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Students' academic language-related challenges in English Medium Instruction: The role of English proficiency and language gain

Adem Soruç [a,*], Mehmet Altay [b], Samantha Curle [c], Dogan Yuksel [b]

[a] Department of Education, University of Bath, UK
[b] Department of Foreign Language Education, Kocaeli University, Turkey
[c] Department of Education, University of Bath, Bath, United Kingdom

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1. Introduction

The interest in the use of English medium instruction (EMI), in particular at the tertiary level, has continued unabated since the beginning of the new millennium (Macaro, Curle, Pun, An, & Dearden, 2018; Wä;chter & Maiworm 2014). It appears to have become one of the biggest global educational phenomena in our present century (Aizawa, Thompson, Rose, & Curle, 2020). Macaro (2018) defines EMI 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" (p. 18). The Turkish context (the setting of this study) falls within this description.

One might ask, why do countries or jurisdictions where English is not the native or the first language implement EMI as an

* Corresponding author.
E-mail addresses: A.Soruc@bath.ac.uk (A. Soruç), mehmet.altay@kocaeli.edu.tr (M. Altay), samanthamcurle@gmail.com (S. Curle), doganyuksel@gmail.com (D. Yuksel).

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educational approach even though it is a well-known fact that learning academic content through a second/foreign language will bring many challenges? (See Aizawa et al., 2020). One of the most conspicuous challenges is caused by the diverse linguistic landscape of the EMI classroom, where the learning of English is not prioritised nor usually supported. These challenges are insurmountable, if not unmanageable, for some students whose language proficiency remains inadequate to understand the academic content being studied. Students may experience challenges across all four language skills: speaking, listening, reading, and writing. These challenges have been described by a few studies in different contexts such as Hong Kong (Evans & Morrison, 2011), Japan (Aizawa & McKinley, 2020; Aizawa et al., 2020; Rose & McKinley, 2018), Brazil (Martínez, 2016), the Netherlands (Wilkinson, 2013) and Turkey (Kamaşak, Sahan, & Rose, 2021; Soruç & Griffiths, 2018; Soruç, Dinler, & Griffiths, 2018). Some of these studies are descriptive in nature, demonstrating the overall challenges either EMI lecturers or students face (e.g., Soruç & Griffiths, 2018; Soruç et al., 2018), while others adopt a more quantitative approach investigating the skill-based challenges (e.g., Aizawa et al., 2020; Kamaşak et al., 2021).

The study reported in this article presents a longitudinal piece of research that adopted a pre/post-test design. It investigates to what extent English language proficiency predicts overall academic language-related challenges of EMI students studying International Relations and Electronic Engineering. It also makes an original contribution to knowledge by examining whether a gain in English language proficiency over four years of EMI education exists, and more importantly, whether this gain predicts student perceived linguistic challenges. This has not been investigated in previous EMI research (see Macaro et al., 2018).

2. Literature review

2.1. Challenges faced by EMI students

In their review of EMI challenges in higher education, Aizawa et al. (2020) presented a typology of challenges in four major categories, namely language-related challenges, institutional/organisational challenges, nationality/culture-related challenges, and materials-related challenges (Bolton & Kuteeva, 2012). The language-related challenges encountered by EMI students have attracted scholarly attention in various research settings (e.g., Airey, 2011; Airey, Lauridsen, Räsänen, Salö, & Schwach, 2017; Airey & Linder, 2006; Aizawa et al., 2020) including Turkey (Hasirci & Cosgun, 2018; Macaro & Akincioglu, 2018; Soruç & Griffiths, 2018; Yıldız, Soruç, & Griffiths, 2017).

The most oft-cited challenge in EMI contexts is students' insufficient English language proficiency (Airey & Linder, 2006; Galloway, Numajiri, & Rees, 2020; Wilkinson & Yasuda, 2013), showing detrimental consequences on students' learning (Curle, Jablonkai, Mittelmeier, Sahan, & Veitch, 2020). It has also been reported that most of these student challenges are highly context-dependent (Curle et al., 2020). For example, based on a survey in the Nordic Countries, Airey, Lauridsen, Räsänen, Salö, and Schwach (2017) reported that students communicated less in class and reported more comprehension difficulties. Likewise, in a Japanese higher education context, Author 3Rose, Curle, Aizawa and Thompson (2019) reported that students majoring in international business faced challenges mostly in the productive skills area (i.e., speaking and writing). This included appropriate academic referencing styles when producing academic reports and essays. Building on that study, Aizawa et al.'s (2020) research conducted in the same Japanese context revealed that students found speaking to be the most challenging skill of their EMI studies.

