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Investigating academic achievement of English medium instruction courses in Turkey

Mehmet Altay
Kocaeli University, Turkey
https://orcid.org/0000-0001-7227-5685
mehmet.altay@kocaeli.edu.tr

Samantha Curle
University of Bath, United Kingdom
https://orcid.org/0000-0003-3790-8656
samanthamcurle@gmail.com

Dogan Yuksel
Kocaeli University, Turkey
https://orcid.org/0000-0001-9131-3907
doganyuksel@gmail.com

Adem Soruç
University of Bath, UK
https://orcid.org/0000-0003-4165-6260
a.soruc@bath.ac.uk

Abstract

This article reports a quantitative study that investigated academic achievement in English medium instruction (EMI) courses at a public university in Turkey. Student test score data on EMI and Turkish medium instruction (TMI) courses as well as general English proficiency scores were collected in two academic divisions: the mathematical, physical, and life sciences (MPLS, *N* = 357); and the social sciences (*N* = 359). Analysis conducted at the macro (academic division), meso (academic department), and micro levels (academic program) showed subtle differences at each level. Overall, results were consistent: English

language proficiency was a strong predictor of academic achievement of social science participants, whereas success in TMI courses predicted EMI success of MPLS participants. These results reinforce the notion that more language support should be given to social science students, whereas learning some content through TMI should be prioritized for MPLS students. Implications for language professionals and EMI practitioners are discussed, and suggestions are made for further research.

Keywords: English medium instruction; academic success; Turkish medium instruction; general English proficiency; higher education

1. Introduction

When the Bologna Declaration was adopted in Europe in 1999, the aim was to "cultivate and develop multilingualism" (Doiz et al., 2013, p. 345) and "motivate and produce a highly-skilled plurilingual, pluricultural workforce" (Coyle 2008, p. 99). Despite this focus on multi- and plurilingualism, English has become the dominant foreign language used as the medium of instruction (MOI) at universities in the European Higher Education Area (EHEA, Doiz et al., 2013). This trend has spread globally in higher education (HE; see Macaro et al., 2018). Commonly known as English medium instruction (EMI), this global phenomenon is defined here as "the use of the English language to teach academic subjects other than English itself in countries or jurisdictions where the first language of the majority of the population is not English" (Macaro, 2018, p. 19). The context of this study, Turkey, falls within this description.

While there is a growing research interest in student learning outcomes of EMI programs (Li, 2018; Rose et al., 2020; Terraschke & Wahid, 2011; Xie & Curle, 2022), no studies have examined EMI success at three levels: division level (macro: mathematical, physical and life sciences (MPLS) and social sciences), department level (meso: engineering and economics, and administrative sciences), and program level (micro: four programs per department; see the appendix). This study, therefore, makes an original contribution to the field by investigating the influence of general English proficiency, success in Turkish medium instruction (TMI), and academic subject on EMI academic achievement.

2. Literature review

2.1. The role of the first language in academic success in English medium instruction

The effect of students' first language (L1) on their academic attainment in EMI courses has not been explored until recently (see Curle et al., 2020). From a linguistic theoretical perspective, in his interdependence hypothesis, Cummins (2017)

proposes two language-independent transfer types, namely: (a) conceptual elements and (b) strategic knowledge transfer from the first language (L1) to the second language (L2). He postulates that these two transfer types might facilitate success in learning a second language (Cummins, 2017). The transfer of conceptual elements (a) is known as the *transfer of knowledge*. This is the transfer of declarative knowledge from the L1 to the L2. Declarative knowledge can be made overt or explicit, "teachable" knowledge that is statically stored in memory (Ullman, 2005). This is conceptual or descriptive knowledge, as opposed to "implicit" knowledge, or knowledge of performance or operation (Watson et al., 2021). It is therefore hypothesized that bilingual learners transfer knowledge from their L1 to perform academically in the L2 (Olivares, 2002). One example could be transferring the understanding of the concept of photosynthesis from the L1 to the L2. The transfer of strategic knowledge (b) occurs when learners become aware of their learning process and apply that process to a new learning circumstance. For example, if a student has learned to use graphic organizers or mnemonic devices to learn new vocabulary in their L1, the same strategy could be applied and used to learn vocabulary in the L2 (Wolfsberger, 2012). The main argument behind transfer of knowledge theory is that learning strategies can be used irrespective of the language/content being learned.

Empirical research has been conducted and provides evidence for the transfer of knowledge. Lemberger and Vinogradova (2002) examined a group of bilingual students' transfer of science literacy skills from their L1 (Russian) to their L2 (English) and concluded that bilingual instruction helped them maintain and build on prior science learning together with well-developed reading and writing skills. In the Korean EMI setting, Kang and Park's (2005) study revealed that students required some form of preparation course in their L1 (Korean) before commencing their EMI academic programs to ensure their studies were successful. Similarly, Turkish students in Curle et al. (2020) noted that their L1 courses helped them understand basic background knowledge in their academic discipline, thus mediating learning and facilitating comprehension of abstract concepts in their EMI courses. The current study takes the theory of transfer of knowledge further by taking academic achievement in L1 courses into account. More specifically, it explores whether knowledge acquired in TMI courses influences EMI success and whether this differs according to academic discipline.

