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Article

A longitudinal examination of psychological capital and academic achievement in EMI courses: A multivariate latent growth curve modeling approach

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With English Medium Instruction (EMI) expanding in China's higher education, understanding the psychological factors supporting student success is essential. This study examines how psychological capital (PsyCap), comprising self-efficacy, hope, resilience, and optimism, relates to academic achievement over time. Using the Psychological Capital Scale for EMI Learners (PsyCap-EMI) and multivariate latent growth curve modeling, data were collected from 489 Chinese EFL students in EMI courses at four time points across 2 years. Results showed that PsyCap gradually increased over time. Higher initial PsyCap predicted stronger initial academic achievement ($\beta = 0.54$). The initial level of PsyCap was negatively correlated with subsequent growth in psychological resources ($r = -0.25$). Additionally, initial PsyCap was negatively linked to academic growth ($\beta = -0.20$), while PsyCap increases were positively but weakly related to academic improvement ($\beta = 0.12$). Qualitative interviews further revealed fluctuations in students' psychological states and academic experiences. The findings highlight the dynamic role of PsyCap in EMI learning and underscore the need for institutional strategies that foster psychological development alongside academic support in linguistically demanding contexts.

Introduction

The adoption of English Medium Instruction (EMI) in academic degree programs is growing worldwide (Wingrove et al. 2025), with the number of EMI programs rapidly increasing in East Asia (Galloway et al. 2017). In 2001, Ministry of Education of the People's Republic of China (2001) issued a directive calling for 5 per cent to 10 per cent of the courses in tertiary schools to be taught in English, which promoted the expansion of EMI in mainland China over the next two decades (Rose et al. 2020). EMI environments present unique psychological challenges for students, as they must not only master the specialized content of their discipline in a second language but also adapt to new academic conventions and cultural expectations. These challenges include overcoming linguistic barriers such as understanding specialized terminology, academic writing, and oral communication in

English, as well as adapting to cultural norms of participation, classroom interaction, and collaborative learning (Jiang et al. 2019). Importantly, students' success in EMI contexts depends not only on their linguistic competence but also on their capacity to cope with sustained cognitive pressure, uncertainty, and academic setbacks. As EMI students are required to engage with complex content through a non-native language over extended periods, psychological factors play a central role in shaping how learners manage stress, maintain engagement, and persist in challenging academic environments. Given these compounded demands, scholars have increasingly turned to psychological perspectives to better understand the factors that contribute to academic success in EMI programs.

To date, investigations into psychological factors in EMI research have lacked a unifying framework, often exploring variables in isolation or in combination with one another without a strong theoretical connection. Psychological capital (PsyCap), which has been widely adopted in the fields of business and management (Luthans and Youssef-Morgan 2017), has recently attracted the attention of education practitioners (Lin 2020; Li et al. 2023; Hsu 2024) as a theoretical avenue to address this concern. PsyCap measures one's positive psychological state of development in self-efficacy (confidence), hope (perseverance to goals), resilience (the ability to adapt to change and maintain emotional stability in challenging situations to obtain success), and optimism (having a positive attribution about success for now and the future) (Luthans et al. 2007).

PsyCap offers a potentially more theoretically grounded approach to examining the combined effect of psychological factors on academic achievement in EMI contexts. Although previous EMI studies have drawn on frameworks such as academic resilience, self-determination theory (SDT) (e.g. Hung et al. 2025), and translanguaging perspectives (e.g. Lu et al. 2025), PsyCap offers a potential for a more integrated psychological lens. To illustrate, academic resilience reflects only one dimension of PsyCap, whereas PsyCap captures four complementary, state-like resources that jointly influence learners' adaptation. Compared with SDT's focus on basic psychological needs, PsyCap explains how students mobilize internal resources to cope with simultaneous linguistic and disciplinary demands.

In addition, recent EMI scholarship has raised several central debates, including what factors are associated with academic success (Lee et al. 2025), how learners adapt to the dual linguistic–disciplinary demands of EMI (Li and Pei 2024), and how psychological challenges are negotiated in such settings (Liyanage 2023). A further unresolved issue concerns the limited use of integrative theoretical frameworks to explain how multiple learner resources jointly shape academic trajectories in EMI. By adopting PsyCap as a multi-component, state-like framework, the present study directly addresses these debates by theorizing and empirically modeling how internal psychological resources may support students' adaptation and achievement over time. Moreover, because PsyCap captures developmental psychological processes relevant to L2 learners more broadly, the findings may extend beyond EMI to contribute to broader discussions in L2 and applied linguistics on learner agency, academic engagement, and positive psychological factors.

This study, therefore, examines the effect of PsyCap on academic achievement in EMI courses. Specifically, it examines the stability or variability of the effect of PsyCap on academic achievement over time. Despite growing interest in learner psychology, EMI research has tended to approach psychological variables through motivational, affective, or sociocultural lenses, leaving limited theorization of how multiple psychological resources jointly support learners in linguistically demanding academic environments. This study, therefore, bridges educational psychology with applied linguistics and complements sociocultural accounts of learner agency by foregrounding the internal capacities that enable students to act agentively in EMI contexts.

Literature review

EMI

In an EMI program, lecturers adopt the English language to teach content subjects in countries or jurisdictions where most of the population does not speak English as the first language

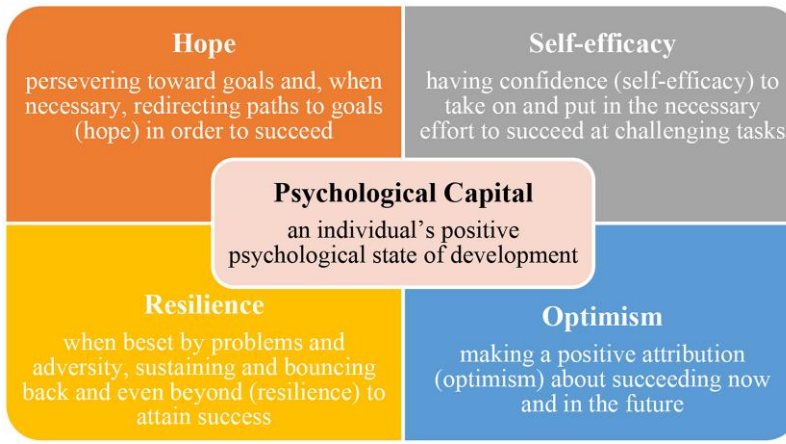

Figure 1. The four elements of the PsyCap.

(Macaro et al. 2018). This definition applies to the EMI context in China's higher education, where EMI provision at universities is rapidly expanding, and many discipline-focused courses are switching the medium of instruction from Chinese to English (Rose et al. 2020). Previous research has identified that multiple factors are relevant or can predict success in EMI contexts. For example, hope (Zhou et al. 2025), resilience (Hsu 2024; Tuna 2024), self-efficacy (Thompson et al. 2022; Sahan et al. 2023), and optimism (Graham and Eslami 2019; Zhang and Pladevall-Ballester 2022) were found to be associated with academic achievement in EMI programs, respectively. However, few studies have examined their joint relevance to students' academic achievement in EMI programs, and even fewer have presented longitudinal evidence. Previous research indicates that students' challenges with EMI change as they progress in their studies (Evans and Morrison 2017). To date, most studies on EMI and learner psychology have been fragmented, often focusing on individual constructs without a cohesive theoretical framework, leading to inconsistent conclusions.