A strand of studies have focused on students' challenges in English-taught programmes in the Turkish higher education setting. A study conducted by Macaro and Akincioglu (2018) revealed that Turkish students did not report major challenges when studying through EMI. However, Hasirci and Cosgun (2018) found that in their study, all participants faced numerous challenges when studying through EMI, mainly due to a lack of English proficiency. Soruç and Griffiths (2018) present these language-related challenges as; difficulties with speaking, listening and vocabulary. Similarly, Yıldız et al. (2017) identified the biggest student language-related problems as difficulties in technical vocabulary, difficulties in following lecturers' speech, and constant lecturer code-switching. More recently, when Kamaşak et al. (2021) investigated the linguistic challenges students face at an EMI university in Turkey, they found writing and speaking to be the most challenging skills when studying through EMI. They suggested that academic discipline, first language (L1) background, prior EMI experience, and language proficiency mediated these perceived challenges.

To summarise, studies conducted on language-related challenges in various EMI settings have revealed mixed results: some studies have not reported any major challenges for EMI students (Macaro & Akincioglu, 2018), while others have found that students face serious challenges in their EMI studies (Airey et al., 2017; Rose et al., 2019; Kamaşak et al., 2021). To date, it is unknown whether there is a relationship between language gained over the duration of several years of studying through EMI and academic language-related challenges. This study is therefore of significance as it fills this research gap.

2.2. Language proficiency and challenges in the EMI context

To date, not many studies have systematically examined the relationship between language proficiency and EMI language-related challenges (but see Curle et al., 2020). This is even though it is generally assumed that students at lower proficiency levels report more linguistic challenges (Sultana, 2014). In one of the first studies that investigated the impact of varying proficiency levels on EMI language-related challenges at a Japanese business management course in Japan ($n = 264$), Aizawa et al. (2020) administered a seven-point EMI Challenges Likert Scale containing 45 items (adapted from Evans & Morrison, 2011). They found a distinct linear relationship between student proficiency and challenges: an increase in students' language proficiency brought about a decrease in language-related challenges.

Indeed, low English language proficiency is the most well-known challenge encountered in various EMI settings (Airey, 2011; Galloway et al., 2020; Tsuneyoshi, 2005). Several studies have addressed the role of inadequate language proficiency on different

language skills, such as unfamiliar technical terms in students' course books, which hinders reading comprehension (Uchihara & Harada, 2018); the inability to produce spontaneous speech, hindering speaking (Suzuki, Harada, Eguchi, Kudo, & Moriya, 2017); being unable to follow different lecturers' accents, a hindrance for listening and comprehending accurately (Soruç & Griffiths, 2018; Evans & Morrison, 2011); and a lack of academic writing skills to follow the appropriate academic style in writing (Evans & Morrison, 2011). The only study investigating whether there is an English language proficiency threshold for EMI students to overcome their academic language-related challenges in English language skills (i.e., reading, listening, speaking, and writing) is Aizawa et al. (2020). They found "no clear discernible threshold" (p. 1) of Japanese students studying an international business course through EMI.

However, no previous study has examined the interplay between language proficiency gain after four years of EMI education and students' academic language-related challenges in two different disciplines (International Relations and Electronic Engineering). Given the dearth of longitudinal research in the EMI literature, the research reported in this article makes an original contribution to EMI knowledge.

2.3. Discipline-based differences in EMI

The literature classifies academic disciplines into three broad categories: physical and life sciences, the humanities, and social sciences. More specifically; 'numeric-based subjects' versus 'arts and humanities' (Dearden & Macaro, 2016), 'hard' versus 'soft' sciences (Dafouz, Camacho, & Urquia, 2014; Neumann, 2001), 'natural sciences' versus 'social sciences and humanities' (Kuteeva & Airey, 2014) to 'STEM' versus 'humanities' (Roothooft, 2019).

Previous EMI literature has adopted a descriptive approach when comparing different disciplines. Some have reported very general lecturers' (Dearden & Macaro, 2016; Kuteeva & Airey, 2014; Roothooft, 2019) and learners' disciplines (Kuteeva & Airey, 2014) perceptions of linguistic complexity in various academic. Others have conducted lexical (Ward, 1999, 2009), linguistic (Halliday, 2004; Wellington & Osborne, 2001) and discourse (Halliday, 2004; Lemke, 1990) level analyses of the language used in different disciplines.