2.2. The role of English language proficiency in academic success in English medium instruction

Recently, there has been an increased interest in EMI academic achievement. A handful of studies have explored significant predictors of EMI academic achievement (i.e.,

EMI success: Curle et al., 2020; Li, 2018; Rose et al., 2020; Terraschke & Wahid, 2011). Rose et al.'s (2020) study with 139 second-year students in Japan found that scores of English language proficiency and English for academic purposes (EAP) were significant predictors of EMI success in an international business course (a social science subject). These findings were echoed in Thompson et al.'s (2019) study in Japan with a similar group of students (i.e., 139 second-year students): English language ability and EAP scores predicted EMI international business administration success. Xie and Curle (2022) developed this line of research in China and found that business English proficiency predicted EMI academic achievement of 106 second-year students studying business management administration. Only two studies on EMI success have been conducted in Turkey, and the results were contrary to previous study findings. Curle et al.'s (2020) study found that instead of English proficiency, success in TMI courses predicted the EMI academic success of 159 fourth-year economics students (a social science subject).

The investigation of social science subjects has so far dominated the EMI success literature, and analysis has focused solely on the micro level (academic program). The current study builds on this EMI academic success literature by comparing two academic divisions (macro level): social science *and* MPLS. Such a comparison might be critical because previous research that has examined the differences between the micro and macro levels has identified significant gaps between these two levels (Aizawa & Rose, 2019; Hu et al., 2014).

2.3. Discipline-specific language differences: Differences according to academic division

EMI is used to teach and learn a range of academic disciplines in higher education, from physical and life sciences to the humanities and social sciences. Previous studies have categorized and named these disciplines (at a macro level) differently; from *numeric-based subjects* to *arts and humanities* (Dearden & Macaro, 2016), *hard* versus *soft* sciences (Dafouz et al., 2014; Neumann, 2001), *natural sciences* versus *social sciences and humanities* (Kuteeva & Airey, 2014) to *STEM* versus *sumanities* (Roothooft, 2019). In this study, we categorize and compare academic disciplines at three levels: division level (macro: MPLS and social sciences), department level (meso: engineering and economics, and administrative sciences), and program level (micro: four programs per department).

When the nuances of language used in different academic disciplines have been investigated, both in the EMI and the English for specific purposes (ESP) literature, many research studies have adopted a descriptive approach, specifically examining lecturers' perceptions (e.g., Dearden & Macaro, 2016; Kuteeva & Airey, 2014; Roothooft, 2019) and learners' perceptions (e.g., Kuteeva & Airey,

2014; May & Casazza, 2012) of linguistic complexity in various academic disciplines. For example, Kuteeva and Airey (2014) found that learners in social sciences depend greatly on their English proficiency because their EMI courses demand that students use language flexibly and creatively. Similarly, in Dearden and Macaro's (2016) study, social science EMI lecturers reported that they deal with numerous language-related issues. MPLS lecturers, on the other hand, stated that they rely more on formulae; they also considered general English proficiency less important than content knowledge (Dearden & Macaro, 2016). Support for this argument also comes from two studies conducted by Ward (1999, 2009). Moreover, Ward (1999) examined five foundation-level engineering textbooks to determine the number of words students need to know to be able to read efficiently. He found that 2000 word families covered up to 95% of the texts. In another study, Ward (2009) identified 299 word types that provided good coverage of the vocabulary used across five engineering subjects. These results demonstrate that a limited number of words (or word groups) are commonly used in MPLS discipline coursebooks. In their book on the nature of language in science and science education, Wellington and Osbourne (2001) argue that the intensity of language used in technical disciplines is low. This is due to learners primarily relying on "a combination and interaction of words, pictures, diagrams, images, animations, graphs, equations, tables and charts" in the pure and applied sciences (Wellington & Osbourne, 2001, p. 6).

In their longitudinal study, Yuksel et al., (2021) investigated whether language improvement over a four-year period of studying through English impacts academic achievement by comparing the scores of the students in a business administration program (a social science subject, $N = 81$) with those in a mechatronics engineering (a mathematics, physical and life sciences subject, $N = 84$). Their results revealed that language proficiency statistically significantly predicted EMI academic achievement in business administration courses but not in mechatronics engineering courses. The current study expands this line of research by exploring whether general English proficiency plays a role in EMI academic achievement and whether this differs according to macro (academic division), meso (academic department), and micro (academic program) levels.

2.4. English medium instruction in Turkey

Although Turkey does not have a colonial past, it has adopted English as the medium of instruction (MOI) in higher education. EMI in Turkey has been exponentially growing in recent years. According to Dearden et al. (2016), 110 out of 178 higher education institutions in Turkey use English to teach academic subjects. Furthermore, Turkey has seen an incremental expansion of the multilingual model

of EMI (a hybrid rather than an "English only" use of language; Macaro, 2018). As of 2019, out of 10,396 undergraduate programs offered by 193 universities in Turkey, 2542 programs provide students with full EMI education, while 378 provide partial EMI. 28% of all EMI programs are, therefore, partial EMI programs (OSYM Manual, 2019).