PsyCap

PsyCap is a concept that has attracted significant attention in psychology and organizational behavior. Figure 1 presents an overview of the theoretical framework of PsyCap. PsyCap, first proposed by Luthans et al. (2007), integrates hope, self-efficacy, resilience, and optimism into a higher-order construct predicting job performance and satisfaction. It is conceptualized as 'state-like and hence open to development and change as opposed to a fixed trait' (p.542), meaning that it is more malleable than fixed traits and at the same time more stable than momentary states. Using data from 404 participants, their study showed that PsyCap was more predictive of workplace outcomes than any single component, highlighting its value in positive organizational behavior. Although limitations in sample and context were noted, the study remains foundational. It suggests that investing in PsyCap development can yield significant and lasting benefits—an idea reinforced by later work, such as Peterson et al. (2011). Research has shown that PsyCap significantly influences job satisfaction, organizational commitment, and performance. Avey et al. (2008) found that higher PsyCap is linked to greater job satisfaction and commitment. Luthans et al. (2006) highlighted PsyCap development as a means to boost well-being and performance. In education, Lin (2020) showed that PsyCap enhanced English learning engagement via mindful learning. Hsu (2024) identified PsyCap as a key factor affecting students' willingness to take EMI courses.

Hope, a core component of PsyCap, is defined by Snyder et al. (2000) as a motivational state grounded in goal pursuit and belief in one's ability to achieve those goals. Luthans et al. (2007) further conceptualized hope through three elements: goals, pathways, and agency. Individuals enhance hope by setting meaningful, challenging goals and generating multiple strategies to overcome obstacles. In EMI settings, hope is relevant as students should navigate both disciplinary demands and language barriers. For example, EMI learners often set goals such as improving technical vocabulary or achieving academic benchmarks, while simultaneously developing pathways through translation tools, peer support, or additional practice. That allows them to sustain progress despite linguistic challenges. In this sense, hope reflects not only long-term aspirations but also the strategies that help students envision success in a dual-demand learning environment. The long-term visionary nature of the construct of hope draws some connections to the future self in the *L2 Motivational Self System* within which learners have often been asked to "imagine" their *Ideal L2 Self*. This wording has been criticized by researchers who have argued that "imagined" future selves are different from an *Ideal Self* (Henry and Liu 2024). We argue that the wording of "I imagine myself" in psychological measurement aligns more closely to the construct of hope, with its longer-term aspirations and focus on pathways to achieve these goals.

Recent empirical studies have affirmed the central role of hope in EMI and EFL contexts, highlighting its predictive value for academic engagement and motivational development. Zhou et al. (2025) reported, in a longitudinal mixed-methods study, that students' ideal language self significantly predicted hope, demonstrating hope's mediating role between language identity and academic motivation in EMI contexts. This finding may be unsurprising, however, given the assessment above that these constructs may theoretically overlap, especially when motivation is measured according to statements about imagined selves. Derakhshan and Yin (2024) further confirmed hope's positive influence on academic engagement among Chinese and Iranian EFL students, although their operationalization of hope is based on the "Achievement Emotions Questionnaire (AEQ)" (Pekrun 2005), which does little more than ask how hopeful students are they will do well in a course, thus side-lining the long-term aspirational dimension of hope theorization. Sun and Wang (2024) extended the scope to EFL teachers and showed that hope mediates the link between grit and creativity, although their hope items included those that focused on pathways to success (e.g. 'If I should find myself in a jam, I could think of many ways to get out of it'), so the relationships with grit are perhaps unsurprising. Together, these findings underscore the multifaceted nature of hope but highlight the fact that measures of hope may overlap considerably with other psychological variables that interact with it.

One of the key components of PsyCap is self-efficacy, an individual's belief in their ability to accomplish tasks and achieve goals. Bandura (1977) proposed a theory of self-efficacy, emphasizing that individuals with high self-efficacy are more likely to set challenging goals, put forth effort to achieve them, and persevere in the face of obstacles. Moreover, self-efficacy is described as an individual's belief in their capability to mobilize the necessary motivation, cognitive resources, and actions to effectively perform a specific task within a given context (Stajkovic and Luthans 1998). Similarly, Luthans et al. (2007) defined self-efficacious individuals as those who are able to adopt stepwise techniques in a specific domain based on their practice and mastery, explain and discuss sub-goals (each step) with the community, learn from peers' success, and receive positive social reinforcement to boost their confidence. In EMI contexts, self-efficacy is important because students usually perform cognitively demanding tasks, such as delivering oral presentations, reading disciplinary texts, and writing academic essays in a second language. High self-efficacy enables students to approach these tasks with confidence and persistence, while low self-efficacy may exacerbate language anxiety and hinder participation.

Although self-efficacy has been widely examined in L2 contexts, direct evidence from EMI settings remains uneven. In EFL research, Wu and Kang (2023) validated a domain-specific scale for EFL PsyCap, establishing self-efficacy as a core component among Chinese secondary school students. Self-efficacy was found to positively predict students' engagement, enjoyment, and academic achievement, while buffering against boredom and anxiety. Similarly, Zhou et al. (2024)

found that Chinese students' self-efficacy in listening to EMI content increased during their first semester at a transnational university. Improved self-efficacy was supported by successful experiences and strategies for managing negative emotions, while motivation shifted between intrinsic and extrinsic goals over time. However, Soruç et al. (2024) found that self-efficacy, along with other non-linguistic factors, increased among EMI students over four years. Yet changes in self-efficacy did not significantly predict academic success. Instead, improvements in English proficiency and instrumental motivation were the strongest predictors of EMI achievement. However, other studies, such as Thompson et al. (2022) and Sahan et al. (2023), confirmed self-efficacy as a reliable predictor of test performance and language-related academic challenges, respectively.

Taken together, these mixed findings suggest that self-efficacy does not operate uniformly in EMI and may depend on other psychological, motivational, and linguistic factors that unfold over time. Existing research, however, rarely examines self-efficacy alongside other psychological resources or models its reciprocal or delayed effects on academic performance. A longitudinal PsyCap framework may clarify how multiple psychological strengths develop and jointly shape EMI learners' academic adaptation.

Resilience, defined as the ability to persist and recover from setbacks (Duckworth et al. 2007), is central to PsyCap. Luthans et al. (2007) emphasized that resilient individuals leverage personal assets and proactively address obstacles to achieve goals. For EMI students, resilience may take effect when they encounter multiple layers of challenge: adapting to unfamiliar pedagogical styles, managing linguistic and cultural barriers, and responding to academic setbacks. Research on EMI has shown that students who demonstrate resilience are more likely to re-engage after failure, adjust strategies, and continue to make progress (Evans and Morrison 2017). In this sense, resilience not only supports immediate academic survival but also underpins long-term adaptation to the sustained demands of EMI programs.

Although resilience has been increasingly examined in L2 education, direct investigations within EMI contexts remain scarce. Most existing studies have been conducted in EFL settings, offering valuable, yet only partially transferable insights into how resilience may function in linguistically demanding academic environments. For example, Kim et al. (2018) investigated the influence of resilience on EFL (de)motivation and proficiency among Korean elementary school students. The findings reveal that resilience indirectly affects English proficiency by influencing EFL motivation and demotivation, with demotivation playing a dominant role in language achievement. Similarly, Liu et al. (2025) demonstrated that resilience, comprising self-regulation, sociability, and empathy, enhances academic achievement and indirectly improves it by reducing anxiety among Chinese senior high school students. The findings highlight the crucial mediating role of anxiety, suggesting that resilience fosters academic success not only through emotional regulation but also by cultivating adaptive social and self-management skills. Additionally, Derakhshan and Fathi (2025) demonstrated that perceived teacher support significantly enhances EFL learners' resilience, or academic buoyancy, thereby reducing L2 boredom and improving foreign language achievement. The findings underscore the importance of fostering both supportive teacher–student relationships and students' psychological resilience to optimize language learning outcomes.

