. 1). Self-undermining refers to certain undesirable behaviors in response to stress, creating obstacles (Bakker & Wang, 2020). One example is that a student experiencing strain because of an upcoming exam and accompanying high study demands may feel upset and irritated and creates interpersonal conflicts with other students. Students may also have trouble concentrating and, therefore, create a backlog in their study tasks. Self-undermining behaviors create hindrances or new, additional demands that add up to the demands that already exist (Bakker & Costa, 2014).

Widlund et al. (2021) used an accelerated longitudinal study design to investigate differences in Finnish adolescents' developmental trajectories of school burnout and engagement and their associations with students' progression in mathematics performance and educational aspirations. One of the trajectory profiles the authors identified was that of declining academic well-being (low and declining engagement, high and increasing burnout). Students in this group started with high performance and aspirations, but they progressed at a slower rate in mathematics and lowered their aspirations over time. Widlund and her colleagues explained these findings by self-undermining behaviors. They argued that self-undermining may have taken the form of poor communication (cf. Bakker & Wang, 2020), which reduced the availability of study resources. Students with elevated stress levels may have fallen behind in their studies, and possibly created conflict with peers and teachers because of their own feelings of irritation and impatience. This, in turn, creates more demands over time (Bakker & Costa, 2014).

Previous research has provided evidence for such a loss spiral by revealing a reciprocal relationship between school stress and students' perceived conflicts with teachers (Kiuru et al., 2020). In their weekly diary study among German higher education students, Körner et al. (2021) found that in the weeks students faced higher study demands (time pressure, overload, complex study tasks), they were more likely to feel emotionally exhausted and consequently more likely to show self-undermining behaviors. Particularly in the weeks students faced complex assignments and needed to process a lot of information, they were drained by their studies and reported a backlog in their study tasks, more mistakes, and poorer communication (i.e., self-undermining). Jia et al. (2021) conducted a study on self-handicapping among Chinese medical students during the COVID-19 crisis. Self-handicapping shows some conceptual overlap with self-undermining. It refers to the process of finding or creating barriers to achieving successful study performance — with the aim of safeguarding one's sense of self-competence (Jones & Berglas, 1978). The results of this study showed that students who experienced higher levels of academic stress (e.g., nervousness and anxiety for the final exams) were more likely to procrastinate and consequently showed more self-handicapping behaviors (e.g., drinking alcohol and deliberately losing learning materials).

Research has also shown that procrastination is predictive of future stress, through maladaptive coping (Sirois & Kitner, 2015). Tice and Baumeister (1997)

assert that procrastination is a self-undermining behavior pattern characterized by short-term benefits (such as rest), but long-term costs (such as exhaustion). Their study examined the occurrence and effects of procrastination on physical symptoms and stress, among a small sample of higher education students. The findings showed that at the beginning of the semester, students who procrastinated reported lower levels of stress and fewer illnesses compared to students who did not procrastinate, indicating short-term benefits. However, toward the end of the term, students who procrastinated reported higher stress levels and more illnesses, as well as lower academic performance. This supports the idea of a loss spiral in which students who show self-undermining behaviors (creating a backlog, avoidance coping) create more stress over time.

A recent study was conducted among a large sample of German university students to investigate the relationship between academic procrastination and learning-related anxiety and hope. The study was conducted with 6-week intervals at the beginning, middle, and end of the academic semester (Gadosey et al., 2023). The results showed that academic procrastination at the start of the academic semester predicted learning-related anxiety and low levels of learning-related hope during the middle of the semester, which, in turn, resulted in even more procrastination toward the end of the semester. These findings suggest that higher tendencies to procrastinate could lead to low levels of hope over time and that students may end up in a spiral of more self-undermining behavior. Conversely, the study reports that lower tendencies to procrastinate may lead to increasing levels of hope, which relates to the gain spirals mentioned earlier.

These results are consistent with previous findings in an organizational context. For example, Bakker and Wang (2020) showed in a series of studies that individuals who were exposed to higher job demands felt more exhausted and were more likely to engage in self-undermining behaviors. Using a weekly diary design, Bakker, Xanthopoulou, and Demerouti (2023) argued and found that weekly emotional demands and workload were predictive of weekly burnout complaints, and indirectly predictive of self-undermining and dysfunctional coping (avoidance and passive coping). These effects were stronger for individuals who already scored relatively high (vs. low) on chronic burnout at the start of the study. Providing additional evidence for a loss cycle, Roczniewska and Bakker (2021) found that employees who felt lower on energetic resources at the start of the day were more likely to engage in self-undermining behaviors and less likely to engage in job crafting, which consequently undermined their daily functioning.