Similar to the exponential growth in the number of the EMI programs (OSYM Manual, 2019), numerous studies have been conducted on various aspects of the use of English to teach academic subjects in Turkey. When these studies are reviewed, we can find some empirical investigations which have examined students' motivations for choosing EMI programs (Kırkgöz, 2005; Turhan & Kırkgöz, 2018) or studies that have undertaken policy-level analysis of the EMI programs (Karakas, 2016). There are some other studies that have investigated the challenges faced by Turkish EMI students and strategies used to overcome those challenges (Soruç & Griffiths, 2018; Soruç et al., 2018). However, few quantitative studies have been conducted. One example is the study by Macaro and Akıncıoğlu (2018), which explored Turkish EMI students' perceptions using year group, gender, and university type as variables. To our best knowledge, no prior study has explored the influence of general English language proficiency, TMI academic achievement, and academic subject on EMI success, at three different levels. This innovative study aims to fill this gap in the literature.

Motivated by these gaps in the literature, the current study seeks to address the following research questions:

1. To what extent do general English proficiency, TMI academic success, and academic division predict EMI academic achievement?
2. To what extent do general English proficiency and TMI academic success predict EMI academic achievement in engineering and economics, and administrative sciences?
3. To what extent do general English proficiency and TMI academic success predict EMI academic achievement in the following academic subjects: civil engineering, electronics and communication engineering, mechatronics engineering, environmental engineering, business administration, international relations, labor economics, and political science and public administration?

3. Methodology

This study adopted a quantitative research approach. First, details about the context and participants of this study are given. Next, the procedural details of data collection and analysis are explained.

3.1. Context

EMI programs at higher education institutions in Turkey are classified into two types: partial EMI and full EMI. The current study investigates partial EMI programs, also known as the implementation of a "multilingual model" of EMI (Macaro, 2018). This means that not the entire program is taught through English; rather, students are required to take a minimum of two EMI courses per semester. In these programs, courses such as introduction to political science, basic concepts in law, history of Turkish politics (in international relations program) and linear algebra and engineering applications, and electric circuit theory and differential equations (in electronics and communications engineering program) are offered in Turkish and account for a minimum of 70% of all the courses, whereas the rest (e.g., research methods in international relations, sociology and business English in the international relations program, and introduction to electronics and telecommunications engineering, linear algebra and engineering applications and computer programming, in the electronics and communication engineering program) are offered in English. Newly admitted students are required to take a general English language proficiency exemption test, that is, Cambridge Preliminary English Test (PET) at the B1 level of difficulty (Cambridge ESOL, 2014). If this test is failed, students then need to complete a one-year intensive general English as a foreign language course alongside their EMI studies.

3.2. Participants

Data were collected at a major public university in Turkey that offers 13 EMI programs in three departments. Departments included in this sample were: Engineering (from the MPLS division), and Economics and Administrative Sciences (from the social science division). The remainder of the sample (i.e., of the total data collected) could not be included in this study due to a lack of a sufficient sample size from each program (two in the humanities, a further two in MPLS, and one in social science).

The Department of Engineering offers six EMI programs, while the Department of Economics and Administrative Sciences offers five. Consent forms were sent out to a total of 1,343 students in 13 academic programs. 908 students gave consent for their scores to be used in this study. A final sample of 716 were included: 357 students from four EMI programs in the Engineering Department, and 359 students from four EMI programs in the Economics and Administrative Sciences Department. All participants were Turkish and had similar learning experiences of English as a foreign language. They were exposed to English only during their EMI classes, and most of them did not get much opportunity to improve their English out of class.

Using a purposive sampling technique (see Rose & McKinley, 2020), participants were included in the sample if they met the following criteria: The participant had completed three and a half years of their degree program, the participant had completed a minimum of 18 EMI courses and 35 TMI courses, the participant had completed the one-year intensive general English program. Background information of participants according to their academic division, department and program is provided in Table 1.

Table 1 Demographic information of participants according to academic division, department and program

Division: Mathematical, physical and life sciences (MPLS) Department: Engineering (*N* = 357)				
Programs	Civil engineering	Electronics and communication engineering	Mechatronics engineering	Environmental engineering
Gender (%)	M: 68 (73) F: 25 (27)	M: 64 (75) F: 21 (25)	M: 72 (79) F: 19 (21)	M: 59 (67) F: 29 (33)
Total students	93	85	91	88
Age range (*M*)	22-27 (24.6)	21-29 (23.9)	22-28 (25.1)	21-28 (24.7)
Division: Social science Department: Economics and administrative sciences: (*N* = 359)				
Programs	Business administration	International relations	Labor economics	Political science and public administration
Gender (%)	M: 38 (46) F: 45 (54)	M: 37 (42) F: 52 (58)	M: 54 (59) F: 38 (41)	M: 45 (47) F: 50 (53)
Total students	83	89	92	95
Age range (*M*)	22-31 (25.2)	22-30 (24.5)	21-30 (26.2)	23-31 (25.3)

Note. M = males, F = females

3.3. Data collection

Quantitative data on four variables were collected for statistical analyses: EMI academic success (i.e., general grade point average [GPA] scores for English-medium taught courses), TMI academic success (i.e., general GPA scores for Turkish-medium taught courses), general English proficiency (i.e., English language test scores), and the academic subject students were studying. After the university had granted all the necessary ethical and legal permissions, and when students gave their informed consent, data were obtained from the University Registrar Office. The four variables were measured as follows:

- *EMI academic success* was calculated by dividing the sum of final course scores for all courses taken in English by the total number of English-medium courses each student took. Final course scores for the students were generated by combining students' mid-term and final exam scores, as well as grades for presentations, projects, and quizzes. All assessment tools used in each course are publicly available on the course list server

of the university. To gain a comprehensive overview of students' EMI academic success, a minimum of 18 English-medium courses was used as a unit threshold to be included in this study.