These studies emphasize that resilience plays a multifaceted role in shaping L2 learning outcomes by mitigating negative emotions, sustaining engagement, and enabling adaptive coping. However, these insights stem largely from EFL classrooms; they do not capture the distinctive pressures of EMI, where students must navigate domain-specific knowledge, academic literacy, and disciplinary communication simultaneously. Additionally, unlike the mixed pattern observed for self-efficacy, most resilience-related findings remain broadly positive. However, this may reflect the scarcity and limited scope of existing EMI research rather than a genuinely consistent effect. As such, the direct influence of resilience on performance in EMI remains empirically underexplored.

Optimism describes an individual's mood or attitude related to an expectation about the social or material future, and this expectation tends to be socially satisfactory, to their advantage, or for

their desire (Tiger 1979). Similarly, optimism is characterized by a positive outlook on the future and the expectation of favorable outcomes. Seligman et al. (2006) introduced the concept of learned optimism, suggesting that individuals can develop a more optimistic outlook through cognitive restructuring and positive thinking. Luthans et al. (2007) describe the development of optimism as building confidence in generating pathways and planning to overcome obstacles. This process laid the groundwork for fostering generally positive expectations and boosting optimism both individually and within the group. By this definition, the researchers consider optimism in EMI contexts to be the ability to create pathways and strategies for overcoming difficulties, which serves as a basis for cultivating overall positive anticipations. When students feel assured about their capability to recognize and plan for overcoming obstacles, their outlook on achieving their learning goals is improved. Meanwhile, students' surrounding community may further boost positive outlooks when individuals observe other members sharing similar expectations and planning for success.

Many studies (Byun et al. 2011; Costa 2017; Galloway et al. 2017) have found that teachers or students hold positive attitudes toward EMI and are generally convinced of its advantages for achievement. However, little empirical evidence has been presented to demonstrate the relationship between individual-level optimism and academic performance. One possible explanation is that optimism is often treated as a trait-like disposition, which may make it less visible in studies focusing on short-term academic adjustment. Yet optimism may still influence EMI learning by shaping how students interpret setbacks, formulate expectations about future success, and engage in self-regulatory behavior—processes that may align with the expectancy–value theory (Eccles and Wigfield 2020). Optimism can be understood as a positive expectancy of future success that sustains students' motivation to engage with demanding EMI tasks. For instance, students with higher optimism may attribute difficulties to modifiable factors (e.g. effort, strategy use) rather than fixed ability, thereby sustaining motivation over time. The relative lack of research on optimism in EMI thus not only represents a conceptual gap but also obscures how optimism interacts with other PsyCap dimensions to influence academic engagement and well-being. These theoretical gaps underscore the need for longitudinal approaches that capture how optimism and other psychological resources jointly evolve and contribute to students' long-term adaptation.

As the reviewed studies suggest, PsyCap has the potential to be situated within the wider L2 affective and EMI literature by offering a more integrated perspective on constructs that have traditionally been studied in isolation. While these studies have generated valuable insights, few offer an integrative lens to capture how multiple psychological factors interact and evolve over time. Including many individual emotion variables in a single model may increase statistical complexity and obscure shared variance. PsyCap is proposed in this study as a way to address this shortcoming by offering a resource-based, state-like framework that synthesizes key emotional and motivational dimensions while remaining sensitive to developmental change. This is also relevant to EMI contexts, which place dual demands on students: mastering disciplinary content and academic English. Moreover, recent longitudinal studies (e.g. Elahi Shirvan and Talebzadeh 2018; Elahi Shirvan et al. 2021) have underscored the fluctuating nature of L2 emotions, further supporting the use of theoretical frameworks, such as PsyCap, to track growth and explain achievement patterns in EMI settings.

The hypothesized model

Based on the PsyCap framework and empirical findings, this study examines the growth in PsyCap and its relationship with academic achievement across four time points over two years, as illustrated in Fig. 2. In this model, PsyCap is represented by its intercept (initial level) and slope (rate of change), while academic achievement is measured by its intercept (initial performance) and slope (growth). The model investigates how initial levels and growth in PsyCap predict academic achievement in EMI contexts. The residuals (a1-2 and g1-4) represent unexplained variance in these growth trajectories, with arrows indicating the hypothesized predictive relationships.

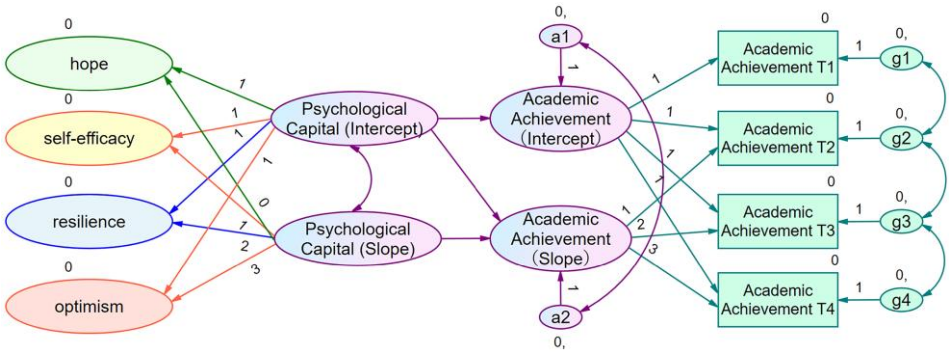

Figure 2. A hypothesized multivariate LGCM of the effect of PsyCap on academic achievement.

Methodology

Research questions

This study is driven by the following research questions (RQs):

RQ1: How does the relationship between PsyCap and academic achievement change over two years of EMI?

RQ2: Given the exploratory nature of the research, a secondary qualitative research question is also posed: How do students perceive the role of PsyCap in shaping their academic performance?

Context, participants, and procedure

The study was conducted at a public university in China, which is one of the national pilot institutions for EMI reform in medical education. It was selected for its integration of EMI courses within the medical and health sciences curriculum. Rather than offering centralized EMI programs, the university embeds EMI within undergraduate courses, both required and elective. Each student was typically enrolled in one to three EMI courses per semester. To support students' adaptation to the EMI environment, the university regularly organizes workshops on academic resources and learning strategies. Faculty members also receive professional development sessions focused on EMI pedagogy to enhance instructional quality. In addition, all undergraduate students are required to take English for Academic Purposes courses tailored to medicine-related fields. These institutional features may have shaped students' EMI experiences, facilitated their access to support, and influenced the development of their psychological resources.

A voluntary sampling strategy was employed to recruit participants at the end of their first semester. The participants were 489 first-year Chinese EFL students (325 males and 164 females; *M* age = 18.20) across ten medicine-related majors who completed this longitudinal survey. Among these participants, 15 students volunteered for follow-up interviews, with a majority from clinical medicine. Nine students were ultimately selected from these 15 to ensure diversity across study majors (see Table 1). These nine covered seven of the 10 majors within medical sciences. Because of the substantial overlap in first-year course content across some medicine-related majors, two participants were selected from clinical medicine and two from pharmacy to strengthen the breadth and comparability of the qualitative sample. The nine interviewees were those who voluntarily completed all four waves, providing full developmental trajectories and thus information-rich cases to complement the quantitative findings. All participants began their participation in their first year of undergraduate study, which helped minimize the influence of prior EMI exposure on learning outcomes. The selection of participants reflects the prominence of EMI

Table 1. Participants and exemplar quotations.