This study compares the challenges of EMI students from the Social Sciences and Mathematical, Physical, and Life Sciences (MPLS) divisions. We purposefully sampled one academic subject (International Relations) from the Social Sciences, and one from MPLS (Electronic Engineering) as language plays different roles in these disciplines. For example, Kuteeva and Airey (2014) argue that students rely heavily on language in the Social Sciences because they need to use language flexibly and creatively. Evidence related to this in an EMI context was found by Dearden and Macaro (2016); Social Science lecturers stated that they focus more on language issues (Dearden & Macaro, 2016) and that teaching in Social Sciences requires more interaction and small group activities. This, according to Bolton and Kuteeva (2012), leads to a more frequent dependence on language (i.e. the use of, the practice, and the need for English). On the other hand, in MPLS academic subjects, lecturers depend more on formulae and downplay the significance of the medium of instruction (Dearden & Macaro, 2016). This study has contributed to the ever-growing EMI literature since limited research has investigated the interplay between discipline-based differences and academic language-related challenges.

3. The study

The current study addresses the following three research questions:

1) To what extent does English language proficiency predict overall academic language-related challenges in International Relations and Electronic Engineering?
2) To what extent does a gain in English language proficiency over four years (if any) predict academic language-related challenges in International Relations and Electronic Engineering?
3) To what extent do academic language-related challenges of the four different language skills vary according to the level of English language proficiency in International Relations and Electronic Engineering?

3.1. Setting

Research into the use of EMI in higher education has witnessed unprecedented growth over the past decade in Turkey (Aslan, 2018; Karakaş, 2018; West, Güven, Parry, & Ergenekon, 2015). Turkish higher education institutions offer two types of EMI programmes: partial EMI and full EMI. The current study was conducted at a public university that adopted a partial EMI model. This model follows the 'Preparatory Year Model' (Macaro, 2018), which requires students (before entering their major) to sit for a general English language proficiency exemption test. If this test is failed, students are required to complete a one-year Intensive General English as a Foreign Language programme before starting their EMI studies. When they start their programmes of study, to fulfil the partial EMI requirements, each student takes a minimum of two courses per semester in English. There were no courses offered both in Turkish and English at the same time. The university offers 13 partial EMI programmes in two divisions. One academic subject was chosen from each division (International Relations from the Social Science Division and Electronic Engineering from the Mathematical, Physical, and Life Sciences Division) to reduce the possible impact of context-related confounding variables (Margić & Vodopija-Krstanović, 2016).

3.2. Participants

After obtaining the necessary legal and ethical permissions from the university to conduct this study, participants' informed written consent was obtained. A total of 198 EMI students, 99 from each academic subject, permitted their data to be used in this study and completed the six-point Likert scale questionnaire on EMI Challenges (see Aizawa et al., 2020). In the International Relations programme, 52 participants were male, and 47 were female. Their age range was between 21 and 26 (M = 23.1). In the Electronic Engineering programme, 56 participants were male, and 43 of them were female. The mean age of the participants was 23.8, ranging between 21 and 27. In their respective programmes, all participants had been taught by the same lecturers for all of their courses. This means that if *Course A* was taken by a student, we made sure that *Lecturer A* was the instructor for this course for all students. This was to ensure consistency among our participants in terms of assessment procedures and grading. This helped us eliminate any possible teacher effect (see Mårtensson & Bild, 2016). Further details about the participants include:

- All participants were Turkish, and they had similar learning experiences of English as a foreign language.
- All students had taken at least two semesters of compulsory General English Proficiency preparatory education before starting their EMI studies.
- All students had completed four academic years of EMI study in their academic subjects.
- All students had completed a minimum of 20 EMI courses and 40 Turkish Medium Instruction courses over eight semesters.

3.3. Test-retest design

In this study, as well as investigating the students' perceived overall academic language-related challenges, we researched a) whether English language proficiency predicts the students' perceived challenges and if so, b) to what extent the language development or gain after four years of EMI education predicts challenges and c) to what extent the challenges of the four language skills vary according to the language proficiency level of the students in two academic disciplines. Therefore, we have adopted a test-retest research design. A frequent way of measuring language development is to compare the difference (if any) of two-time points of measurement on a standardised proficiency test (in this study, the Cambridge PET). Considering the four-year interval between the two measurements, the researchers maintain that students' language gain was not affected by the effect of the test/retest design (Salkind, 2010). This way, a comparable, standardised assessment can be reached at each time point (Ross, 1998). This test/retest method, which has also been used in other EMI studies (see Rogier, 2012), was used in this study to determine whether there were any language gains after four years of EMI study.