- *TMI academic success* was calculated by dividing the sum of final course scores for all courses taken in Turkish by the total number of courses each student took in Turkish. Similar to EMI academic success, final course scores were derived from various assessment tools including mid-term and final exam scores, presentations, projects and quizzes. A minimum of 35 Turkish-medium courses was used as a unit threshold to be included in this study.
- *General English proficiency*: A version of the Cambridge Preliminary English Test (PET) at the B1 difficulty level (Cambridge ESOL, 2014) was used to measure general English language proficiency. This included sections on all four language skills: reading, writing, listening, and speaking. PET exam reports include scores in each skill as well as a single final score. The final scores of the students 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).
- *The framework for academic divisions and departments*, as adopted by the University of Oxford (ODDF; University of Oxford, 2020), was used as a model to classify and group academic subjects into two academic divisions: MPLS, and social sciences. *Academic subject* is a general term that encompasses the different levels of academic division, academic department, and academic program.

3.4. Data analysis

Using the computing software R, we performed multiple linear regressions on the dataset to determine if general English proficiency, TMI academic success, and academic subject predict EMI academic achievement. Separate models were run at the macro level (division, RQ1), the meso level (department, RQ2), and the micro level (program, RQ3). Levels of analysis are illustrated in Figure 1. This was done to determine the unique variance in EMI academic success as explained by each of the predictor variables at each level. Multi-level modelling was determined to be inappropriate due to the sample size (Cohen, 1998).

There were missing data, and each model met the assumptions for multiple linear regressions (i.e., linearity, normality, multicollinearity, correlation, and homoscedasticity; Field, 2013). As the variables in each model (at each level) were very

similar, the hypothesis was that the results of each model would be similar. However, the next section demonstrates that this was not the case.

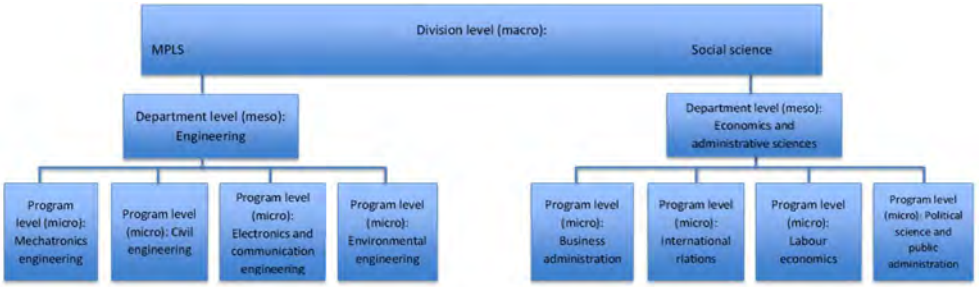

Figure 1 Levels of data analysis

4. Results

To answer each research question, we ran multiple linear regressions on the dataset at three different levels: the macro level (academic division), the meso level (academic department), and the micro-level (academic program). Research questions 2 and 3 are presented separately according to division, with the results grouped for MPLS subjects and social science subjects.

4.1. To what extent do general English proficiency, TMI academic success, and academic division predict EMI academic achievement?

Model 1 (see Table 2) showed that all three predictors statistically significantly predicted EMI academic success ($F(3, 712) = 63.69$, $p = .000$). This included: general English proficiency (beta = .145, $t = 4.275$, $p = .000$), TMI academic success (beta = .384, $t = 11.082$, $p = .000$), and academic division (beta = .129, $t = 3.686$, $p = .000$). The adjusted R^2 showed that these three predictors explained 20% of the variance in EMI academic success.

Table 2 Model 1: General English proficiency, TMI academic success, and academic division predicting EMI success according to division

	B	Estimate	Std. error	*t*
Constant	.000	12.588	4.921	2.558*
General English proficiency	.145	.248	.058	4.275***
TMI academic success	.384	.406	.036	11.082***
Academic division	.129	3.232	.876	3.686***

Note. Adjusted $R^2 = .20$***; significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$

4.2. MPLS academic subjects

4.2.1. To what extent do general English proficiency and TMI academic success predict EMI academic achievement in engineering? (division level)

The model presented in Table 3 shows that TMI academic success was the only statistically significant predictor of EMI academic success in the Engineering Department ($F(2, 354 = 193.7$, $p = .000$). The adjusted R^2 showed that TMI academic success explained 51.9% of the variance in EMI engineering academic success (beta = .727, $t = 19.584$, $p = .000$).