#	Major	Pseudonym	Gender
1	Biotechnology	Adam	Male
2	Clinical Medicine	Bella	Female
3	Clinical Medicine	Chloe	Female
4	Medical Imaging	Diana	Female
5	Pharmacy	Ella	Female
6	Pharmacy	Frank	Male
7	Chinese Pharmacy	George	Male
8	Anesthesiology	Hannah	Female
9	Preventive Medicine	Ivy	Female

provision in medical education in China, where students face the dual challenge of complex disciplinary knowledge and specialist terminology in English.

All participants had passed a standardized English proficiency qualification test prior to course enrollment and had received at least 6 years of formal English education during secondary school. All participants' first language was Chinese. Data collection consisted of a questionnaire including PsyCap measurements and semi-structured interviews. These were conducted at four time points: February 2023, August 2023, February 2024, and August 2024. The longitudinal design enabled the researchers to track potential changes in students' EMI learning experiences and perceptions across different academic semesters.

Instruments

This study adopted a mixed-methods sequential explanatory design, which involves collecting and analyzing quantitative data in the first phase, followed by qualitative data in the second phase (Ivankova et al. 2006). Specifically, quantitative data were first collected using the PsyCap-EMI scale and academic records to identify general trends and relationships regarding participants' PsyCap and EMI learning outcomes. These findings were further explored and explained through semi-structured interviews with a subset of participants. The qualitative phase aimed to elaborate on or clarify the quantitative results by gaining deeper insights into participants' EMI learning experiences. By integrating both types of data, the sequential explanatory design allowed for a deeper analysis: the quantitative phase established general patterns, while the qualitative phase provided contextual understanding and explanations for those patterns. This methodological approach is valuable when the research aims to both measure outcomes and understand the underlying processes or experiences.

The PsyCap-EMI scale (see Supplementary Appendix S1) was developed and validated by the researchers, using the same dataset as the present study. The scale and validation process are available at the project website (https://sites.google.com/view/psycap-emi). The instrument was tailored to explore how students adapt and thrive in academic environments where English is not their first language. The questionnaire is context-sensitive, capturing how learners perceive their ability to thrive academically in English-language settings, especially in non-native English-speaking regions. One of its main strengths lies in its empirical grounding and theoretical alignment with positive psychology and educational resilience frameworks.

Academic achievement measures the participants' academic performance during the first and second years. After obtaining informed consent from the participants, their academic records were retrieved from the university's student system using their student numbers. Each participant was required to take at least one EMI course in each semester. Additionally, participants

could choose 0 to 3 major-related elective courses taught in EMI. Furthermore, students could optionally enroll in 0 to 2 elective courses offered to the public.

The major-related compulsory courses include, but are not limited to, Clinical Medicine, Anesthesiology, Nursing, Biology, Traditional Chinese Medicine, Pharmacy, Immunology, and Anatomy. The major-specific elective courses include, but are not limited to, Mathematical Statistics, Physical Chemistry, and Medical Physics. General elective courses include, but are not limited to, Positive Psychology, Medical Philosophy, Cross-cultural Communication in Medicine, and Medical Communication Skills.

The qualitative data were collected via semi-structured interviews, which were chosen for their flexibility and depth, allowing researchers to explore participants' underlying perspectives that may not surface in surveys. This method enables a balance between predetermined questions and spontaneous follow-ups, facilitating deeper insights into students' experiences during longitudinal research (Selvi 2020).

The development of the interview protocols followed a structured four-step process proposed by Selvi (2020). First, a literature review established the conceptual foundation for the questions. Then, the researchers drafted an interview guide with small talk, demographic, main, and follow-up questions, organized from general to specific. Pilot interviews were conducted with five students who had completed the PsyCap-EMI scale. Feedback revealed areas needing clarification or additional prompts. Based on input from three pilot participants, the interview guide was iteratively refined to ensure clarity, relevance, and depth in capturing students' PsyCap and emotional well-being. The finalized version of the interview protocol was then adopted for all subsequent interviews in the main study and is provided in Supplementary Appendix S2.

Data analysis

The data analysis began with a confirmatory factor analysis (CFA) conducted in SPSS Amos 31.0 to validate the structure of the PsyCap-EMI scale. Structural equation modeling (SEM) was then employed to examine hypothesized relationships grounded in theory, empirical findings, and practical insights (Kline 2005). SEM enables the simultaneous analysis of multiple independent and dependent variables, making it suitable for capturing patterns in learner behavior (Wu and Rose 2025). Within the SEM framework, LGCM was applied (Kline 2005). LGCM enables researchers to model individual trajectories and inter-individual differences, thereby capturing both average developmental trends and heterogeneity across participants. LGCM is appropriate for this study because it allows examination of how changes in PsyCap and academic achievement develop longitudinally and how their growth is related. Interpreting the findings involves focusing on the significance and direction of intercept–slope relationships, which indicate how initial levels of PsyCap predict growth in academic achievement.

To assess longitudinal changes in PsyCap and its relation to academic achievement, a series of univariate and multivariate LGCMs were conducted using IBM SPSS Amos 31.0. Initially, a correlation analysis across all latent factors was conducted to capture the dynamic interplay among constructs over time. Then, separate univariate LGCMs were constructed to capture the initial status (intercept) and developmental trajectory (slope) of PsyCap and academic outcomes across four measurement points. For each model, the intercept loadings were fixed at 1, while slope loadings were set to 0, 1, 2, and 3 to reflect equal time intervals between waves. The models estimated both the means and variances of intercept and slope to account for between-person variability in initial levels and growth patterns. Covariances between the intercept and slope were also examined to determine whether initial PsyCap levels predicted the rate of change over time. A multivariate LGCM was then constructed to explore the predictive relationship between PsyCap and academic achievement trajectories. Model estimation employed the maximum likelihood method. To evaluate model fit, this study adopted commonly accepted cutoff values for structural equation modeling indices, including $\chi^2/df \leq 2$, CFI ≥ 0.95, GFI ≥ 0.90, AGFI ≥ 0.80, RMSEA ≤ 0.08, NNFI ≥ 0.90, and IFI ≥ 0.90 (Schumacker and Lomax 2004).

Finally, the interview data were transcribed by the researchers and processed and coded by NVivo 15. The coding and analysis procedures consist of structuring with data-driven coding according to PsyCap constructs (setting primary categories), and generating via data-driven coding (setting subcategories for each primary category) (Selvi 2020). The coding process is thus both theory-driven at the top level and data-driven at the sub-level, meaning that the decision of the primary categories is informed by the overarching theoretical frameworks reviewed in the Literature Review, and the relevance and commonalities of the qualitative data decide the subcategories. The coding scheme is provided in Supplementary Appendix S3.

Ethical considerations

This study follows the guidelines proposed by the British Educational Research Association (BERA) (2018). This study involves collecting various identifying data, including participants' student numbers, grades, psychometric data, demographic information, contact details, and voice recordings. The data collected from the participants were de-identified to protect their confidentiality and privacy after all data collection procedures were completed. Participants were assigned unique participant numbers; no identifying information, such as names or contact details, is included in the research dataset. After de-identification, the original individuals cannot be traced.

