Linguistic and non-linguistic factors impacting EMI academic success: a longitudinal study

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Abstract

This study explored changes in English language proficiency and several non-linguistic factors during four years of English medium instruction (EMI) in two academic disciplines in a Turkish university setting. Moreover, it also investigated whether changes (if any) had a predictive impact on the academic success of EMI students. In addition, potential differences between disciplines were also investigated. The participants were 241 EMI students from Business Administration ($n = 117$) and Mechanical Engineering ($n = 124$) programmes. Our findings revealed that in addition to the language proficiency scores, various non-linguistic factors, including self-efficacy, ideal L2 self, motivation, self-regulation skills, and anxiety levels, changed throughout EMI education. However, only English proficiency and instrumental motivation emerged as positively significant predictors of EMI success.Our findings also revealed that the increase in participants' intrinsic motivation scores was a significant negative predictor of EMI success. These results are discussed and implications are given regarding the impact of linguistic and non-linguistic factors in EMI contexts.

Keywords EMI · Longitudinal · English language proficiency · Individual differences · Motivation · Self-regulation · Self-efficacy

Introduction

Recent research reports a remarkable increase in the prevalence of English-taught programs in non-Anglophone higher education (Galloway & Ruegg, 2020; Lei & Hu, 2022). These studies affirm that the utilization of English as the medium of instruction (EMI) for delivering academic content in higher education is now a prevalent and established practice in various non-Anglophone regions. The recent surge of interest in EMI programs can be attributed to the potential advantage of concurrently achieving two objectives, colloquially referred to as "killing two birds with one stone." This implies the simultaneous development of both subject-specific knowledge and English language proficiency (Hu & Lei, 2014).

In order to examine how the 'two birds, one stone' argument works in practice, recent research in EMI has adopted a longitudinal lens and examined development and/or change on both the linguistic and non-linguistic levels. For example, at the linguistic level, Yuksel et al. (2023a), Wei (2022), and Pu et al. (2022) longitudinally examined language development or the development of some linguistic structures after/during EMI studies. Similarly, Zhou and Thompson (2023) and Zhou et al. (2023) examined the development of students' self-regulated listening strategies, self-efficacy and motivational beliefs longitudinally. Building on these previous studies, this study examines the increase and/or change in some linguistic (i.e., English) and non-linguistic (i.e., ideal second language (L2) self, self-efficacy, motivation, self-regulation skills, and language learning anxiety) characteristics of four-year undergraduate EMI students. We also examine whether changes (if any) have an impact on the academic success of EMI students. In addition, any differences between disciplines were also investigated.

Literature review

Cost-effectiveness in EMI

The growing popularity of EMI in higher education systems has prompted calls for a critical evaluation of its cost-effectiveness due to its profound effects on students, faculty, and staff. Much of the focus on cost-effectiveness or cost-benefit EMI research, is targeted at policymakers (see Macaro et al., 2018), who are tasked to weigh up perceived benefits of EMI for the students and the university compared to the potential costs to educational quality and students' learning outcomes. Evaluating the cost-benefit ratio of EMI is a complex endeavour, underpinned by various factors. EMI offers potential benefits such as enhanced English proficiency (Yuksel et al., 2023a), improved career prospects (Sahan & Şahan, 2021), and a more globally oriented learning environment (Bowles & Murphy, 2020). However, there are also potential drawbacks, including increased stress levels (Barouch Gilbert et al., 2014; Galloway & Ruegg, 2020), decreased academic performance (Byun et al., 2011), and limited cultural understanding (Bradford, 2016). In addition to these apparent pros and cons, Macaro (2018) highlights less tangible factors that merit consideration. EMI can influence students' motivation, study-related anxiety, and cognitive development. As indicated by prior research, further investigation is necessary to comprehensively assess the impact of EMI on these myriad of educational variables (Aizawa et al., 2023). Thus, this longitudinal study seeks to analyze how EMI contributes to changes in linguistic and non-linguistic aspects.

Factors impacting academic success in EMI

In order to explore the potential costs of EMI to learning, researchers have recently become interested in the linguistics and non-linguistic factors influencing students' academic success in English-taught courses. Linguistic factors include general English proficiency (Curle et al., 2020) and business English proficiency (Rose et al., 2020; Xie & Curle, 2022). Non-linguistic factors include motivation (Lasagabaster, 2016; Rose et al., 2020; Xie & Curle, 2022), self-efficacy (Thompson et al., 2022), self-regulation and anxiety (Kaya et al., 2023), language mindset (Yuksel et al., 2021, 2023b), academic ability (Lin & Lei, 2021) and digital literacy (Ahmed & Roche, 2021). Findings from these studies

suggest that both linguistic and non-linguistic factors–especially those connected to learner psychology–play a role in students' academic success in EMI classes.

English language proficiency

Numerous studies have examined the connection between English language proficiency and academic performance within EMI programs (Curle et al., 2020; Xie & Curle, 2022; Muttaqin et al., 2022; Rose et al., 2020). Among these investigations, findings have varied. For instance, some studies revealed that overall language proficiency did not serve as a predictor of academic success in an economics course within the Turkish context (Curle et al., 2020). Conversely, academic English proficiency emerged as a significant predictor of EMI academic achievement in social sciences programs in China (Xie & Curle, 2022). Additionally, general English proficiency was found to be a significant predictor of academic success in social sciences programs in Turkiye. Notably, academic success in Turkish medium courses significantly predicted academic achievement in engineering EMI courses (Altay et al., 2022). Less research has been conducted on academic success in the Natural Sciences, compared to social and applied sciences, although a recent study of Chemistry students in Japan has suggested that lower proficiency students may need to work harder to achieve the same level of success as their higher proficiency counterparts (see Aizawa et al., 2023).