3.4. Data collection

A quantitative survey approach (Jalongo & Saracho, 2016; McKinley & Rose, 2020) was adopted in this study. The current data set included:

- General English proficiency (GEP) test: this was given to the same group of participants at two different times. The first test was given at the beginning of the fall semester in 2016 (i.e., pre-test, Time 1). This was after the students had completed their preparatory year programme (PYP) before starting their major in EMI. The second test was given after four years of EMI study in the fall semester of 2020 (i.e., post-test, Time 2). The GEP test was an institutionally adapted version of the Cambridge Preliminary English Test (PET) (Cambridge Assessment, 2014). This test measured students' language skills, namely Reading, Writing, Listening, and Speaking. Validity and reliability of each component of the PET were reported in a series of papers published in Studies in Language Testing (SILT): validity of the writing section of the PET was explored in Shaw and Weir (2007), the reading section in Khalifa and Weir (2009), the speaking section in Taylor (2011) and the listening section in Geranpayeh and Taylor (2013).
- The score of 'language gain' was calculated by comparing the results on the pre-and post-test. Since the second research question of this study specifically focused on 'language gain', participants whose pre-and post-test results did not demonstrate an increase in proficiency were excluded from the analysis. Therefore, the sample size for this analysis decreased from 99 to 74 in Social Sciences and from 99 to 71 in MPLS.
- The EMI challenges scale (see the Appendix) was used to measure student perceptions of language-related challenges. This 45-item survey was developed by Evans and Morrison (2011) and validated in the Japanese EMI context by Aizawa et al. (2020). In the current study, we used the version used by Aizawa et al. (2020). This scale was created to investigate student perceptions of the language-related challenges in all four language skill areas: academic writing (15 items), academic speaking (10 items), academic reading (10 items), and academic listening (10 items). Item responses were on a six-point Likert scale with the responses from 1 (very easy) to 6 (very difficult). The higher the score, the more challenging the corresponding language skill. The internal reliability of the scale (Cronbach's Alpha) was 0.834 (Dörnyei, 2007).

3.5. Data analyses

Data management and analysis for the first two research questions were done using the computing software R, and SPSS 15 was used for the third research question. For RQ1, the responses of participants for the EMI challenges scale were used as the outcome

variable. Two simple linear regression models were run (one for each academic subject) to examine the prediction of students' perceived challenges according to their language proficiency scores obtained at Time 1.

To answer RQ2, first, participants' 'language gain' scores were calculated by subtracting the pre- GEP test score from the post- GEP test score. Then, again, two simple linear regression models were run (one for each academic subject) to see if the language gain scores predicted challenges.

RQ3 focused on the extent to which challenges (of the four different English language skills) vary according to the level of English language proficiency in the two academic subjects (International Relations and Electronic Engineering). Based on the scale as provided by Cambridge Assessment English (UCLES, 2019), GEP scores were transformed into CEFR proficiency levels. It emerged that students were at an A2, B1, or B2 CEFR level. Therefore, a three (three CEFR levels) by four (four Challenges scales) between-subjects multivariate analysis of variance (MANOVA) was carried out to test whether there were any significant differences in academic language-related challenges according to CEFR level. As the EMI Challenges Scale concentrates on the four language skills, the results are clustered accordingly.

4. Results

4.1. English language proficiency and language-related challenges in EMI

Our first research question sought to explore the extent to which English language proficiency predicts academic language-related challenges experienced when studying International Relations and Electronic Engineering through English. Simple linear regression was used to explore this relationship. The higher the score on the EMI Challenges Scale, the more language-related challenges students experienced in their EMI studies; the lower the score, the fewer challenges experienced. Descriptive statistics in Table 1 show that the range of General English Proficiency (GEP) in both subjects was similar (International Relations = 28, Electronic Engineering = 27). The skewness (falling within −1 to +1) and kurtosis (falling within −3 to +3) were within an acceptable range (Hair, Black, Babin, & Anderson, 2010). The mean for International Relations was 74.88, whereas Electronic Engineering was slightly higher at 76.68. The standard deviations also differed; International Relations was 6.59, Electronic Engineering was 5.96. Language-related Challenges had a similar range in both subjects (3 and 4 respectively), with means of approximately 4 and standard deviations close to 1. Again, skewness and kurtosis were within an acceptable range. The data met all the assumptions for simple linear regression.

As Table 2 shows, the R^2 value for International Relations was 0.368, which means that 36.8% of the variance in academic language-related challenges in International Relations was explained by English proficiency. EMI Challenges decreased by 0.094 for every one-point increase in English proficiency. English proficiency was a statistically significant predictor of Challenges when studying international relations through EMI ($F(1,97) = 58.21$, $p = 0.0000$). Therefore, the higher students' general English proficiency, the lower their academic language-related challenges when studying International Relations through EMI.