Table 3 Model 2: General English proficiency, TMI academic success, and academic division predicting EMI success in engineering

	B	Estimate	Std. error	*t*
Constant	.000	11.555	5.544	2.084*
General English Proficiency	-.036	-.068	.069	-.983
TMI academic success	.727	.860	.043	19.58***

Note. Adjusted $R^2 = .519$***; significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$

4.2.2. To what extent do general English proficiency and TMI academic success predict EMI academic achievement in civil engineering? (program level)

Model 3 (see Table 4) showed that both predictors statistically significantly predicted EMI academic success in civil engineering ($F(2, 90) = 76.27$, $p = .000$). This included: general English proficiency (beta = -.182, $t = -2.738$, $p = .007$) and TMI academic success (beta = .820, $t = 12.341$, $p = .000$). The adjusted R^2 showed that these two predictors explained 62% of the variance in EMI civil engineering academic success.

Table 4 Model 3: General English proficiency, TMI academic success, and academic division predicting EMI success in civil engineering

	B	Estimate	Std. error	*t*
Constant	.000	-23.706	12.450	-1.904
General English Proficiency	-.182	-.407	.148	-2.738**
TMI academic success	.820	1.752	.142	12.341***

Note. Adjusted $R^2 = .62$***; significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$

4.2.3. To what extent do general English proficiency and TMI academic success predict EMI academic achievement in electronics and communication engineering? (program level)

Table 5 illustrates that TMI academic success was the only statistically significant predictor of EMI academic success in electronics and communication engineering ($F(2, 82 = 68.62, p = .000)$. The adjusted R^2 showed that TMI academic success explained 61.6% of the variance in EMI electronics and communication engineering academic success (beta = .793, $t = 11.636$, $p = .000$). This strong, positive, linear relationship is illustrated in Figure 2; the more successful students were in their TMI courses (see the incremental rise on the *y* axis), so too were they more successful in their EMI courses (see the incremental rise on the *x* axis).

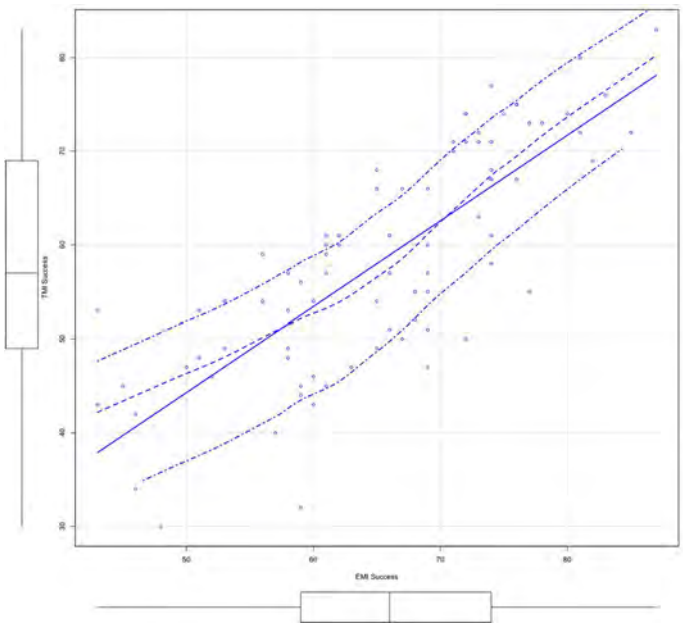

Figure 2 Scatterplot of EMI academic success in electronics and communication engineering and TMI academic success

Table 5 Model 4: General English proficiency, TMI academic success, and academic division predicting EMI success in electronics and communication engineering

	B	Estimate	Std. error	*t*
Constant	.000	-.433	.252	-.047
General English Proficiency	-.015	-.024	.109	-.223
TMI academic success	.793	.925	.079	11.636***

Note. Adjusted $R^2 = .616$***; significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$

4.2.4. To what extent do general English proficiency and TMI academic success predict EMI academic achievement in mechatronics engineering? (program level)

Model 5 (see Table 6) highlighted that TMI academic success was the only statistically significant predictor of EMI academic success in mechatronics engineering ($F(2, 88 = 120.2, p = .000)$. The adjusted R^2 showed that TMI academic success explained 72.5% of the variance in EMI mechatronics engineering academic success (beta = .855, $t = 15.212$, $p = .000$).

Table 6 Model 5: General English proficiency, TMI academic success, and academic division predicting EMI success in mechatronics engineering

	B	Estimate	Std. error	*t*
Constant	.000	13.377	8.150	1.641
General English Proficiency	.001	.003	.107	.031
TMI academic success	.855	.863	.056	15.212***

Note. Adjusted $R^2 = .725$***; significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$

4.2.5. To what extent do general English proficiency and TMI academic success predict EMI academic achievement in environmental engineering? (program level)

In Table 7, Model 6 demonstrates that TMI academic success was the only statistically significant predictor of EMI academic success in environmental engineering ($F(2, 85 = 304.6, p = .000)$. The adjusted R^2 showed that TMI academic success explained 87.4% of the variance in EMI environmental engineering academic success (beta = .940, $t = 24.643$, $p = .000$).