Proposition 8: Study demands and strain may lead to reactive, maladaptive self-regulation cognitions and behaviors (self-undermining).

Proposition 9: Study-related strain can instigate a loss spiral of self-undermining and study demands.

Student and Higher Education Outcomes

Study characteristics, like job characteristics, can have an important impact on student burnout and engagement and indirectly influence student and higher

education outcomes. Student burnout and engagement are positioned as two central well-being constructs in SD–R theory because of their significant impact on student behaviors as well as student and higher education outcomes (see Fig. 1).

Research has shown that demands and resources directly relate to key student outcomes. A study among higher education students found that hindering study demands (e.g., high workload, inadequate comprehension in classes) adversely affected students' academic achievement (i.e., GPA scores). In contrast, challenging study demands (e.g., perception of the degree of work difficulty in classes) showed a positive relationship with students' academic achievement and were negatively related to students' hours of withdrawal or disengagement (Travis et al., 2020). Study resources have a positive impact on student outcomes. For instance, resources such as student support (instructional, peer, and technical support) were shown to have a positive impact on students' satisfaction with their study course (Lee et al., 2011), while support from family and friends directly affected students' academic achievement (Saeed et al., 2023).

Research among students has also provided evidence of burnout and engagement's unique and differential effects on various key outcomes. Such outcomes include, but are not limited to, academic performance (e.g., GPA score) (Schreiber & Yu, 2016), life satisfaction (Lesener et al., 2020), intention to drop out and satisfaction with studies (Álvarez-Pérez et al., 2021; Mostert & Pienaar, 2020), psychological well-being (Chaudhry et al., 2024), students' likelihood of being satisfied with the higher education experience, and pursuing postgraduate studies (Öz & Boyacı, 2021).

However, the relationship between student burnout, engagement, and student outcomes is not necessarily direct or linear. Rather, it is a result of the dynamic interplay of different factors, influenced by both antecedents and outcomes as outlined in the health impairment and the motivational processes. Öz and Boyacı (2021) conducted a study to examine the association between student engagement and outcomes. Their findings showed that engagement explained variance in students' GPA scores and increased the likelihood that students were satisfied with their experience at the university, as well as the likelihood that students pursued a postgraduate degree. This is consistent with the idea that activated positive emotions like energy and enthusiasm encourage active involvement with goal pursuits and with the environment (Lyubomirsky et al., 2005).

In addition, various studies have shown that student burnout and engagement can act as mediators between study-related antecedents and outcomes in SD–R theory (cf. Fig. 1). For example, a study among part-time employed students (Laughman et al., 2016) investigated the relationship between work–school conflict and job outcomes. Their findings showed that work–school conflict predicted work outcomes and that burnout mediated these effects. Similarly, Chaudhry et al. (2024) provided evidence for the mediating effect of student engagement. Their study among management students investigated the relationship between various types of student support and psychological well-being. Their findings showed that academic engagement partially mediated the relationship between a positive internal team environment, family support, and psychological well-being.

Moreover, academic engagement fully mediated the relationship between institutional support and psychological well-being.

Körner et al. (2021) specifically investigated the mediating role of engagement and exhaustion in the relationship between study characteristics and study crafting and self-undermining behaviors among students. Their findings revealed a positive relationship between study resources and study crafting mediated by engagement, as well as a positive relationship between study demands and self-undermining mediated by exhaustion. Another recent survey among medical students found that students with a high risk of burnout tend to have a lower academic performance rate (Ilić & Ilić, 2023). Interestingly, this study also found that students with higher GPAs tended to have a higher risk of burnout — highlighting the intricate dynamics between these relationships.

We conclude that when students feel full of energy and are really enthusiastic about their studies (i.e., engaged), they are able to invest considerable cognitive and energetic resources in their studies. Consistent with this perspective, SD–R theory proposes that engaged students are more likely to be proactive (e.g., engage in study crafting, playful work design, and strengths use) and function better. In contrast, when students feel exhausted and cynical about their studies (i.e., burnout), they do not have the psychological resources to invest effort in their studies. As a consequence, they may start to undermine themselves and enter a loss spiral. This has negative implications for their own performance and for the higher education institution at large. Therefore, using previous SD–R models and theory, we may predict student and higher education outcomes, including academic performance, class attendance, learning activities, active participation, and inclination to drop out (Bakker et al., 2015; Loyens et al., 2007).

Proposition 10: Study demands and resources are directly related to student and higher education outcomes and indirectly related through the mediation of student burnout and engagement.