As Table 3 shows, the R^2 value for Electronic Engineering was 0.11, which means that 11% of the variance in academic language-related challenges in Electronic Engineering was explained by English proficiency. EMI Challenges decreased by 0.069 for every one-point increase in English proficiency. English proficiency was a statistically significant predictor of EMI Challenges ($F(1,97) = 13.12$, $p = 0.0004$). This indicates that students with a higher level of general English proficiency experienced fewer language-related challenges when studying Electronic Engineering through EMI.

4.2. Gains in English proficiency and challenges in EMI

Our second research question sought to explore the extent to which a *gain* in English language proficiency over four years predicts academic language-related challenges. First, paired sample t-tests were used to establish whether English language proficiency gains over four years were significant or not (comparing Time 1 (Year 1) with scores at Time 2 (Year 4)), for each academic subject (Social Sciences and Mathematical, Physical, and Life Sciences).

4.2.1. International relations English language proficiency gains

International Relations (Social Science) data showed that there was a statistically significant increase in English language proficiency scores after four years of EMI study (Year 4: M = 74.88, SD = 6.59), compared to scores at the start of EMI study (Year 1: M = 72.04, SD = 5.55), t (98) = -5.05, p = 0.000***. These results suggest that studying International Relations through English does increase students' English language proficiency over time.

Table 1
Descriptive statistics of GEP scores and EMI Challenges.

Academic Subject	Variable	N	Mean	SD	Median	Min	Max	Range	Skew	Kurtosis
International Relations	GEP score	99	74.88	6.59	74	62	90	28	0.33	−0.55
	EMI Challenges Scale	99	3.56	1.01	4	2	5	3	−0.21	−1.09
Electronic Engineering	GEP score	99	76.68	5.96	77	65	92	27	0.16	−0.51
	EMI Challenges Scale	99	3.69	1.20	4	2	6	4	−0.26	−1.26

Table 2
International Relations - Simple Linear Regression output: GEP scores and EMI Challenges.

	$\triangle R^2$	B	Standardised β	t value	p-value
Constant	0.368	10.601		11.44	0.000***
GEP Score		−0.094	−0.612	−7.63	0.000***

Significance codes: p < 0.001***.

Table 3
Electronic Engineering - Simple Linear Regression output: GEP scores and EMI Challenges.

	$\triangle R^2$	B	Standardised β	t value	p-value
Constant	0.11	9.01		6.103	0.000***
GEP Score		−0.069	−0.345	3.622	0.00046***

Significance codes: p < 0.001***.

4.2.2. Electronic Engineering English language proficiency gains

Electronic Engineering (Mathematical, Physical, and Life Sciences) data showed that there was a statistically significant increase in English language proficiency scores after four years of EMI study (Year 4: M = 76.68, SD = 5.96), compared to scores at the start of EMI study (Year 1: M = 74.17, SD = 6.08), t (98) = −4.202, p = 0.000***. Again, these results suggest that studying Electronic Engineering through English does increase students' English language proficiency over time.

Next, Simple linear regression was used to explore the relationship between English language proficiency gains and academic language-related challenges. Descriptive statistics in Table 4 show that the range of General English Proficiency (GEP) gain in both subjects was similar (International Relations = 10, Electronic Engineering = 11). The skewness (falling within −1 to +1) and kurtosis (falling within −3 to +3) were within an acceptable range (Hair et al., 2010). Language-related Challenges had a similar range in both subjects (3 and 4 respectively), with means of approximately 3 and standard deviations close to 1. Again, skewness and kurtosis were within an acceptable range. The data met all the assumptions for simple linear regression.

As Table 5 shows, the R^2 value for International Relations was 0.097, which means that 9.7% of the variance in academic language-related challenges in International Relations was explained by a gain in English language proficiency. EMI Challenges decreased by 0.126 for every one-point increase in English proficiency gain. A gain in English proficiency was, therefore, a statistically significant predictor of challenges when studying international relations through EMI (F (1,72) = 8.87, p = 0.003**). Therefore, the higher students' general English proficiency gain, the lower their academic language-related challenges when studying International Relations through EMI.

As Table 6 shows, the R^2 value for Electronic Engineering was 0.007, which means that 0.07% of the variance in academic language-related challenges in Electronic Engineering was explained by a gain in English language proficiency. EMI challenges decreased by 0.066 for every one-point increase in English proficiency gain. Although this indicates that the higher students' general English proficiency gain, the lower their academic language-related challenges when studying Electronic Engineering through EMI, this relationship was *not* statistically significant (F (1,69) = 1.52, p = 0.221).