Results

Descriptive data and correlation coefficients

Figure 3 presents the means, SDs, normality (skewness and kurtosis), and correlation coefficients for the PsyCap-EMI variables across four time points. For clarity, variables such as "hope1" represent the statistical values of the Hope dimension of PsyCap at Time 1 (t1). The mean trajectory for each wave is indicated by a red triangular marker along the central trend line in each violin plot. As suggested by Lorenz et al. (2004), accurate modeling of growth trajectories assumes that correlations between adjacent measurement points (i.e. t and $t+1$) are stronger than those between non-adjacent points. This assumption was supported by the data, which showed that, across all constructs, correlations between successive time points were consistently higher, indicating strong temporal stability. Moreover, the mean scores for each construct showed a steady upward trend over time, suggesting that participants' levels of hope, self-efficacy, resilience, and optimism gradually increased across the four semesters. Meanwhile, the distribution of the data met the criteria for normality, with skewness values ranging from −0.805 to −0.155 and kurtosis values ranging from −0.339 to 1.405, both well within the acceptable thresholds of ±2.00 for skewness and ±4.00 for kurtosis (Bentler 1995). These findings provide a robust foundation for the latent growth curve modeling and offer a clear depiction of the positive developmental trajectories in PsyCap.

CFA

CFAs were conducted to assess the structural validity of each PsyCap dimension across four time points. All four models demonstrated acceptable fit, supporting the factorial validity of the subscales. Detailed model fit indices are presented in Supplementary Appendix S4.

LGCM

LGCMs were estimated to examine the longitudinal trajectories of PsyCap and academic achievement. Results indicated that both PsyCap and academic achievement exhibited significant upward trends over time, with substantial individual variation in initial levels and growth rates. These findings justify the use of parallel-process modeling to examine the associations between PsyCap and academic achievement. Full parameter estimates are reported in Supplementary Appendix S5.

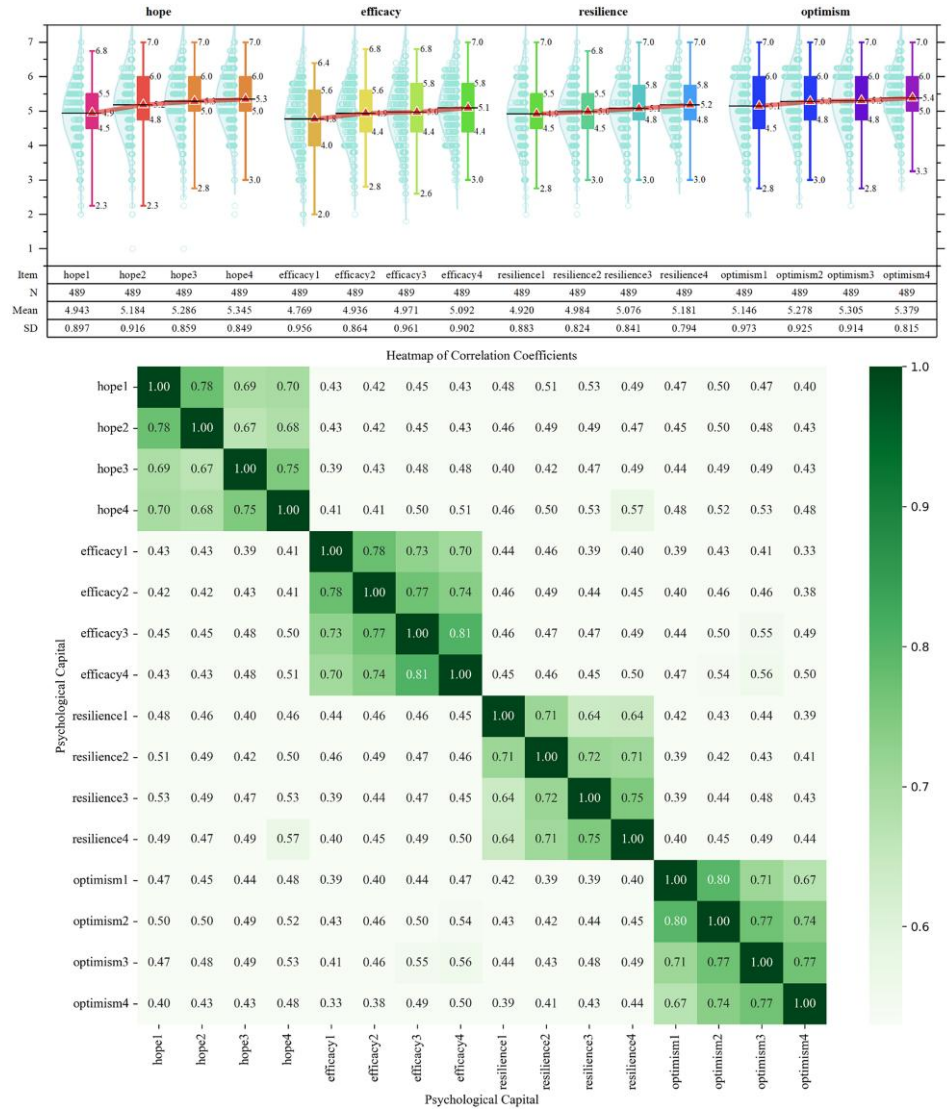

Figure 3. Descriptive data and heatmap of correlation coefficients.

Parallel process modeling of PsyCap and academic achievement

To address RQ1 and examine the longitudinal interplay between PsyCap and academic achievement, a parallel process latent growth curve model was estimated. This model assessed the covariances and directional relationships between the growth parameters (intercept and slope) of both constructs. The model demonstrated a satisfactory fit to the data: $\chi^2(2475) = 4157.967$, $\chi^2/df = 1.680$, $P = 0.000$, CFI = 0.935, IFI = 0.935, TLI = 0.932, and RMSEA = 0.037. These indices indicate that the model captures students' psychological and academic development. The high CFI/TLI values indicate that the model structure aligns well with the actual data patterns, while the low RMSEA value indicates minimal approximation error. This means that the reported slopes and trajectories can be interpreted with confidence.

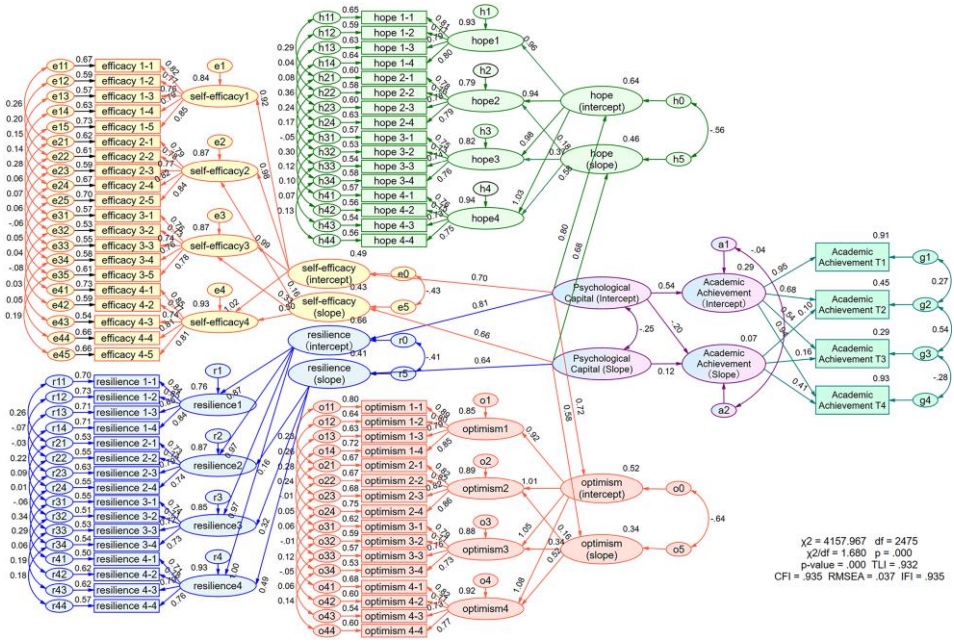

Figure 4. Parallel process latent growth curve model of PsyCap and academic achievement. (*Note:* The labels such as hope1-1 refer to the first item of the hope dimension in the first measurement round (T1), with the second "1" indicating the item number. Labels like h11-h44, e11-e44, r11-r44, and o11-o44 represent the residuals at different time points.).