Expanding upon the role of English language proficiency, Yuksel et al. (2023a) delved into whether an improvement in general English proficiency forecasted academic success within social sciences and engineering programs. Their findings indicated that as EMI students' proficiency levels advanced, their academic success demonstrated a corresponding increase.

Self-efficacy

Self-efficacy involves an individual's confidence in their ability to accomplish tasks or reach goals. This multifaceted concept is shaped by past experiences, observations of others, and one's physiological state (Bandura, 1986). Self-efficacy beliefs hold significance in the realm of learning, as they can shape a learner's objectives, motivation, and anxiety levels. Research has indicated that self-efficacy beliefs can exert an influence on the level of achievement in language learning (e.g., Raoofi et al., 2012).

Research on self-efficacy within the EMI context remains limited, but there are some noteworthy findings. Certain studies have uncovered a positive correlation between self-efficacy beliefs and achievement in EMI (Thompson et al., 2022). However, there are also studies indicating that perceived academic competence in EMI does not necessarily translate into actual success in this environment (Xie & Curle, 2022). More recently, Soruç et al. (2022) identified that a sense of self-efficacy plays a significant role in determining the academic success of EMI students within the Turkish higher education context, irrespective of their academic program specialization.

Motivation: instrumentality, intrinsic motivation and ideal L2 self

Motivation has been a subject of extensive research, with recent studies delving into the L2 Motivational Self-System (L2MSS), which posits that learners' drive to acquire a second language stems from their aspiration to bridge the gap between their current proficiency

level and their envisioned ideal self as proficient L2 user. Instrumentality relates to the motivation to learn a second language for practical purposes, like enhancing career prospects. Intrinsic motivation pertains to the inner drive to acquire an L2 for enjoyment or personal gratification. The ideal L2 self revolves around fostering a positive self-image that embodies the qualities one aspires to possess as a proficient language user. The construct of instrumental motivation was chosen over extrinsic motivation as our preferred term in keeping with the motivational instrument developed by Iwaniec (2014), which has been the basis of several studies that have explored success and motivation in EMI.

To date, only a limited number of studies have explored the influence of motivation on academic achievement within the EMI context. A study by Lasagabaster (2016) found connections between certain motivational aspects, such as the ideal L2 self, and reported intentions for effort or motivated behaviour. However, it is important to note that this does not necessarily imply a direct correlation between motivation and academic success. In contrast, two other studies, conducted by Xie and Curle (2022) and Rose et al. (2020), operationalizing motivation as the ideal L2 self, did not find motivation to be a predictor of academic success in EMI. In the study by Soruç et al. (2022), two distinct types of motivation, specifically instrumentality and intrinsic motivation, were identified as indirect indicators of EMI students' academic achievements in both social sciences and engineering programs in the Turkish context. Thus, in terms of the motivation and EMI literature, three constructs emerge in terms of potential mixed or positive effects on learning success: instrumental, intrinsic, and Ideal L2 Self. Accordingly, these were the motivational sub-constructs selected for further investigation in our study.

Language learning anxiety

Language learning anxiety is a common emotional response characterised by feelings of uneasiness and apprehension that individuals may experience when engaging in language learning activities or communicating in a language other than their native tongue (L2). This emotional state can manifest with varying degrees of intensity, dependent on individual factors and contextual circumstances. Research findings have consistently highlighted that language learning anxiety can exert detrimental effects on language acquisition outcomes. Individuals who grapple with high levels of anxiety are more prone to encountering challenges when attempting to acquire a new language, and their progress toward achieving language learning objectives may be hindered as a result.

In the realm of English as a Medium of Instruction (EMI) education, several studies have probed into student anxiety triggered by studying in English. These inquiries, such as those conducted by Chou (2018) and Tsui and Cheng (2022), have consistently revealed the existence of anxiety among EMI students. However, the scope of research pertaining to the relationship between language learning anxiety and academic success within EMI settings remains somewhat limited. Nevertheless, the available body of research indicates that anxiety can have an adverse influence on academic performance across both social sciences and engineering programs (Yuksel et al., 2023b).

Self-regulation

Self-regulation, within the context of education, refers to students' capacity to independently manage and direct their own learning processes (Bandura, 1991). This multifaceted skill encompasses various aspects, including setting clear learning objectives,

devising plans for learning activities, organising their study materials, continuously monitoring their progress, and critically assessing the effectiveness of their learning strategies. In the realm of language learning, self-regulation is widely recognized as a crucial determinant of success. Research conducted by Bai (2018) has illuminated this point, demonstrating that learners who exhibit self-regulated learning tendencies are more likely to experience improvements in their language proficiency compared to those who lack such self-regulation.

The significance of self-regulation extends beyond language learning and has gained recognition for its potential impact on overall academic achievement, especially in EMI contexts. For instance, a study conducted by Bai and Wang (2023) revealed that students who demonstrate self-regulation in their learning endeavours are more prone to achieving higher grades when compared to their counterparts who do not exhibit such self-regulation. These findings collectively emphasise the pivotal role that self-regulation plays in the learning process and its capacity to enhance both language proficiency and academic performance.

Self-regulation holds significant importance for all students, but its relevance becomes especially pronounced in the context of EMI, where students are required to engage in learning using a language that is not their native tongue. Despite its importance, there exists limited research on self-regulation within EMI contexts. A study conducted by Hu and Gao (2018) made an interesting observation: High-achieving EMI students tended to employ a broader range of learning strategies compared to their low-achieving counterparts. This finding implies that self-regulation might indeed be a pivotal factor contributing to success in EMI settings.