4.3. English proficiency thresholds and language-related challenges in EMI

The third research question sought to explore how academic language-related challenges vary according to English language proficiency level. General English language proficiency scores (GEP) were converted to Common European Framework of Reference for Languages (CEFR) levels. Table 7 provides a breakdown of students' CEFR levels according to an academic subject. Most students were at the B1 CEFR level (International Relations n = 54; Electronic Engineering, n = 56).

A three (three CEFR levels) by four (four Challenges scales) between-subjects multivariate analysis of variance (MANOVA) was carried out to test whether there were any significant differences in academic language-related challenges according to CEFR level. Descriptive statistics in Table 8 illustrate that no variables were highly skewed (all fell within a −1 to +1 range) or highly kurtotic (all fell within −3 to +3, Hair et al., 2010). The dimensions on the EMI Challenges Scales were independent of each other (ICC = 0.52), and the covariance matrices were equal (Box's M test, p = 0.24). Levene's F tests were all non-significant (p > 0.05); therefore, the assumption of homogeneity was met. The data, therefore, met all the assumptions for MANOVA.

Table 4
Descriptive statistics of GEP Gain and EMI Challenges.

Academic Subject	Variable	N	Mean	SD	Median	Min	Max	Range	Skew	Kurtosis
International Relations	GEP Gain	74	4.92	2.67	5	1	11	10	0.18	−0.96
	EMI Challenges Scale	74	3.39	1.02	3	2	5	3	0.02	−1.17
Electronic Engineering	GEP Gain	71	4.54	2.63	4	1	12	11	0.76	0.04
	EMI Challenges Scale	71	3.63	1.19	4	2	6	4	−0.24	−1.31

Table 5
International Relations - Simple Linear Regression output: GEP Gain and EMI Challenges.

	$\triangle R^2$	B	Standardised β	t value	p-value
Constant	0.097	4.013		16.93	<0.000***
GEP Score		−0.126	−0.331	−2.97	0.003**

Significance codes: $p < 0.01$**, $p < 0.001$***.

Table 6
Electronic Engineering - Simple Linear Regression output: GEP Gain and EMI Challenges.

	$\triangle R^2$	B	Standardised β	t value	p-value
Constant	0.007	3.934		13.994	<0.000***
GEP Score		−0.066	−0.147	−1.235	0.221

Significance codes: $p < 0.001$***.

Table 7
Frequency distribution of CEFR levels.

Academic Subject	CEFR Level	n
International Relations	A2	21
	B1	54
	B2	24
Electronic Engineering	A2	12
	B1	56
	B2	31

Table 8
Descriptive statistics of CEFR levels and EMI Challenges.

Academic Subject	Variable	N	Mean	SD	Median	Min	Max	Range	Skew	Kurtosis
International Relations	Perceived ease of academic writing	99	3.61	1.08	4	1	5	4	−0.30	−1.02
	Perceived ease of academic reading	99	3.38	0.92	4	2	5	3	−0.12	−0.98
	Perceived ease of academic speaking	99	3.54	0.87	4	2	5	3	−0.24	−0.69
	Perceived ease of academic listening	99	3.69	0.99	4	2	5	3	−0.17	−1.04
	Overall CEFR	99	B1 (3.03)	0.68	(B1) 3	(A2) 2	(B2) 4	2	−0.04	−0.84
Electronic Engineering	Perceived ease of academic writing	99	3.78	1.31	4	2	6	4	−0.27	−1.38
	Perceived ease of academic reading	99	3.52	1.14	4	2	6	4	−0.10	−1.13
	Perceived ease of academic speaking	99	3.52	1.11	4	2	6	4	−0.17	−1.19
	Perceived ease of academic listening	99	3.80	1.14	4	2	6	4	−0.21	−0.92
	Overall CEFR	99	B1 (3.19)	0.63	B1 (3)	(A2) 2	(B2) 4	2	−0.17	−0.65

MANOVA results showed a statistically significant effect of CEFR level (i.e., the means of the four language-related challenges differed significantly according to CEFR level) in *both* academic subjects. Results for International Relations were: Pillai's Trace = $F(1, 97) = 8.82, p = 0.000$***, $\eta_p^2 = 0.273$. Results for Electronic Engineering were: Pillai's Trace = $F(1, 97) = 2.81, p = 0.02$*, $\eta_p^2 = 0.106$.