As shown in Fig. 4, the correlation between the intercept and slope of PsyCap was significantly negative ($r = -0.25$), implying that students who began with higher PsyCap experienced less growth in PsyCap over time, and students with lower initial levels of psychological capital tended to exhibit greater growth in psychological resources over time.

The intercept of PsyCap was significantly and positively associated with the intercept of academic achievement ($\beta = 0.54$), indicating that students with higher initial levels of PsyCap also tended to exhibit higher initial levels of academic performance. Conversely, students with lower initial psychological capital were more likely to demonstrate lower academic performance at the beginning of the program.

Interestingly, the intercept of PsyCap was negatively associated with the slope of academic achievement ($\beta = -0.20$), although the effect was relatively weak. This result suggests that students with higher initial psychological capital tended to exhibit slower gains in academic performance over time. Conversely, students who started with lower levels of psychological capital and correspondingly lower academic performance may have demonstrated greater academic growth as they adapted to the challenges of EMI learning.

Finally, the slope of PsyCap was positively associated with the slope of academic achievement ($\beta = 0.12$), suggesting that students who experienced greater increases in psychological capital over time also tended to demonstrate more improvements in their academic performance, and vice versa. These patterns underscore the dynamic interplay between psychological resources and academic success, emphasizing that sustained development, rather than static traits, is crucial for long-term achievement in EMI courses.

Heterogeneity of the model

Heterogeneity describes the diversity of developmental patterns observed among individuals (Guyatt et al. 2011). In the present study, significant variances in the intercepts and slopes of

Table 2. Longitudinal measurement invariances.

	CFI	TLI	RMSEA	ΔCFI	ΔTLI	ΔRMSEA
Configural invariance	0.915	0.913	0.030	/	/	/
Metric invariance	0.915	0.913	0.030	0.000	0.000	0.000
Scalar invariance	0.915	0.913	0.030	0.000	0.000	0.000
Residual invariance	0.910	0.911	0.031	−0.005	−0.002	0.001

both PsyCap and academic achievement suggest individual differences in students' baseline levels and rates of change over time. These findings confirm that students do not follow a uniform developmental path; instead, their growth trajectories vary, with some students exhibiting accelerated increases and others showing relatively stable or slower changes.

In addition, longitudinal measurement invariance testing was conducted to ensure the validity of the constructs across the four time points. This process ensures that the same constructs are measured consistently across time points, enabling reliable comparisons. Results in Table 2 indicated that configural, metric, scalar, and residual invariance were successfully established, as the changes in model fit indices (ΔCFI, ΔTLI, and ΔRMSEA) across nested models remained below the commonly accepted threshold of 0.01 (Cheung and Rensvold 2002; Klassen et al. 2023). This supports the interpretation that both PsyCap and academic achievement were measured equivalently across time, and that any observed individual variability in growth reflects true developmental heterogeneity rather than measurement artifacts.

These heterogeneous developmental patterns also have essential pedagogical implications. Students who begin with lower PsyCap or show slower growth may require targeted scaffolding and structured mastery experiences. In contrast, those with faster improvement may benefit from more advanced challenges to sustain engagement. Recognizing these differentiated trajectories allows EMI instructors to tailor support more effectively rather than relying on uniform instructional approaches.

Qualitative results

To contextualize the longitudinal quantitative findings and address RQ2, qualitative analyses were conducted at within-case and across-case levels, following the mixed-methods sequential explanatory design (Ivankova et al. 2006). Interviews were audio-recorded and transcribed verbatim. Their sustained participation ensured complete longitudinal narratives, which offered vivid, context-rich insights into their psychological and academic experiences. Analyzing these accounts revealed diverse developmental trajectories, consistent with the LGCM results, and highlighted the heterogeneous ways in which PsyCap unfolded across individuals.

Theme 1 (Individuals' Divergent Trajectories of PsyCap): The negative covariance between the intercept and slope of PsyCap ($r = -0.25$) highlights that students with higher initial levels of PsyCap tended to experience less growth or even a decline over time, while students with lower initial levels of PsyCap tended to exhibit greater growth in psychological resources over time. Qualitative data further illustrate this heterogeneity. For instance, Adam's (Biotechnology, male) optimism decreased over the four time points (5.75, 5.5, 5.75, 5.25) with fluctuations in between. They noted at Time 4,

> *"My optimism gradually decreased, with some fluctuations, because I believe excessive optimism isn't always a good thing. I have a sense of caution. Additionally, as the difficulty of my courses increased, my optimism also slightly declined."*

In contrast, Bella's (Clinical Medicine, female) self-efficacy showed an upward and stable trend (3.8, 4, 5, 6) with their reflection at Time 4:

"At the beginning, I felt that the people around me were so impressive, and I lacked confidence […] *When teachers assigned oral discussions or debates, I was afraid of speaking up* […] *Now, I'm still working hard on this, and although I haven't reached my full potential yet, I feel more efficacious."*

These interview insights are consistent with the negative correlation between the intercept and the slope, suggesting that students with higher initial PsyCap levels might experience slower growth or even a decline over time, as seen in Adam's case. Conversely, Bella's steady increase in self-efficacy indicates rapid growth. This further emphasizes the complex, individualized nature of PsyCap development. Cross-case comparisons showed that Adam's and Bella's trajectories represented two ends of a broader pattern: most participants (seven out of nine) exhibited nonlinear or uneven PsyCap development rather than uniform growth across components.

Theme 2 (PsyCap was positively associated with academic achievement at Time 1): Students with higher initial levels of PsyCap performed better in EMI courses in the first semester. This supports the quantitative finding that the PsyCap intercept was positively associated with academic achievement at Time 1 ($\beta = 0.54$). For example, Diana (Medical Imaging, Female) described how traits such as resilience helped them navigate early challenges:

"At the beginning of the semester, although I understood the course content, I was unfamiliar with many technical terms, such as those in pharmacology. I had to start from the basics, memorizing vocabulary and organizing both the Chinese and English meanings […] *In the end, I achieved a high score in this course."*

This narrative illustrates resilience, as the student adapted to a steep learning curve by persisting with vocabulary memorization and dual-language organization. It also implies a degree of self-efficacy, reflected in their confidence that consistent effort would lead to success.

Hope was also evident in Adam's reflections, "*I thought about strengthening my academic record during my undergraduate years and then making a real breakthrough when I apply for postgraduate programs.* […] *That was why I took this EMI course."* This comment demonstrates goal-directed thinking (building a stronger profile during undergraduate study) and pathways thinking (envisioning postgraduate study as an opportunity for significant advancement). It shows how hope complemented Student 1's optimism in sustaining academic motivation during the early stages of EMI learning.

Theme 3 (Psychological growth and academic improvement): Quantitative analysis revealed a positive association between the slope of PsyCap and the slope of academic achievement ($\beta = 0.12$), suggesting that students who developed greater psychological resources over time also tended to experience stronger academic gains. However, qualitative data showed that no participant reported simultaneous growth across all four PsyCap components alongside academic improvement. Instead, all students described connections between one or two dimensions and their academic progress, reflecting substantial individual variance in psychological growth.