Recommendations for Research

Now that we have formulated SD–R theory, it is important to set an agenda for future research. Rigorous testing of the propositions put forward in this article is needed. SD–R theory (graphically depicted in Fig. 1) can be used to guide such research. Studies could test health impairment versus motivational processes and investigate whether the two processes are indeed unique and predict different outcomes. For example, SD–R theory predicts that study demands are most predictive of physical health and class absence, whereas study resources are most predictive of grades and university dropout. In addition, research should test statistical interactions between study demands and study resources. Are time pressure, interpersonal conflicts, and complex assignments less stressful if students have access to an abundance of study resources (e.g., support from professors, career opportunities) and personal resources (e.g., optimism, self-efficacy)? Do study resources such as study skills workshops and extracurricular activities particularly have a positive influence on engagement and performance when study challenges are high? Another stream

of research may test the loss and gain spirals proposed in SD–R theory (Bakker, Demerouti, & Sanz-Vergel, 2023; Bakker, Xanthopoulou, & Demerouti, 2023). Are students with burnout complaints more likely to show self-undermining and procrastination, and does this lead to a further increase in study demands? Are students high in engagement more likely to craft their studies and to proactively optimize their demands and resources leading to more engagement? Does a playful approach of study tasks and assignments facilitate persistence and help students deal with daily hindrance demands (e.g., repetitive study tasks, financial uncertainty, higher education bureaucracy)?

It should be noted that various pathways in SD–R theory are reciprocal, implying that scholars can use most variables as predictors *and* outcomes. Thus, next to using study demands as predictors of strain and self-undermining, study demands could be used as outcomes of strain and self-undermining. Similarly, study resources can be modeled and tested as predictors and outcomes of student engagement and study crafting. In short, testing the basic hypotheses in SD–R theory has just started, and we need a range of new studies to further establish its validity. Studies may apply longitudinal research designs with months or years between the assessments, or "shortitudinal" designs (Dormann & Griffin, 2015) with daily or weekly assessments so that causal and reversed causal effects can be modeled. Shortitudinal studies collect data over short periods of time, typically a few days or weeks with frequent assessments conducted daily. They allow examining changes in variables over time and capture short-term fluctuations in student experiences and behaviors. We also need rigorous qualitative research to explore the various study demands and resources students are exposed to and to explore their unique experiences in various higher education settings.

Future research may also extend SD–R theory and explore new avenues. Here, we briefly discuss three possible research directions, namely (a) trait versus state effects in SD–R theory; (b) the impact of the higher education climate and lecturer influence; and (c) an expanded SD–R theory.

Traits Versus States in SD–R Theory

Scholars in educational psychology have typically relied on self-report questionnaires and cross-sectional and longitudinal research designs to investigate student well-being and performance. In these studies, the person is the unit of analysis and the statistical analyses are based on differences between persons (e.g., their personalities, or their typical ("trait-like") study environment, well-being, and behaviors). An underlying assumption in these studies is that the investigated constructs have some stability over time. However, students' experiences and behaviors may fluctuate considerably over short periods of time, for example, as a function of daily discussions with peers and professors, participation in group coursework, and engagement in extracurricular activities (Bakker et al., 2015; Doerksen et al., 2014; Xue et al., 2022). Such short-term fluctuations ("states") can be studied using daily diary designs in which not the person, but the *situation* is the unit of analysis. Diary studies enable researchers to capture "life as it is lived" (Bolger et al., 2003, p. 597). For example, with the experience sampling method, students may be asked to fill out

a brief questionnaire on their smartphone every time they receive a push message. Alternatively, in a daily diary study, students may be requested to fill out a short online questionnaire at the end of every day during a 1- or 2-week period (see Ohly et al., 2010).

In JD–R theory (Bakker, 2015; Bakker, Demerouti, & Sanz-Vergel, 2023), personality is positioned as a trait-level variable that moderates the loss and gain cycles displayed in Fig. 1. Thus, the impact of daily demands and resources on well-being and study behaviors, as well as the impact of daily (proactive or reactive) behaviors on demands and resources, is proposed to be different for individuals with different personalities (see, for example, Bakker & Oerlemans, 2016). In an educational context, this may mean that students high (vs. low) in extraversion (i.e., likely to make contact with other students and be at the center of attention) benefit more from daily social resources in their study environment (feedback, social support). Such social interactions could result in feeling more engaged while studying. There is some preliminary evidence for the proposition that personality traits moderate daily study processes.