A more recent study by Soruç et al. (2022) further emphasised the significance of self-regulation, indicating that it played a noteworthy role in determining academic success among EMI students in both engineering and social sciences disciplines. However, it is worth noting that the research conducted by Yuksel et al. (2023b) yielded somewhat divergent results. Specifically, their findings suggested that self-regulation predicted academic success among EMI students in engineering programs but did not exhibit a significant predictive relationship with academic success in social sciences EMI programs. These nuanced outcomes underscore the importance of considering disciplinary variations when examining the influence of self-regulation within EMI contexts.

Change in the linguistic and non-linguistic factors in EMI

Recent research in the field of EMI has predominantly focused on the influence of linguistic and non-linguistic factors on academic success, primarily assessed at a single time point. However, some exceptions have delved into areas such as language gain (Soruç et al., 2022), self-regulated listening strategies (Zhou & Thompson, 2023), self-efficacy, and motivational beliefs (Zhou et al., 2023) with a longitudinal perspective. Building on the foundation of these earlier studies, our research takes a novel approach. Firstly, we examine the changes in linguistic and non-linguistic factors within a test-retest design over a four-year period of EMI exposure. Subsequently, we investigate whether these changes have an impact on academic success within the Turkish EMI context. Additionally, we explore potential discipline-based differences. Driven by the limited existing longitudinal research on EMI academic success, this study seeks to address the following research questions:

RQ1. After four years of EMI education, is there any significant change in EMI students' language proficiency, ideal L2 self, sense of self-efficacy, type of motivation (instrumentality and intrinsic motivation), language learning anxiety, and self-regulation skills?

RQ2. Does the change in students' language proficiency, ideal L2 self, sense of self-efficacy, type of motivation (instrumentality and intrinsic motivation), language learning anxiety, and self-regulation skills significantly predict their academic success?

RQ3. Is there any significant difference between the students from social sciences and engineering programmes when the change is considered in their language proficiency, ideal L2 self, sense of self-efficacy, type of motivation (instrumentality and intrinsic motivation), language learning anxiety, and self-regulation skills?

Methodology

This study employed a test-retest longitudinal research design, wherein participants underwent tests, tasks, or measurements at two distinct time points, Time 1 (Year 1) and Time 2 (Year 4). This dual-time measurement approach allows researchers to attain standardised and comparable assessments at each designated time interval (Ross, 1998), a methodology consistent with prior research in the field of EMI (Rogier, 2012). In line with previous EMI research (O'Loughlin & Arkoudis, 2020), this study also employed a test-retest method to investigate whether the accrued gains in language proficiency after four years of EMI study had any predictive implications for students' academic success. Additionally, the study surveyed students' individual characteristics, including their motivation type, self-efficacy, self-regulation, and anxiety, at both time points to explore potential effects on their EMI academic performance (please refer to Appendix 1 for the list of all items). The study was conducted in two stages. The first stage pertained to the adaptation and validation of the scales into Turkish language, the language of the scales. The scales were firstly adapted to Turkish, and validity and reliability measurements were accordingly conducted. Then, in the second stage, after ensuring the scales are both valid and reliable, data were collected and analysed at 4-year intervals using the adapted scales. In this respect, the data used in the two stages were collected from independent sample groups; but the data collected in the main study were from the same group of students, four years apart.

Participants

The study involved a total of 241 participants who were selected through a convenience sampling method from two partial EMI programmes offered by a state university in Turkiye. Among the participants, 48.5% ($n=117$) were enrolled in the Business Administration programme, representing a social science discipline, while the remaining 51.5% ($n=124$) were pursuing studies in Mechanical Engineering, an engineering discipline. All participants were native Turkish speakers having studied English for about eight years before they started their major. The language proficiency of the students varied (discussed further in 3.2.7), which is typical in EFL contexts like Turkiye because of the varied and limited exposure to English for most students beyond the narrow confines of the classroom.

Participants underwent identical language proficiency tests and completed the same individual differences scales before commencing EMI studies and after completing their coursework. The initial administration of the proficiency test and scales took place in the

classroom before the commencement of Year 1, and the same assessments were repeated at the conclusion of Year 4 when students had completed their EMI courses. It is important to note that as the research context represents partial EMI programs, we acknowledge a potential influence of performance in Turkish medium courses on academic achievement. This is a relationship that has been explored in previous research with a different student population (Curle et al., 2020), but is not the focus of the current study which explores developmental gains over four years.

Prior to their participation, all participants received a letter outlining the study's overall scope, including the potential publication of findings, and were assured that their involvement would not impact their academic grades. Furthermore, they were informed that they could withdraw from the study at any point without needing to provide a specific reason. All participants confirmed their understanding of these conditions and formally signed the letter to signify their consent to participate.

Data collection ınstruments

Ideal L2 Self (ILS)

A five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), was utilized to assess the students' level of Ideal L2 Self. Initially developed and employed in the Polish context by Iwaniec (2014), this scale consisted of six original items. To assess its validity in the Turkish context, exploratory factor analysis (EFA) was conducted using data collected from students in the International Relations programme ($n = 158$). Subsequently, one item was removed following EFA, resulting in a refined scale comprising five items that collectively measured a single construct. Consequently, based on the outcomes of exploratory and confirmatory factor analyses, as well as the Cronbach's alpha test values, it can be concluded that the Ideal L2 Self scale is both a valid and reliable instrument (please refer to Appendix 2 for detailed information).

Instrumentality Scale (IS)

Data regarding the students' level of instrumental motivation were collected through the Instrumentality scale (Iwaniec, 2014). The authors of this study conducted the validation of this scale within the Turkish context running both exploratory and confirmatory factor analyses and the assessment of item reliability for internal consistency via Cronbach's alpha test. While the original version of the scale comprised seven items, two items were removed following exploratory factor analysis conducted with Mechatronics Engineering students ($n = 182$). Consequently, the instrument employed in this study generated both valid and reliable results (please refer to Appendix 2 for comprehensive details).