Table 7 Model 6: General English proficiency, TMI academic success, and academic division predicting EMI success in environmental engineering

	B	Estimate	Std. error	*t*
Constant	.000	3.103	5.359	.579
General English Proficiency	-.044	-.079	.068	-1.162
TMI academic success	.940	1.017	.041	24.643***

Note. Adjusted $R^2 = .874$***; significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$

4.3. Social sciences

4.3.1. To what extent do general English proficiency and TMI academic success predict EMI academic achievement in economics and administrative sciences? (department level)

In Table 8 Model 7 displays general English proficiency as the only statistically significant predictor of EMI academic success in the Economics and Administrative Sciences Department ($F(2, 356 = 22.74, p = .0000$). The adjusted R^2 showed that English proficiency explained 10.8% of the variance in EMI economics and administrative sciences academic success (beta = 0.337, $t = 6.741$, $p = .0000$).

Table 8 Model 7: General English proficiency, TMI academic success, and academic division predicting EMI success in economics and administrative sciences

	B	Estimate	Std. error	*t*
Constant	.000	30.065	6.165	4.877***
General English Proficiency	.337	.508	.075	6.741***
TMI academic success	-.033	-.31	.047	-.664

Note. Adjusted R^2 = .108***; significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$

4.3.2. To what extent do general English proficiency and TMI academic success predict EMI academic achievement in business administration? (program level)

Table 9 (Model 8) shows both predictors were statistically significant for business administration ($F(2, 80) = 21.22$, $p = .000$). This included: general English proficiency (beta = .559, $t = 6.169$, $p = .000$) and TMI academic success (beta = -.239, $t = -2.644$, $p = .009$). The adjusted R^2 showed that these two predictors explained 33% of the variance in EMI business administration academic success.

Table 9 Model 8: General English proficiency, TMI academic success, and academic division predicting EMI success in business administration

	B	Estimate	Std. error	*t*
Constant	.000	22.003	9.973	2.206*
General English Proficiency	.559	.802	.130	6.169***
TMI academic success	-.239	-.200	.075	-2.644**

Note. Adjusted R^2 = .33***; significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$

4.3.3. To what extent do general English proficiency and TMI academic success predict EMI academic achievement in international relations? (program level)

Table 10 shows the results from Model 9. General English proficiency was the only statistically significant predictor of EMI academic success in international relations ($F(2, 86 = 3.79$, $p = .000$). The adjusted R^2 showed that English proficiency explained 5.9% of the variance in EMI international relations academic achievement (beta = .274, $t = 2.617$, $p = .01$).

Table 10 Model 9: General English proficiency, TMI academic success, and academic division predicting EMI success in international relations

	B	Estimate	Std. error	*t*
Constant	.000	14.244	18.248	.781
General English Proficiency	.274	.489	.187	2.617*
TMI academic success	.136	.180	.138	1.302

Note. Adjusted $R^2 = .059$***; significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$

4.3.4. To what extent do general English proficiency and TMI academic success predict EMI academic achievement in labor economics? (program level)

Model 10 (see Table 11) shows that general English proficiency was the only statistically significant predictor of EMI academic success in labor economics ($F(2, 89 = 11.81$, $p = .000$). The adjusted R^2 showed that English proficiency explained 19% of the variance in EMI labor economics academic success (beta = .458, $t = 4.85$, $p = .000$). This relationship is illustrated in Figure 3. This scatterplot shows a strong, positive, linear association between that English proficiency and EMI labor economics academic success.

Table 11 Model 10: General English proficiency, TMI academic success, and academic division predicting EMI success in labor economics

	B	Estimate	Std. error	*t*
Constant	.000	10.687	12.402	.862
General English Proficiency	.458	.719	.148	4.856***
TMI academic success	.038	.034	.085	.408

Note. Adjusted $R^2 = .191$***; significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$

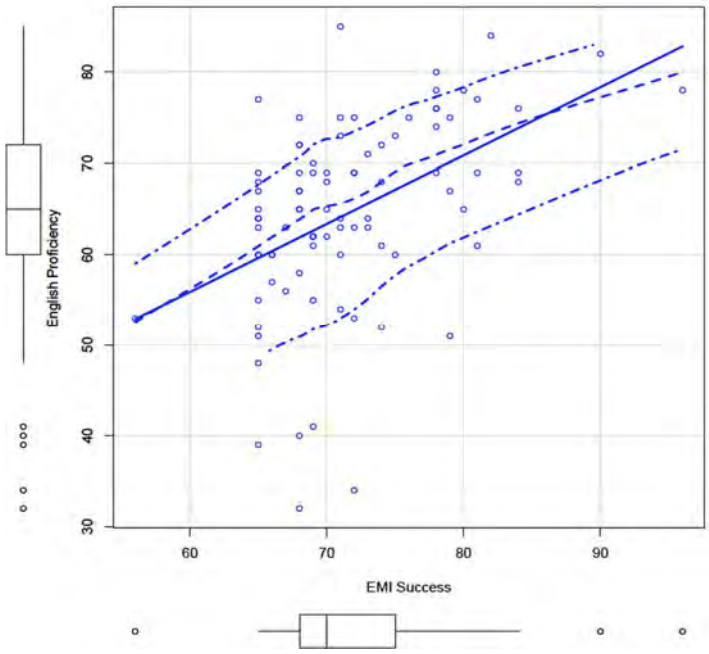

Figure 3 Scatterplot of EMI academic success in labor economics and general English proficiency

4.3.5. To what extent do general English proficiency and TMI academic success predict EMI academic achievement in political science and public administration? (program level)

Model 11 (Table 12) highlights general English proficiency as the only statistically significant predictor of EMI academic success in political science and public administration ($F(2, 92 = 4.4$, $p = .013$). The adjusted R^2 showed that English proficiency explained 6% of the variance in EMI political science and public administration academic success (beta = .280, $t = 2.786$, $p = .006$).