Longua et al. (2009) used a 30-day diary study to examine the influence of personality on how students responded to combinations of negative and positive daily events (e.g., progress on study tasks, conflicts with friends or family). They found that positive daily events buffered the effect of negative daily events on negative affect (e.g., feeling angry, jittery, nervous) for students low in neuroticism and those high in extraversion, but not for students high in neuroticism or low in extraversion. Positive daily events also buffered the impact of negative daily events on night-time stress, but only for students low in neuroticism. Bakker et al. (2015) conducted a study among psychology students and found that students' weekly study resources (e.g., social support, feedback) and personal resources (self-esteem, optimism, self-efficacy) facilitated their student engagement (vigor, dedication, and absorption). Student engagement, in turn, was predictive of observed learning activities during the weekly educational group meetings and contributed significantly to the course grade. Moreover, as hypothesized using a SD–R theoretical perspective, the results showed that the impact of study and personal resources on student engagement was stronger for students high versus low in openness to new experiences. Future research should test other personality factors (e.g., conscientiousness, proactive personality) as cross-level moderators of the impact of daily study demands and resources on student well-being, behaviors, and outcomes.

The Higher Education Climate and Lecturer Influence

The abovementioned research recommendations focus on individual students — their perceptions of study demands and resources, their study behaviors, and their well-being. However, students are part of a system and may also be influenced by their teachers or professors, or by the overall climate of the educational institute where they study. The higher education climate refers to "factors that serve as conditions for learning and that support physical and emotional safety, connection and support, and engagement" (U.S. Department of Education, Office of Safe and Healthy Students, 2016, p. 1). When students perceive that the climate in their

institution is psychologically safe, they have a stronger sense of belonging (Allen et al., 2018) and their academic achievements are better (Bear et al., 2011). We argue that the higher education climate is predictive of study demands and resources. In institutes with a psychologically safe climate, students can be expected to be exposed to reasonable study demands and have access to sufficient study resources (cf. Dollard & Bakker, 2010). New research is needed to test psychosocial safety climate as a higher-level variable that influences the study environment, and indirectly contributes to student well-being and performance.

Research with the JD–R theory has shown that leaders may influence the prevalence of job demands and resources, employee well-being, and employee proactive behaviors (e.g., Thun & Bakker, 2018; Tummers & Bakker, 2021). When leaders empower their employees and show individual consideration — i.e., supporting their development and providing trust and autonomy — their employees are more likely to take initiative and proactively optimize their own job design. Consequently, employees can feel more engaged and perform better (Bakker, 2022). Mirroring these leader–employee effects in a work context, future research in educational contexts could test the impact of professors and lecturers on students. This is a multilevel effect in which the enthusiastic behaviors and engagement of professors are expected to influence study demands and resources, student well-being, and student behaviors. For example, it can be hypothesized that engaged professors will be best able to inspire students, influence their enthusiasm and vigor (i.e., student engagement), and influence their study performance (Bakker, 2005; Frenzel et al., 2018; Pachler et al., 2019). Vujčić et al. (2022) found that teacher engagement was positively related to student well-being because students were more willing to invest time and energy in study tasks and activities. In addition, teacher engagement will have a positive impact on study resources, because engaged teachers are more willing to help their students — offering support, information, and feedback (cf. Christian et al., 2011; Simbula & Guglielmi, 2013).

Expanding SD–R Theory

We have identified various opportunities for future research, but there are many more options that we will briefly mention here. First, we have indicated that more research on study demands and resources is needed, but students are also confronted with demands and resources in other life domains, including family, self, and sports, for example. Demerouti and Bakker (2023) have recently integrated demands and resources from the home and personal domains and argued that demands in one domain can be buffered or boosted by resources from another domain. In a study context, the impact of family and personal demands (e.g., high expectations, perfectionism) on student burnout may, for example, be buffered by study resources (e.g., social support and feedback from lecturers).

Second, future research is needed to explore how SD–R theory relates to or complements other established motivational theories within the educational context. One potential theory to explore is expectancy-value theory, which posits that an individual's motivation is influenced by the perceived likelihood of success and the value they place on the potential outcome (Wigfield & Eccles, 2000). This theory