Intrinsic Motivation Scale (IMS)

The scale originally developed by Iwaniec (2014) to assess intrinsic motivation was employed to gather data on the students' intrinsic motivation levels in this study. Similarly, the scale was validated by carrying out exploratory and confirmatory factor analyses for use in the Turkish context, and its reliability was assessed. The initial scale consisted of ten items; however, following exploratory factor analysis conducted with Mechanical Engineering students ($n = 182$), three items were excluded from the scale. Consequently, the

scale was refined to encompass seven items, all loaded onto a single factor: Intrinsic motivation. Instrument is valid and reliable (for comprehensive details, please refer to Appendix 2).

Self-efficacy Scale (SES)

To measure students' sense of self-efficacy, the instrument developed by Iwaniec (2014) was employed. In contrast to previous research in the EMI context, such as the work by Thompson et al. (2019), which utilised a single item to gauge self-efficacy, this study adopted an eight-item Likert scale. Through exploratory and confirmatory factor analyses, the scale was validated in the Turkish context with a group of International Relations students ($n = 158$). This analysis resulted in removing two items, resulting in a refined scale comprising six items, all contributing to a single self-efficacy factor. The self-efficacy scale employed in this study is both valid and reliable (for a detailed reference, please consult Appendix 2).

Self-Regulation Scale (SRS)

Students' self-regulation skills were assessed using a multi-item, five-point Likert scale originally developed by Iwaniec (2014). The authors conducted the validation of this scale within the Turkish context by running factor analyses and the assessment of item reliability in a separate study (Yuksel et al., 2023b). The initial scale comprised 12 items, but after validation, it was refined to include eight items, as employed in this study. The data collected in this study were derived from a valid and reliable instrument (for comprehensive details, please consult Appendix 2).

Language Learning Anxiety Scale (LLAS)

Data about students' language learning anxiety in the EMI context were collected using a five-point Likert scale adopted from Iwaniec (2014). The validation of this instrument within the Turkish context and the assessment of its reliability were conducted in a separate study involving International Relations EMI students ($n = 148$) and Mechanical Engineering students ($n = 172$) (Soruç et al., 2022). These students represented an entirely separate sample from the main study reported in this paper, although they were from the same university but part of an earlier graduating cohort. While the original study conducted in the Polish context (Iwaniec, 2014) featured eight items, this study retained only five items after conducting exploratory and confirmatory factor analyses. Three items were removed based on the results of these analyses. Therefore, it can be concluded that both a valid and reliable instrument was employed in this study (for comprehensive details, please refer to Appendix 2).

Language proficiency measured by general english proficiency

The Cambridge Preliminary English Test, set at a B1 difficulty level (Cambridge ESOL, 2014), was employed to assess students' English language proficiency at two-time points: Time 1 (Year 1) and Time 2 (Year 4). The primary aim was to determine whether there was any measurable language gain after four years of English Medium study. This comprehensive test was preferred because it is accepted by almost all universities and colleges of

higher education and can be used as a yardstick or evidence that shows the student can follow a course delivered in English (Özdemir-Yılmazer, 2022). The exam encompassed four language skills: Reading, Writing, Listening, and Speaking, allowing for the assessment of students' language proficiency in all these domains. The test was administered at Time 1, just before students commenced their semester, and again at Time 2, following four years of EMI coursework, when students had completed their EMI courses at the end of the semester. The exam difficulty level was at B1 level because this represents a higher level of proficiency of EMI students in Turkish universities, and given the four-year interval between the two measurements, the researchers ensured that students' language gain was not affected by the effect of the test/retest design. This level would, therefore, avoid a ceiling or floor effect in the results. The Cambridge Preliminary English Test reports include scores in each skill as well as a single final score. The final scores of the students (from 0 to 100) were used in this study. The validity and reliability of each component of the PET was verified in a series of studies: Shaw and Weir (2007, writing), Khalifa and Weir (2009, reading), Taylor (2011, speaking) and Geranpayeh and Taylor (2013, listening).

EMI success measured via course GPA

This study assessed students' performance in their EMI courses through their Grade Point Average (GPA) scores. The GPA scores were computed by averaging the final course scores (between 0 and 100) of the total English-taught courses each student took. A minimum of eight courses was set as the threshold to evaluate students' overall academic success in each EMI programme. This threshold was set for practical reasons because each student had to select at least two EMI courses per semester as part of their compulsory requirement. And in order to measure the main effect of the courses on students' language proficiency gain over a four-year period, this threshold allowed for longitudinal comparisons year on year.

Procedure

Once permission was received from the university and consent letters were collected from the students, the research commenced. Data collection took place in two phases: firstly, before the students started their EMI courses in Year 1, the data were gathered in actual classrooms. Secondly, due to the COVID 19 pandemic circumstances in 2020–21 that resulted in the closure of universities and classes to migrate online, data for Year 4 had to be collected online. The data collected at these two time points (Year 1 and Year 4) were matched. The language proficiency scores from Year 1 were subtracted from those of Year 4 to assess language proficiency gains. A similar procedure was followed for the students' responses to the scales administered at Time 1 (Year 1) and Time 2 (Year 4). In this case, their Year 4 responses were subtracted from their Year 1 responses to identify observable changes in individual characteristics.