Table 12 Model 11: General English proficiency, TMI academic success, and academic division predicting EMI success in political science and public administration

	B	Estimate	Std. error	*t*
Constant	.000	33.422	10.966	3.048**
General English Proficiency	.280	.368	.132	2.786**
TMI academic success	.062	.059	.095	.624

Note. Adjusted $R^2 = .06$; significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$

5. Discussion

5.1. RQ1: To what extent do general English proficiency, TMI academic success, and academic division predict EMI academic achievement?

This study investigated the influence of general English language proficiency, TMI success, and academic discipline on EMI academic achievement at three different levels (i.e., macro, meso, and micro). When the dataset was analyzed at division level, all three independent variables statistically significantly predicted EMI academic success, explaining 20% of the variance. This finding partially supports previous studies that have examined the impact of these variables independently (e.g., Rose et al., 2020; Soruç et al., 2021; Yuksel et al., 2021) but contradicts Curle et al., (2020), who only found L1 MOI success to be a significant predictor of EMI academic success.

General English language proficiency was found to be a strong predictor of EMI success in the social sciences (at the macro, meso *and* micro levels). It cannot be ignored that the Matthew effect (Merton, 1968) might be present here: students most likely to achieve high grades in social science EMI programs are those who might already be highly proficient in English. Nevertheless, this finding may be due to the role that English plays in this discipline. Kuteeva and Airey (2014) argue that English-taught programs in social sciences rely heavily on L2 skills because of the need to use the language flexibly and creatively. Evidence related to this was reported by Dearden and Macaro (2016). In their study, EMI lecturers in this discipline reported that they focused on language issues to a large extent. In addition, Bolton and Kuteeva (2012) state that the teaching and learning of social sciences involve more interactive, small group seminars, which leads to a heavy reliance on language (i.e., the use of, practice, and need for English).

The overall finding that general English language proficiency did not predict EMI academic achievement in MPLS disciplines may be explained from two perspectives, that is, the language used in EMI materials, and also, actual language practices in EMI classrooms. Firstly, Ward's (2009) analysis of five engineering textbooks found that students only need to know 299 word types for comprehension. EMI students may, therefore, have mastered these word types, which broadly are MPLS-related jargon. It stands to reason, therefore, that general English language proficiency would play less of a role in this academic discipline. This may, however, vary from MPLS discipline to MPLS discipline. An anomaly in this study was civil engineering, where both general English proficiency and TMI success were significant predictors. Therefore, to further understand these subtle disparities in the influence of general versus academic vocabulary knowledge in EMI MPLS disciplines, further MPLS discipline-comparative

research (at micro level) needs to be conducted. Secondly, findings of Roothooft's (2019) study illustrated that humanities EMI lecturers were stricter about limiting the use of the mother tongue in the EMI classroom than STEM lecturers. This discipline-specific, in-classroom use of language may provide insight into why, in this study, TMI academic achievement was a strong predictor of MPLS students' EMI academic achievement. MPLS students may be benefiting from the L1 in TMI not only in terms of knowledge transfer, but also through their daily EMI learning experience, thus possibly explaining the heavy influence of L1 success. However, the situation may vary from one EMI context to another; therefore, it is necessary to conduct further research into how in-classroom EMI language practices directly influence EMI academic achievement.

5.2. RQ2: To what extent do general English proficiency and TMI academic success predict EMI academic achievement in: Engineering and economics, and administrative sciences?

When each department was analyzed, results indicated that academic achievement in TMI courses played a significant role in EMI academic achievement in engineering (a MPLS department), whereas general English language proficiency influenced EMI success in economics and administrative sciences (a social sciences department). These findings are in line with previous studies that have explored EMI academic achievement in the social sciences. For example, Curle et al. (2020) found that TMI was a statistically significant predictor while general English proficiency of the students was also found to have a significant impact. With respect to general English proficiency, Kuteeva and Airey (2014) argue that students rely heavily on language in the social sciences because they need to use it flexibly and creatively. On the other hand, Dearden and Macaro (2016) suggest that lectures in MPLS depend more on formulae and downplay the significance of the medium of instruction.

5.3. RQ3: To what extent do general English proficiency and TMI academic success predict EMI academic achievement in the following academic subjects: civil engineering, electronics and communication engineering, mechatronics engineering, environmental engineering, business administration, international relations, labor economics, and political science and public administration?