In order to explore the nuanced differences between each CEFR level and each language-related challenge, post-hoc ANOVAs and the Games–Howell test (Field, Miles, & Field, 2012) were run on the data. A Bonferroni correction was applied to the α-levels of the ANOVAs to control for the overall Type I error rate (Tabachnick & Fidell, 2013).

4.3.1. *Writing-related challenges*

A post-hoc ANOVA revealed an overall statistically significant effect of CEFR level on writing-related challenges for both academic subjects: International Relations ($F(1, 97) = 32.5, p = 0.000$***, $\eta_p^2 = 0.25$) and Electronic Engineering ($F(1, 97) = 8.3, p = 0.004$**, $\eta_p^2 = 0.07$). The post-hoc Games-Howell test revealed a statistically significant difference between CEFR level A2 and B2 (*Mean difference* = 1.18, $p = 0.03$*) in Electronic Engineering. International Relations showed statistically significant differences in CEFR levels:

A2 and B2 (*Mean difference* = 1.56, $p = 0.000$***)

B1 and B2 (*Mean difference* = 1.27, $p = 0.000$***)

4.3.2. Reading-related challenges

Likewise, there was an overall statistically significant effect of CEFR level on academic reading-related challenges for both academic subjects: International Relations (F (1, 97) = 21.66, p = 0.000***, η_p^2 = 0.18) and Electronic Engineering (F (1, 97) = 10.2, p = 0.001**, η_p^2 = 0.09). The Games-Howell post-hoc test revealed a statistically significant difference between CEFR level A2 and B2 (*Mean difference* = 1.15, p = 0.02*) in Electronic Engineering. International Relations showed statistically significant differences in CEFR levels:

A2 and B2 (*Mean difference* = 1.14, p = 0.000***)

B1 and B2 (*Mean difference* = 0.95, p = 0.000***)

4.3.3. Speaking-related challenges

Similarly, academic speaking-related challenges showed an overall statistically significant effect according to CEFR level for both academic subjects: International Relations (F (1, 97) = 15.69, p = 0.000***, η_p^2 = 0.13) and Electronic Engineering (F (1, 97) = 10.7, p = 0.001**, η_p^2 = 0.09). Post-hoc analysis showed statistically significant differences between CEFR level A2 and B2 (*Mean difference* = 1.15, p = 0.02*) in Electronic Engineering. International Relations showed statistically significant differences in CEFR levels:

A2 and B2 (*Mean difference* = 0.95, p = 0.000***)

B1 and B2 (*Mean difference* = 0.69, p = 0.006***)

4.3.4. Listening-related challenges

Finally, there was also an overall statistically significant effect of CEFR level academic listening-related challenges for both academic subjects: International Relations (F (1, 97) = 30.6, p = 0.000***, η_p^2 = 0.24) and Electronic Engineering (F (1, 97) = 4.7, p = 0.01*, η_p^2 = 0.08). The Games-Howell post-hoc test showed statistically significant differences between CEFR levels A2 and B2 (*Mean difference* = 1.11, p = 0.011*) in Electronic Engineering. International Relations showed statistically significant differences in CEFR levels:

A2 and B2 (*Mean difference* = 1.40, p = 0.000***)

B1 and B2 (*Mean difference* = 1.02, p = 0.000***)

4.3.5. Results summary

These results indicate that in Electronic Engineering, students experience significantly different levels of linguistic-related challenges in each skill when at a lower proficiency (A2) compared to a higher proficiency (B2). Fig. 1 indicates this linear relationship and obvious difference; however, there is no apparent threshold where challenges abruptly decrease or level off.

In International Relations, however, a proficiency threshold is evident. Students experience significantly higher levels of linguistic-related challenges as proficiency decreases. Fig. 2 not only indicates a clear linear relationship between challenges and proficiency; it

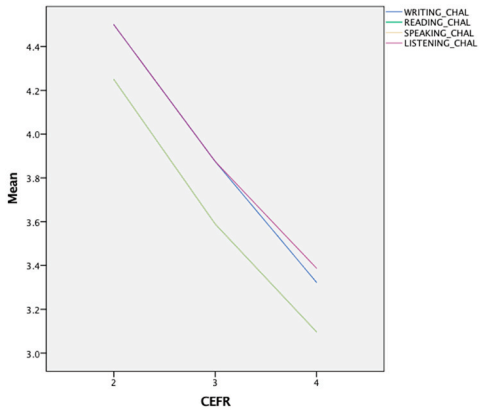

Fig. 1. Electronic Engineering: Mean frequency of Challenges by CEFR level
NOTE: CEFR 2 = A2; 3 = B1; 4 = B2; 5 = C1.

also demonstrates an apparent proficiency threshold where challenges suddenly decrease at the B2 level. This suggests that once students reach a B2 level of English proficiency in Social Science subjects, students will experience significantly less academic linguistic-related challenges in their EMI studies.