George (Chinese Pharmacy, Male) is an example. Over four time points, this student's resilience (6.25, 5.75, 6, 6) and self-efficacy (5.6, 5.8, 6, 6) scores remained stable at a high level, while their academic performance also improved (84, 88.4, 85, 87). Their narrative revealed how resilience and self-efficacy played a key role in academic development:

T1: *"Some of my classmates are very smart. When the teacher lectures, they responded extremely quickly. I couldn't adapt to lecturers' accents at first* […] *I couldn't respond right away.* […] *That's why I work very hard."*

This reflection shows low initial self-efficacy, with a sense of distance from teacher-student interaction. The student contrasted their performance with that of high-achieving peers and compensated through effort, a sign of resilience beginning to form despite challenges.

T2: *"In the second semester, I might have relaxed a little. I felt I could follow the teachers better, and my grades are better."*

By the second time point, the student began to show signs of improved self-efficacy, suggesting adaptation to EMI instruction and increased linguistic confidence.

> T3: *"After class, I would review what I had learned that day. At first, I would prepare in advance, like deciding what question to ask, then use a translation tool to translate the question and memorize it before asking the teacher."*

This quote reflects increasing self-regulation and resilience. Although full comprehension remained difficult, the student developed strategic approaches, such as preparation, translation, and rehearsal, to maintain academic participation in EMI courses.

> T4: *"This semester, I attended classes and took on an internship. My academic performance didn't decline because of the internship; in fact, it improved* […] *I agree that the more hardworking and resilient a person is, the better their academic performance might be. But it depends on the individual. Even if it's proportional, the slope is different. Some people may see a big leap in academic performance as their resilience increases. But others may see only gradual progress, even with strong resilience. For me, I think I'm the latter type."*

This final reflection shows academic coping strategies and strong resilience. Despite increased responsibilities, the student maintained academic performance and adopted external support tools to overcome time and comprehension constraints. Overall, this case demonstrates the positive relationship between PsyCap growth and academic improvement, as indicated in the quantitative model. Rather than showing growth across all four components, this student's reflections reveal deep engagement with resilience and self-efficacy, which helped them navigate the challenges of EMI study. Across the dataset, no case demonstrated simultaneous growth in all four PsyCap components, but several, like George, showed improvement in one or two components that aligned with their academic gains, reflecting the heterogeneous nature of the PsyCap–achievement combination.

Theme 4 (Pressures and fatigue: When high PsyCap doesn't guarantee academic growth) Quantitative analysis revealed a weak but negative association between the intercept of PsyCap and the slope of academic achievement ($\beta = -0.20$). This finding suggests that students with higher initial levels of PsyCap tended to demonstrate less academic improvement over time. Chloe (Clinical Medicine, female) reported a high initial level of PsyCap (6.26 at T1), and their academic scores remained relatively stable but showed little upward momentum over time (80, 78.2, 80.4, 79) at T4:

> *"I think that no matter what happens, my mindset when I review before exams each semester is about the same, all quite positive. In the first year, I was studying normally, and I think I wasn't hardworking, nor did I have a clear direction. Then, in the first year, I got a small scholarship. Then in the second year, I worked harder. I felt a lot of pressure because I wanted to get bigger scholarship. But the grades in that semester were bad. I felt a bit burned out. Then in the fourth semester, I studied kind of in a 'slacking off' way."*

This reflection indicates that Chloe's generally positive mindset reflects trait-like optimism, but this form of optimism did not translate into adaptive coping or sustained engagement as academic pressure increased. Her experiences of burnout and declining effort suggest limited resilience development, as she struggled to persist when confronted with rising expectations. In PsyCap terms, Chloe entered the course with high initial optimism but did not build the corresponding resilience or self-efficacy needed to maintain academic growth. This helps explain why students with higher initial PsyCap may show weaker improvement over time, highlighting the distinction between static psychological strengths and adaptive psychological development. Across cases, participants with high initial PsyCap did not universally show declining achievement, but Chloe's experience illustrates a recurring pattern among several students who struggled to convert trait-like positivity into adaptive, sustained effort under academic pressure.

Discussion

Interpretation of the growth of PsyCap and academic achievement

Both PsyCap and academic achievement showed growth over the 2-year period, suggesting that students gradually developed greater psychological resources and academic outcomes. This finding is consistent with previous research by Li et al. (2023) and Sweet and Swayze (2023), indicating that PsyCap is positively linked to academic performance. The negative link between initial PsyCap and subsequent growth indicates a ceiling effect, suggesting that students with high initial levels had little room to improve. This situation was also reported in Salanova and Ortega-Maldonado (2019), where participants' initial PsyCap levels were already near the upper limit at the pre-test, making it almost impossible to see further significant development through the intervention. It also mirrors findings from Harty et al. (2016), where participants with lower baseline PsyCap improved more sharply than those who initially scored higher. Likewise, students with higher initial PsyCap demonstrated slower academic improvement, possibly because their early advantage left less room for further visible progress. In contrast, students who strengthened their PsyCap during the program achieved greater academic achievement, reinforcing arguments that continuous psychological development, especially in self-efficacy, plays a critical role in sustaining academic success under the linguistic and cognitive demands of EMI programs (Thompson et al. 2022).

These findings extend previous work by suggesting that it is not merely the initial level of PsyCap but its growth over time that meaningfully supports academic achievement in EMI settings. This dynamic view complements positive psychology perspectives (Seligman 2002) and underscores that in EMI contexts, sustaining success requires not only language and academic skills but also the continuous cultivation of psychological strengths to manage the dual demands of language and discipline learning. While prior EMI studies have examined individual constructs such as hope or self-efficacy in isolation, they often lacked a unifying theoretical lens, resulting in fragmented understandings of learner psychology. By adopting PsyCap as an integrative framework and employing a longitudinal design, the present study moves beyond these *ad hoc* approaches, offering a more systematic account of how multiple psychological resources jointly develop and interact with academic achievement in EMI contexts.

Changing relationship between PsyCap and academic achievement

The results showed that students with higher initial levels of PsyCap achieved better academic outcomes at the beginning of the courses, consistent with prior studies identifying PsyCap as a significant predictor of early academic adjustment (Luthans et al. 2012; Khajavy et al. 2019). In EMI environments, where students must simultaneously master subject content and academic English, initial psychological strengths such as self-efficacy and resilience likely played a key role in facilitating early academic adaptation (Thompson et al. 2022; Zhang and Dai 2024). However, the negative association between initial PsyCap and academic growth suggests that early advantages may not ensure continued improvement without ongoing development, reflecting similar patterns in EMI research where static competencies are insufficient to cope with evolving academic challenges (Jiang et al. 2019).

A contribution of this study is the observation that growth in PsyCap, rather than its initial magnitude, appears more closely associated with longer-term academic development across EMI courses. Students who expanded their psychological strengths over time achieved greater academic gains, highlighting the importance of fostering adaptability in settings where language, content mastery, and intercultural adjustment are simultaneously required (Zhou et al. 2025). These results suggest that EMI support strategies should move beyond language training alone to incorporate psychological resource development as a key component of academic success.

Students' perceptions of the role of PsyCap

While the survey data showed a general increase in PsyCap across four semesters, students' narratives suggested a more fragmented, context-sensitive process. Most notably, no interviewee

reported parallel development of all four PsyCap components, echoing the person-specific variability observed in other recent EMI studies (Zhou et al. 2025).