When each program was analyzed individually, nuances in the data emerged. Results showed that general English language proficiency and TMI achievement predicted achievement in EMI business administration courses (33% of the variance). This is somewhat in line with Curle et al.'s (2020) study of economics

students in Turkey, which found TMI success rather than English proficiency predicted student EMI achievement in economics. These subtle differences in findings need to be further explored in various EMI contexts in order for results to be generalizable. Furthermore, even though Halliday (2004) states that the social sciences make greater use of narrative or expository language, some subjects (such as economics and business studies) may rely more on numbers and formulae rather than language as such. More research is therefore called for in this respect. Furthermore, the type of support we provide for EMI students should be tailored at the micro-level (program). Providing economics and business students with some courses through their L1 appears to positively affect their EMI academic achievement.

When academic programs in the MPLS division were analyzed separately, results revealed that academic achievement in Turkish-medium courses was the strongest, most consistent predictor of EMI success, explaining overall 51.9% of the variance in EMI success scores. These findings therefore indicate that EMI academic achievement is enhanced when MPLS students study some courses through their L1 alongside their EMI courses. The phenomenon of "transfer of knowledge" might explain this influence (Olivares, 2002). As students are acquiring knowledge in their L1 at the same time as learning similar (or even more advanced) concepts through English, understanding of abstract concepts is faciliated (Cummins, 2017), thus positively affecting learning outcomes. Applying the knowledge acquired in the L1 helps students to become more academically successful in the L2 (Brooks & Danserau, 1987; Dong, 2002; Lemberger & Vinogradova 2002). Cummins' (2017) model of multilingual transfer, therefore, provides theoretical support for the cognitive transfer of conceptual elements as well as metacognitive and metalinguistic learning strategies from L1 to L2. This issue deserves further research, particularly in contexts employing multilingual models of EMI (Macaro, 2018).

6. Limitations

Our results should be evaluated taking the limitations of this study into account. Firstly, only partial EMI students were sampled since the effect of TMI over EMI academic achievement could have only been investigated in this EMI model. In addition, only Turkish students were included. Future studies might attempt to undertake multiple-country comparisons to increase generalizability. Furthermore, the effect sizes in this study might be another limitation. First, although Cohen (1988) argues that power, significance criterion, sample size, and effect size are a function of the other "which means that when any three of them are fixed, the fourth is completely determined" (p. 14). Nevertheless, replication

studies are called for to compare effect sizes. Second, this study adopted a quantitative research approach, reporting only the nuanced statistical significance of the influence of certain variables on EMI academic success. Future studies might adopt a qualitative or mixed-method approach. Interview or classroom observation data might shed further light on the role of English language proficiency and the mother tongue in EMI students' academic success, as well as other possible influencing variables. Finally, limitations of the measures used in this study should be recognized. In particular, EMI academic success has been operationalized as a single number in this study. However, the complexity of this construct should be acknowledged and thus future studies might take a more nuanced measurement approach to capture this complexity.

7. Conclusion

This study examined the influence of general English proficiency, success in TMI, and academic subject (or discipline), on EMI academic achievement. It presented evidence of the influence of these variables at three different academic levels: macro (division), meso (department), and micro (program). Findings illustrated subtle differences at each level. This has clear implications for EMI policymakers. Based on this evidence, these stakeholders should consider discipline-specific issues faced by EMI lecturers and students at the three different levels. Aizawa and Rose (2019) argue that EMI policy and practice usually do not overlap and top-down policies usually ignore academic discipline-based practices. To have sound practices, policies should be tailored according to the needs of each academic discipline in terms of the number and role of L1 courses students take alongside their EMI courses as well as the English language support offered to students. Results from this study also have implications for EMI practitioners. Lecturers teaching the academic subjects examined in this paper may draw on this evidence to further support their students. For example, civil engineering lecturers are now aware that not only do courses taught through Turkish enhance EMI learning, but that students may also require *more, sustained* English language support (compared to, for example, mechatronics engineering students). These academic disciplinary differences in EMI contexts need to be taken into account when designing EMI student support programs.

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APPENDIX

The University of Oxford's divisions and departments framework (University of Oxford, 2020)

HUMANITIES	MATHEMATICAL, PHYSICAL AND LIFE SCIENCES	SOCIAL SCIENCES	MEDICAL SCIENCES
Classics	Computer Science	Anthropology and Museum Ethnography	Biochemistry
English Language and Literature	Chemistry	Archaeology	Clinical Medicine
History	Earth Sciences	Government	Clinical Neurosciences
History of Art	Engineering Science	Economics	Experimental Psychology
Medieval and Modern Languages	Materials	Education	Medicine
Music	Mathematics	Geography and the Environment	Obstetrics and Gynecology
Oriental Studies	Physics	Interdisciplinary Area Studies	Oncology
Philosophy	Plant Sciences	International Development	Orthopedics, Rheumatology and Musculoskeletal Sciences
Theology and Religion	Statistics	Technology and the Internet	Pediatrics
Art	Zoology	Business	Pathology
		Law	Pharmacology
		Politics and International Relations	Physiology, Anatomy and Genetics
		Social Policy and Intervention	Population Health
		Sociology	Psychiatry
			Surgical Sciences
			Primary Care Health Sciences

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