could complement SD–R theory by providing a more nuanced understanding of how the study resource of feedback about study performance (e.g., derived from course grades and other indicators of study success) predicts student engagement. In a similar vein, future research could investigate how principles from goal-setting theory could be integrated into SD–R theory. Goal-setting theory proposes that setting specific, challenging, and attainable goals can enhance an individual's motivation and performance (Locke & Latham, 2002). New research could explore how goal-setting influences students' ability to manage study demands and proactively use study resources, and how these SD–R strategies indirectly facilitate student engagement. As a final example, it would be interesting to investigate how growth mindset (Dweck, 2006; Yeager & Dweck, 2020) may qualify the impact of daily or weekly study demands and resources on student engagement and performance. Integrating mindset and SD–R theories, it can be hypothesized that study challenges and resources will have a stronger positive impact on engagement and performance for students with a growth mindset, because they tend to view challenges as opportunities to learn and improve, rather than threats. They invest more effort, proactively try new strategies, and seek resources when needed. Exploring the potential synergies between SD–R theory and other motivational theories in the educational psychology literature could contribute to developing more comprehensive and effective interventions for supporting student well-being.

Third and finally, it would be interesting and important to investigate the role of other proactive behaviors students may use next to study crafting and playful study design, and to integrate these behaviors in the SD–R theory. For example, research has elucidated that when students proactively use their character strengths, they report more personal resources (hope, resilience), improved happiness and subjective well-being, and reduced stress and depressive complaints (e.g., Ghielen et al., 2018). When students use their strengths (e.g., kindness, courage, creativity), they can be authentic and are more likely to succeed, which boosts their personal resources. In a similar vein, a recent study has shown that when students use proactive vitality management — i.e., individual, goal-oriented behavior aimed at managing physical and mental energy to promote optimal functioning (Op den Kamp et al., 2020), they experience more meaning and improved subjective well-being (Zhang et al., 2024).

Practical Recommendations

SD–R theory has several implications for practice. Here, we recommend three practical approaches that can be considered. First, the SD–R theory offers a clear framework for the assessment of student well-being and its possible causes and consequences. Higher education institutions may want to include various specific study demands and resources in their underlying survey instruments to assess drivers of student burnout, engagement, and critical outcomes (e.g., information about class attendance, course grades, dropouts, and career progress). Once a higher education institution or faculty has made a clear diagnosis of their students' levels of study demands and resources and their predictive validity for student well-being,

behaviors, and study outcomes, management could detect groups of students with the most versus least favorable study demands and resources and initiate interventions at the group or department level. For example, departments in which students report very high time pressure could take measures by adjusting courses and grading, or by offering their students training in time management, goal setting, and new efficient ways of dealing with high quantities of complex information in a short time. Departments in which students report low opportunities for skill variety could try to initiate novel ways of educating their students.

A second practical implication is that student counsellors may try to reduce self-undermining behaviors and increase proactive study behaviors through training and workshops (proven effective in job crafting interventions; for a meta-analysis, see Oprea et al., 2019). A recent study among students has provided evidence for the effectiveness of a study crafting intervention (Körner et al., 2023), showing that students can learn to optimize their own study demands and resources, and increase their own well-being. Furthermore, workshops and trainings could be organized to reduce burnout and self-undermining behaviors. These trainings may first use rational emotive training therapy or mindfulness (Madigan et al., 2023), and then explain how self-undermining behaviors may be warning signs of burnout. Once students have regained energy in several sessions, they may learn about study crafting to optimize their study design so that the root cause of their burnout complaints is addressed as well.

Third, higher education institutions may provide interventions for lecturers and professors to facilitate positive crossover of engagement and optimization of the study design (study demands and resources). In trainings and workshops, professors may learn about SD–R theory, role-modeling, and the crossover of teacher engagement to students (cf. Bakker, 2005, 2022). Through exercises, lecturers can learn about possible ways to increase study resources for students and to stimulate proactive behaviors such as study crafting and playful study design. Research in the work context has suggested that leaders who intellectually challenge their employees and inspire and empower them can indeed increase employee proactive behaviors and engagement (Bakker, Hetland, et al., 2023).

Conclusion

In this article, we introduced the Study Demands–Resources theory to explain various processes that are involved in student well-being (burnout and engagement). We used the well-established Job Demands–Resources theory, previous Study Demands–Resources models, and existing literature on student well-being to develop 10 propositions. Our review showed that students are confronted with a variety of study demands and resources, and that it is crucial to self-regulate the impact of these study characteristics. We identified several studies showing that students can engage in proactive study behaviors, including study crafting and playful study design. Students feel more engaged when they proactively optimize their own job demands and resources and playfully redesign their study tasks to be more fun or more challenging. Higher education institutions' management,

lecturers, professors, and students may use SD–R theory to optimize student well-being and outcomes. We hope that this article will inspire educational psychology scholars, fostering collective efforts to enhance the well-being and academic success of our students.

Declarations

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