Subsequently, descriptive mean scores of the data, along with standard deviations, were computed. Pearson correlation coefficients were also calculated to examine relationships between variables. Hierarchical regression analysis was then conducted to investigate the relationships between variables. Prior to analysis, basic assumptions were checked. The Durbin–Watson value was 1.95, tolerance values ranged from 0.954 to 0.992, VIF values ranged from 1.008 to 1.048, and condition index values ranged from 1.000 to 1.958. All these values indicated the absence of autocorrelation and the

absence of multicollinearity issues. The analyses were performed separately for both Business Administration students ($n = 117$) in the social science field and Mechanical Engineering students ($n = 124$) in the engineering field. Descriptive analysis, Pearson correlation coefficients, and regression analysis were conducted using the SPSS 21.0 software program.

Results

We initially computed the descriptive statistics for EMI success and the changes in language proficiency, ideal L2 self, self-efficacy, instrumentality, intrinsic motivation, language anxiety, and self-regulation over four years. In this regard, the participants' EMI success scores varied between 45 and 88 (M = 65.03, SD = 8.32). When assessing the lowest, highest, and average scores of students over this four-year span, the following observations were made:

- General English Proficiency (GEP) gain scores ranged from -9 to 16 (mean ± SD; 2.71 ± 4.34).
- Ideal L2 self gain scores ranged from -13 to 22 (mean ± SD; 0.39 ± 4.72).
- Self-efficacy gain scores ranged from -16 to 15 (mean ± SD; 0.23 ± 6.23).
- Instrumentality gain scores ranged from -20 to 18 (mean ± SD; -0.66 ± 6.45).
- Intrinsic motivation gain scores ranged from -19 to 20 (mean ± SD; 1.44 ± 7.46).
- Language anxiety gain scores ranged from -24 to 20 (mean ± SD; 0.03 ± 8.22).
- Self-regulation gain scores ranged from -23 to 21 (mean ± SD; 1.37 ± 8.29).

These statistics provide an overview of the distribution and variation in the individual characteristics of the participants over the four years.

When considering the changes in variables over the four years, it is notable that, on average, there was an increase in all variables at the end of the fourth year, except for instrumentality scores, which decreased. Specifically, improvements were observed in language proficiency, intrinsic motivation, self efficacy and self-regulation, indicating significant progress in these areas. However, instrumentality scores exhibited a decrease, and there was only a marginal increase in anxiety levels.

In our analysis, EMI success served as the dependent variable, and we examined the correlations between EMI success and changes in other variables, as summarised in Table 1.

Our correlation analysis unveiled several findings regarding the relationships between EMI success and various factors. Notably, there was a low-level positive significant correlation between EMI success and language proficiency gain scores, as well as

Table 1 Correlations between EMI success and GEP, ideal L2 self (L2S), self-efficacy (SE), instrumentality (Ins), intrinsic motivation (IM), language learning anxiety (LLA) and self-regulation (SR)

	GEP	L2S	SE	Ins	IM	LLA	SR
EMI Success	0.259 **	0.033	0.002	0.236 **	−0.212 **	−0.021	−0.055

* $p < 0.050$

with instrumentality scores. Conversely, a low-level negative significant correlation was observed between EMI success and intrinsic motivation. No significant relationships were identified between EMI success and ideal L2 self, self-efficacy, language learning anxiety or self-regulation.

Subsequently, we conducted a regression analysis to assess the predictive power of GEP and other non-linguistic factors on EMI success. The results of this regression analysis are presented in Table 2.

The linear regression analysis aimed to assess the predictive capacity of four-year gain scores in various factors, including language proficiency, ideal L2 self, self-efficacy, instrumentality, intrinsic motivation, language learning anxiety, and self-regulation, on EMI success (see Table 2). The overall model exhibited statistical significance (total model: $F_{7,233} = 6.104$, $p < 0.001$), with a *corrected R^2* of 0.130.

Our findings indicate that gain scores in language proficiency, instrumentality, and intrinsic motivation significantly predict EMI success. However, ideal L2 self, self-efficacy, language learning anxiety, and self-regulation gain scores are not significantly predictive concerning EMI success. Collectively, gain scores in both linguistic (language proficiency) and non-linguistic factors (ideal L2 self, self-efficacy, instrumentality, intrinsic motivation, language learning anxiety, and self-regulation) accounted for 13% of the variance in EMI success.

Our findings underscore several key insights. Firstly, and most notably, an increase in language proficiency is significantly connected to EMI success. That is, the development of participants' language proficiency over four years emerges as the most crucial predictor of EMI success. However, we have to be cautious in interpreting this finding as the relationship between EMI success and the development of language proficiency could be bi-directional. Moreover, as identified in a previous study (Curle et al., 2020), considering the partial EMI context, success in Turkish medium courses might have impacted EMI success as well, which is a variable that was not captured in our study. Furthermore, an increase in instrumentality within the same time frame effectively predicts EMI success. In essence, as participants' instrumentality scores increased, their EMI success scores also saw parallel improvements.

Additionally, the increase in participants' intrinsic motivation scores emerged as a significant negative predictor of EMI success. This suggests that high intrinsic motivation among students in the first year positively contributes to EMI success. However, a subsequent increase in intrinsic motivation scores has a negative impact on EMI success. High

Table 2 Regression analysis with EMI success as the outcome variable and change in linguistic and non-linguistic variables as predictors

	B	Std. Error	β	T	Significance
Constant	64.313	0.605		106.279	0.000
language proficiency gain	**0.480**	**0.117**	**0.250**	**4.100**	**0.000**
ideal L2 self gain	0.010	0.107	0.006	0.094	0.925
self-efficacy gain	−0.033	0.081	−0.024	−0.403	0.688
instrumentality gain	**0.242**	**0.079**	**0.188**	**3.043**	**0.003**
intrinsic motivation gain	**−0.213**	**0.069**	**−0.191**	**−3.106**	**0.002**
language anxiety gain	−0.020	0.061	−0.020	−0.325	0.745
self-regulation gain	−0.086	0.061	−0.085	−1.407	0.161

intrinsic motivation in the later years of university education decreases EMI success. This finding is unpacked further in the discussion section of this paper.