Resilience and self-efficacy emerged as the most salient components in students' responses. Three even described resilience as their primary resource when coping with stress, academic setbacks, or performance pressure. This was particularly evident among students who experienced a significant decline in grades but recovered by adjusting their strategies. Their narratives reflected an active process of bouncing back and re-engaging with learning, consistent with the construct of resilience as adaptive capacity in adverse contexts (Connor and Davidson 2003). Self-efficacy was similarly foregrounded, often described as a growing sense of competence in performing EMI tasks, such as delivering oral presentations or reading academic articles in English. Three students reported that increased exposure to EMI tasks and a growing familiarity with academic expectations contributed to an upward spiral of belief in their capabilities, echoing Bandura's (1977) theory of mastery experience. These insights are consistent with quantitative studies identifying self-efficacy as a strong predictor of engagement and EMI academic success (Thompson et al. 2022; Sahan et al. 2023; Hsu 2024). Importantly, resilience and self-efficacy often interacted. Students felt more confident because they had recovered from failure, and they could recover more effectively because they believed in their abilities.

In contrast to resilience and self-efficacy, hope and optimism were less frequently directly mentioned and often linked to distant aspirations rather than concrete academic strategies. While quantitative data showed modest growth in these dimensions, interviews suggested they were less instrumental in students' everyday learning. Optimism appeared more trait-like, which may explain its weaker association with academic achievement (Sweet and Swayze 2023). As Adam observed, "*excessive optimism isn't always a good thing*," noting their underlying anxiety that too much optimism might lead to complacency and insufficient preparation for future academic challenges. Such reflections indicate that hope and optimism may function more as background traits, gradually internalized but less visible in self-reflection, highlighting the importance of integrating survey data with qualitative insights to reveal both measurable trends and lived experiences.

Overall, these findings reinforce the importance of a person-centered approach to understanding PsyCap development. In EMI contexts where academic demands and language challenges intersect, students rely on different PsyCap dimensions at different stages, often driven by context-specific needs rather than linear growth. This echoes the work of Soruç et al. (2024), who emphasize the necessity of mixed-method, longitudinal approaches to fully capture the evolving psychological landscapes of EMI learners.

Contributions to applied linguistics research

This study deepens the integration of PsyCap into L2 learner psychology by positioning it as a resource-based framework that synthesizes key constructs previously studied in isolation. Whereas prior L2 affective research has focused heavily on discrete emotional experiences, such as hope (Zhou et al. 2025), anxiety or enjoyment (Dewaele and MacIntyre 2014), grit (Takezawa 2022), and self-efficacy (Zhou et al. 2024), PsyCap foregrounds the psychological capacities that enable learners to regulate those emotions, persist through difficulty, and sustain engagement over time. The present findings confirm that growth in these capacities, particularly self-efficacy and resilience, is closely tied to academic adaptation in EMI, supporting Bandura's (1977) view that mastery experience plays a central role in agentic development. Moreover, the observed ceiling effects and component-specific growth patterns echo recent research highlighting the context-sensitive, non-uniform nature of psychological development (Chen 2022). These insights extend the relevance of PsyCap beyond its origins in organizational psychology, reinforcing its utility for modeling how psychological resources can be cultivated in linguistically demanding academic environments such as EMI.

Pedagogical implications

This study suggests that EMI pedagogy should support not only language and content learning but also the psychological resources that sustain achievement. To strengthen resilience, instructors

can embed narrative-based case studies where students recount and analyze how they overcame academic or linguistic setbacks. Peer mentoring programs, goal-setting exercises, and weekly reflective journaling may help students normalize difficulty and develop adaptive strategies. Resilience training can also be introduced through light-touch workshops or classroom discussions on managing performance pressure and academic disappointment. Although hope and optimism were less prominently reflected in student narratives, they remain pedagogically relevant. To cultivate hope, teachers can introduce pathway-thinking activities that guide students to set academic goals, anticipate obstacles, and generate alternative strategies. Optimism may be nurtured through future-oriented writing prompts or classroom exercises where students envision successful application of EMI learning in internships, medical careers, or postgraduate study. Peer appreciation rounds or "strength spotting" discussions can help build a supportive and hopeful learning environment. Feedback may focus on strategies and effort rather than only outcomes. Activities such as peer mentoring, goal-setting, and reflective journaling can help students normalize setbacks and strengthen resilience.

These recommendations are reinforced by our quantitative and qualitative evidence. The negative association between initial PsyCap and academic growth ($\beta = -0.20$) suggests that high early resources do not automatically guarantee continued progress, a finding echoed by students who described the difficulties of memorizing extensive terminology or using translation tools to participate in class. Similarly, while slopes of PsyCap and achievement were positively related ($\beta = 0.12$), interviews revealed that sociocultural pressures, such as scholarship maintenance, employment prospects, and internship anxiety, sometimes blunted these gains, leading to fatigue or burnout. Finally, the heavy terminology and high-stakes assessment ecology of medicine-related EMI courses appeared to magnify the importance of resilience and self-efficacy, partially explaining their stronger salience relative to hope and optimism. Taken together, these insights suggest that effective EMI pedagogy may benefit from the integration of psychological scaffolding into everyday instruction, faculty collaboration, and program design, ensuring that PsyCap growth is actively cultivated alongside language proficiency and disciplinary knowledge.

Institutional and policy implications

The findings suggest that institutions should consider integrating psychological support into broader educational policy and curriculum design. Professional development for EMI instructors can include training on fostering students' self-efficacy, resilience, hope, and optimism. As many EMI faculty report limited preparation in addressing students' affective needs (Zhou 2025), PsyCap-informed professional development may enhance their ability to respond to students holistically.

At the curricular level, EMI programs could embed reflective tasks or co-curricular modules to strengthen psychological resources. This is particularly important in high-stress fields such as medicine, where students face cognitive and emotional pressures in a second language. At the policy level, institutions may invest in linguistically and culturally sensitive counseling services and track psychological well-being alongside academic performance. These measures align with calls to build inclusive and equitable EMI learning environments (De Costa et al. 2021). Overall, supporting PsyCap development at multiple levels can help EMI students thrive academically and psychologically in demanding environments.

Conclusion

This study examined the dynamic relationship between PsyCap and academic achievement in EMI courses over 2 years, combining quantitative and qualitative approaches. Findings revealed that initial levels of PsyCap were linked to early academic success, and the growth of psychological resources was also closely associated with sustained academic improvement. Additionally, qualitative analyses showed that students perceived PsyCap as a multifaceted active emotional

resource that enhanced their ability to navigate academic challenges, manage workload, and maintain consistent performance under the dual pressures of language and content learning in EMI environments. Taken together, these results offer one of the first longitudinal, mixed-method accounts of PsyCap development in EMI higher education, extending existing research by demonstrating its dynamic and context-dependent role in student success.

Several limitations should be acknowledged when interpreting the findings of this study. First, the sample was drawn from students enrolled in EMI courses at one university, which may restrict the generalizability of the results to other educational contexts or linguistic backgrounds. Future research could include a wider range of institutional settings and disciplinary areas to enhance external validity. Second, although LGCM reveals developmental trends and links between initial levels and growth, its observational nature limits causal claims. While stronger than cross-sectional designs, it cannot rule out alternative explanations. Future studies could use quasi-experimental or intervention designs to further test PsyCap's causal role in academic achievement by targeting its malleable aspects. Third, although PsyCap was measured with validated scales and complemented by qualitative interviews, the reliance on self-reported data may introduce biases related to social desirability or self-perception. Future studies could integrate teacher evaluations, academic records, or behavioral indicators to triangulate findings.

Future research could explore how factors, such as fluctuations in academic English proficiency, sociocultural adaptation, instructional quality, and peer academic support, interact with PsyCap to shape long-term academic trajectories. In addition, the application of more advanced longitudinal models, such as latent transition analysis or growth mixture modeling, may provide deeper insights into the heterogeneous developmental patterns of EMI learners' psychological resources and academic outcomes over time.

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Supplementary data

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