Discipline-based differences regarding EMI success

This study delved into the influence of linguistic and non-linguistic factors within two distinct academic disciplines, specifically social sciences and engineering. Regression analyses were conducted independently for each of these sub-datasets. The outcomes of the regression analysis for social sciences students are detailed in Table 3.

In our linear regression analysis, where language proficiency, ideal L2 self, self-efficacy, instrumentality, intrinsic motivation, language anxiety, and self-regulation served as predictors of GPA scores for social science students (refer to Table 3; total model: $F_{7,109} = 5.60$, $p < 0.001$, corrected $R^2 = 0.217$), we observed that only language proficiency and instrumentality gain scores significantly predicted EMI success in the social sciences. None of the other factors exhibited a significant predictor regarding EMI success in this academic discipline.

Collectively, gain scores in both linguistic (language proficiency) and non-linguistic factors (ideal L2 self, self-efficacy, instrumentality, intrinsic motivation, language anxiety, and self-regulation) accounted for 21.7% of the variance in EMI success among social science students.

These findings underscore the significant impact of increased language proficiency scores on the success of social science students in EMI content courses. This emphasises that the development of students' language proficiency over the four-year period stands as the most critical predictor for EMI success within this academic discipline. Furthermore, our results indicate that changes in the instrumentality scores of our participants significantly influence EMI success over the same four-year span. In summary, we have identified language proficiency and instrumentality as the most prominent contributors to EMI success among social science students.

In our linear regression analysis using language proficiency, ideal L2 self, self-efficacy, instrumentality, intrinsic motivation, language anxiety, and self-regulation as predictors of EMI success among engineering students (see Table 4; total model: $F_{7,116} = 4.286$, $p < 0.001$, corrected $R^2 = 0.158$), we observed a significant negative predictive relationship between intrinsic motivation gain scores and EMI success. None of the other factors

Table 3 Regression analysis with EMI success among social sciences students as outcome variable and linguistic and non-linguistic variables as predictors

	B	Std. Error	β	T	Significance
Constant	63.002	5.102		12.348	0.000
language proficiency gain	**0.642**	**0.159**	**0.351**	**4.030**	**0.000**
ideal L2 self gain	−0.014	0.146	−0.008	−0.094	0.925
self-efficacy gain	0.011	0.107	0.008	0.101	0.920
instrumentality gain	**0.319**	**0.118**	**0.239**	**2.705**	**0.008**
intrinsic motivation gain	0.078	0.094	0.070	0.827	0.410
language anxiety gain	−0.115	0.078	−0.124	−1.469	0.145
self-regulation gain	−0.137	0.082	−0.140	−1.678	0.096

Table 4 Regression analysis with EMI success among engineering students as outcome variable and linguistic and non-linguistic variables as predictors

	B	Std. Error	β	T	Significance
Constant	67.307	5.187		12.976	0.000
language proficiency gain	0.215	0.178	0.106	1.209	0.229
ideal L2 self gain	0.054	0.147	0.031	0.368	0.714
self-efficacy gain	−0.012	0.114	−0.009	−0.101	0.919
instrumentality gain	0.125	0.108	0.102	1.164	0.247
intrinsic motivation gain	**−0.445**	**0.093**	**−0.410**	**−4.770**	**0.000**
language anxiety gain	0.104	0.092	0.095	1.120	0.265
self-regulation gain	−0.009	0.084	−0.009	−0.102	0.919

predicted EMI success significantly in this academic discipline. The gain scores in intrinsic motivation alone explained 15.8% of the variance in EMI success.

These findings underscore the significance of changes in intrinsic motivation scores among engineering students in our study. The negative prediction indicates that high intrinsic motivation among students in the early years positively correlates with EMI success. However, changes in the fourth year have a negative impact on the EMI content scores of engineering students.

Discussion

By scrutinizing the predictive significance of linguistic (specifically, English language proficiency) and non-linguistic elements (namely, ideal L2 self, self-efficacy, motivation types, language learning anxiety, and self-regulation skills) concerning EMI success, this research has significantly advanced our understanding of these variables within the EMI literature. Over the span of this comprehensive four-year study, quantitative data were systematically gathered from EMI students on two occasions: upon the commencement of their EMI education and upon its conclusion.

Our initial research question sought to determine whether a statistically significant change in EMI students' success (our outcome variable) could be observed, along with notable improvements in their linguistic and non-linguistic scores. Following year-long immersion in an English-rich environment, wherein students engaged with their peers primarily for content learning rather than language development, one may have expected that all scores would exhibit an upward trajectory, with the exception of anxiety which would dissipate over increased exposure to EMI. This expectation is based on findings from research into English as a foreign language, where students improve their language proficiency by being engaged in various communicative opportunities (e.g., Kinsella & Singleton, 2014; Marinova-Todd, 2003; Moyer, 2009; Muñoz & Singleton, 2011). This expectation was mostly reflected in our data. That is, the gain scores indicated that students' self-efficacy, ideal L2 self, self-regulation and intrinsic motivation saw a positive increase. At the same time, anxiety levels decreased slightly over time.

In this study, exposure to English through content-based courses was found to facilitate improvement in students' English language proficiency as a by-product of their participation in courses conducted in English. This substantiates the pivotal role of EMI courses in

fostering language development. Notably, students' sense of self-efficacy, motivation, ideal L2 self-concept, self-regulation and language learning anxiety levels demonstrated change throughout the study, indicative of their dynamic (rather than static) nature.

The second research question in this study pertains to the identification of the most significant among the linguistic and non-linguistic variables contributing to academic success. Our hypothesis posited that these factors are mutually dependent, akin to the ripples generated by a raindrop in a pool, where the influence of one factor cascades to impact others on a broader scale. Among these variables, it was observed, however, that only language proficiency and the instrumental type of motivation emerged as positively significant predictors of EMI success. This outcome is noteworthy as it underscores the notion that as EMI students enhance their language proficiency, they concurrently recognize the instrumental advantages associated with EMI education in terms of future job prospects, higher income potential, and improved lifestyles for themselves and their families. Consequently, it can be inferred that a snowball effect is at play, whereby EMI students transition into instrumental motivation upon achieving higher language proficiency, compelling them to invest greater time and effort in achieving success in their content-based courses.

On the other facet of the same issue, this study has illuminated the dynamic character of motivation, a concept thoroughly substantiated in existing scholarly works (Dörnyei et al., 2015; Griffiths & Soruç, 2021). In this study, we demonstrated the fact that success in the EMI context does not depend on isolated factors (e.g. linguistic and non-linguistic factors) but on complex interactions among several possible variables. The results of this study revealed that an increase in EMI students' intrinsic motivation bears a negative relationship with EMI success while their instrumental scores saw parallel increases along with their EMI success scores. This echoes the findings of Zhou et al. (2023), which found that the initial intrinsic motivation of the students that predicts academic success might be replaced with instrumental factors in the later stages of EMI studies. This fact emphasises that a student's motivation levels can fluctuate, with individuals experiencing varying degrees of motivation over time, often due to ecological changes in their educational background, including changes in their goal orientation.

This dynamic phenomenon was evident in the present study. EMI students embarked on their educational journey with noble intentions of integrating into a target community or culture during their initial year of EMI education. However, as time progressed, their emphasis shifted away from intrinsic motivation. They transitioned from pursuing EMI courses with the primary goal of integration with a specific individual or group to a more instrumental motivation, where the primary objective was to utilise the medium of instruction, English, as a means to attain specific goals by the end of their fourth year.

The exploration of potential discipline-based disparities, by examining whether students in social sciences and engineering exhibit variations in terms of linguistic and non-linguistic factors, serves as a gateway to gaining deeper insights into the ecological characteristics of these two academic domains. Our third research question sought to unveil any distinctions between these academic disciplines. Surprisingly, our findings in the social sciences revealed that although language proficiency and instrumental motivation emerged as significant predictors of EMI success, the same did not hold true for the engineering programme.

In the social sciences, students demonstrated notable change in their academic accomplishments in EMI courses, primarily attributed to the improvement in their language proficiency and their motivation to employ the medium of instruction for instrumental purposes. Another notable finding was that social science students' intrinsic motivation did not decline over time. This might be related to, among other things, the more intertwined nature of language skills and social science studies. These students may have more

extended opportunities to intrinsically-drive their language learning during EMI studies due to a dependence on their English skills to engage with content. Compared to STEM, learning tasks in the social sciences may require students to use more flexible and creative language (Kuteeva & Airey, 2014). However, a different pattern emerged in the engineering programme. Here, we observed a significant decrease in engineering students' gain scores dependent on the rise of their intrinsic motivation over the course of four years of EMI education. This outcome assumes significance as it underscores the divergent roles of language proficiency and the dynamic nature of motivation within these two distinct academic disciplines.

In a previous study by Yuksel et al. (2023a), an examination of the role of language proficiency in EMI academic success revealed a potential distinction between students in the business administration and mechatronics engineering programmes, highlighting the significant impact of enhanced language proficiency on the former programme compared to the latter. In the broader context of the influence of language proficiency on EMI academic success, several research studies, including those by Rose et al. (2020), Thompson et al. (2022), and Xie and Curle (2022), have also observed similar outcomes, irrespective of specific academic disciplines.

Concerning non-linguistic variables, findings from the Spanish EMI context, as demonstrated by Lasagabaster (2016), indicated that one aspect of motivation, specifically the ideal L2 self, had a significant predictive effect on EMI students' academic success. This result was statistically significant. However, contrasting results emerged in studies conducted by Rose et al. (2020) and Xie and Curle (2022), which investigated motivation in the context of a social sciences programme (International Business) in Japanese and Chinese EMI settings. In these cases, motivation was not found to be a predictor of academic success. In a similar study that explored the change in the non-linguistic variables in an EMI context longitudinally, Zhou et al. (2023) found that the students' intrinsic motivation levels decreased after the initial stage whereas instrumentality was a main factor in the academic success of Chinese students. The authors concluded that EMI success was more driven by instrumental factors and rewards rather than an intrinsic curiosity. Considering this interesting finding, we can argue that EMI is not a one-size-fits-all scenario in terms of students' needs and pathways to success (Rose et al., 2023).

Implications and conclusions

Albeit a large sample size, the study's results may be somewhat limited due to its focus on a single university as well as several non-linguistic factors. To ensure wider applicability, we recommend replicating the study in various contexts with more individual learner differences. However, we still believe that the findings of this study allow us to draw several educational and research implications from its conclusions.

Educational implications

In EMI contexts, continuous exposure to English has been shown to positively impact students' language proficiency. This adds some evidence that the perceived benefits of EMI on language development are supported. In addition to this conclusion, our study also found that EMI students initially demonstrated strong instrumental and integrative motivations. However, over time, their focus shifts more towards instrumental motivation, aimed at

using English for future career success, and this shift predicted their academic success. This might mean that as students get closer to graduation, lecturers could try to harness the instrumental motivating forces that might lead to better student engagement in EMI. If EMI can be better tied to the types of instrumental motives measured in our study (job hunting, future career, earning higher salaries, etc.), this may lead to greater gains in student success (i.e. higher GPA).

Furthermore, our study has shown that discipline-specific differences in EMI contexts warrant further attention, particularly the contrasting preferences of social sciences and engineering students. Social sciences students rely more on English for verbal classroom interactions, suggesting a potential need for ongoing language instruction, which can significantly affect their academic success. What this points to is that EMI is not a one-size-fits-all scenario in terms of students' needs and pathways to success. English medium programs should make bespoke adjustments to meet the disciplinary needs of their students.

Research implications

Apart from language proficiency scores, various non-linguistic factors, including self-efficacy, ideal L2 self, motivation types, self-regulation skills, and anxiety levels, change throughout EMI education. This has implications for future studies that explore learners' psychological variables. One-shot studies, where data are collected at a single time, might not appropriately capture such variables which we have shown to be dynamic. Thus, longitudinal research is needed for future studies that aim to explore these constructs. Furthermore, we have found that, while self-efficacy, self-regulation skills, and ideal L2-self change over time, accompanied by reduced anxiety (although not significant), gains in these factors do not reliably predict EMI students' achievement or gain scores. Future investigations may benefit from use of more advanced statistical techniques to unpick the complexities of how such variables fluctuate in line with educational outcomes. Latent growth curve modelling on a larger dataset, with more time points might better reveal the effects of these linguistic and non-linguistic variables on academic outcomes. Similarly a cross-lagged panel model of the effect of these variables (measured at more frequent time-points) on EMI grades might also reveal more nuanced findings.

Appendix 1

Ideal L2 Self

    1-When I imagine my future job, I see myself using English.
    3-I imagine myself communicating in English abroad.
    4-I often imagine myself writing emails in English.
    5-I often imagine myself reading books and articles in English.
    6-I often imagine myself watching TV and films in English.

Instrumentality

    2-I study English because it will facilitate a job hunt.
    4-I study English because I would like to spend some time abroad.
    5-I need English for my future career.

6-I study English as it will help me to earn good money.

7-I study English as it is necessary to pass my exams.

Intrinsic motivation

2-I am curious about how people communicate in English.

3-I am interested in English.

6-I find learning English enjoyable.

7-When I learn something new in English, I feel happy and satisfied.

8-I am curious to find out the meanings of new words in English.

9-I am happy when I see that I am making progress in English.

10-I like solving challenging tasks in English.

Self-efficacy beliefs

3-I am certain that I will be able to communicate in English.

4-I am certain that I will be able to watch television and films in English.

5-I am certain that I will be able to understand a conversation in English.

6-I am certain that I will be able to write emails and letters in English.

7-I am certain that I will be able to get my ideas across when writing in English.

8-I am certain that I will be able to read books and newspapers in English.

Self-regulation

1-If there is something I don't understand in English, I do my best to find the answer in a variety of resources (coursebooks, dictionaries, online resources).

4-I try to prepare for every English lesson, even if I know that I won't be tested.

5-I try to learn English by watching films in English and listening to music in English.

6-I have my own ways of studying English vocabulary.

7-I plan my preparation and reviews before the test.

8- I have my own special techniques to make even the most boring activities more interesting.

11-When studying English, I arrange my environment so that to avoid possible distractions (TV, the Internet, mobile phone).

12-I study English as long as it takes me to achieve my own goals.

Language learning anxiety

2-Even if I'm well prepared for the class, I feel anxious about it.

3-In language class, I can get so nervous that I forget things I know.

6-I feel more tense and nervous in my language class than in my other classes.

7-I'm afraid other students will laugh at me when I speak English.

8-I start to panic when I have to speak without preparation in language class.

Appendix 2

Scale	Total items	Factor loading	EV	Reliability	Standard solution	Fit measure	Model value
Ideal to self	5	0.591-0.913	66.65	0.87	0.48-0.94	χ^2/df	1.29
						RMSEA	0.040
						SRMR	0.027
						CFI	0.99
						NFI	0.99
						NNFI	0.99
						GFI	0.99
						AGFI	0.96
Language Learning Anxiety	5	0.539-0.880	61.73	0.91	0.69-0.96	χ^2/df	1.697
						RMSEA	0.062
						SRMR	0.016
						CFI	0.99
						NFI	0.99
						NNFI	0.99
						GFI	0.99
						AGFI	0.94
Self-regulation	8	0.719-0.979	85.49	0.96	0.53-0.99	χ^2/df	1.879
						RMSEA	0.069
						SRMR	0.033
						CFI	0.99
						NFI	0.99
						NNFI	0.99
						GFI	0.96
						AGFI	0.91
Instrumentality	5	0.733-0.933	73.70	0.91	0.67-0.87	χ^2/df	2.045
						RMSEA	0.082
						SRMR	0.026
						CFI	0.99
						NFI	0.99
						NNFI	0.99
						GFI	0.98
						AGFI	0.92
Intrinsic Motivation	7	0.802-0.905	77.21	0.95	0.62-0.98	χ^2/df	1.879
						RMSEA	0.071
						SRMR	0.028
						CFI	0.99
						NFI	0.99
						NNFI	0.99
						GFI	0.97
						AGFI	0.92

Scale	Total items	Factor loading	EV	Reliability	Standard solution	Fit measure	Model value
Self-efficacy	6	0.668-0.907	71.31	0.92	0.75-0.90	χ^2/df	1.560
						RMSEA	0.056
						SRMR	0.020
						CFI	0.99
						NFI	0.99
						NNFI	0.99
						GFI	0.98
						AGFI	0.94

Declarations

Disclosure statement There are no potential conflicts of interest.

We, hereby, confirm that the work described has not been published previously, that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder.

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