5. Discussion

This study first examined the extent to which English language proficiency predicts academic language-related challenges of EMI students from the Social Sciences (International Relations) and the Mathematical, Physical, and Life Sciences (Electronic Engineering). Then we investigated whether language gain after four years of EMI study predicts the language-related challenges of these EMI students. Finally, we explored whether these challenges vary according to language proficiency in terms of the four English language skills and whether a distinct proficiency threshold exists, at which point challenges significantly decrease.

5.1. Relationship between language proficiency and challenges in two academic subjects

Descriptive statistics of general English language proficiency scores and EMI challenges showed the mean scores for the two academic subjects did not hugely differ: 74.88 for International Relations, while 76.68 for Electronic Engineering. When simple linear regression analysis was conducted, we found that English proficiency was a statistically significant predictor of academic language-related challenges when studying both academic subjects through English. This provided evidence that the higher students' general English language proficiency, the fewer language-related challenges experienced when studying through EMI, no matter the subject studied. This result accords well with Aizawa et al. (2020) and Kamaşak et al. (2021), who found a statistically significant relationship between English language proficiency and language-related challenges in Japanese and Turkish EMI contexts, respectively. Furthermore, when the effect size of this finding is closely examined, 36.8% of the variance in academic language-related challenges can be explained by English language proficiency in International Relations, while only 11% of the variance is explained in Electronic Engineering. Taking these results, as well as previous research into consideration (Aizawa et al., 2020; Kamaşak et al., 2021), we maintain that regardless of the academic subject studied, EMI students experience significantly fewer language-related challenges, higher their general English proficiency.

5.2. Gain in English language proficiency and academic language-related challenges

Results of our study revealed that studying both International Relations and Electronic Engineering through English over a four-year period increased students' English language proficiency. This study confirms the findings of a previous study that examined two different academic subjects (i.e., Business Administration (a Social Science subject) and Mechatronics Engineering (a Mathematical, Physical, and Life Sciences subject) in the Turkish higher education setting (Yuksel, Soruç, Altay, & Curle, 2021). Both of these studies correspond with that of Rogier (2012), who found a similar increase in the United Arab Emirates. However, two other studies (Lei & Hu, 2014; Yang, 2015) found no evidence of English improvement after only one and two years of EMI studies in Chinese and Taiwanese contexts, respectively.

This study also examined if a gain in language proficiency was a predictor of language-related challenges when studying International Relations and Electronic Engineering through EMI. The results showed that even though language gain was a statistically significant predictor of academic language-related challenges for students studying International Relations, language gain was not a

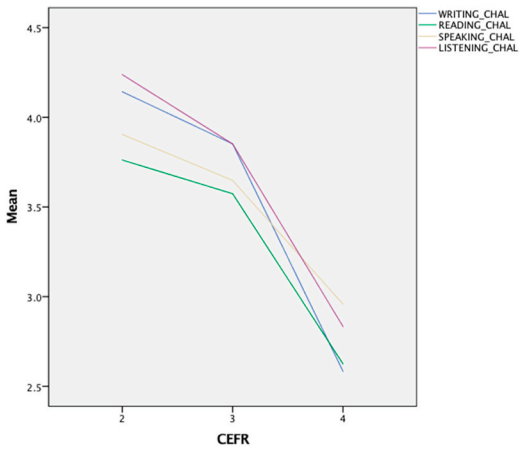

Fig. 2. International Relations: Mean frequency of Challenges by CEFR level
NOTE: CEFR 2 = A2; 3 = B1; 4 = B2; 5 = C1.

significant predictor of challenges for Electronic Engineering students. This affirms Dearden and Macaro's (2016) call to explore discipline-based differences in EMI contexts. Even though both groups of students significantly improved their language proficiency over four years of EMI, this did not then translate into an experience of fewer language-related challenges for Electronic Engineering students. Underlying reasons for this (at this point) can only be speculated. We, therefore, call for further research into this peculiarity by questioning: comparing Social Science and MPLS academic subjects, what positive effects does language gain have on students' EMI studies? Another aspect that might be explored in this vein is that of Language Learning Mindsets; might these play more of an important role in MPLS students' experience of language-related challenges when studying through EMI? Or might Maths Mindsets be more prominent? (see Yuksel, Curle, & Kaya, 2021). These are questions that need to be answered to further understand the different level and type of challenges faced by EMI students based on the discipline studied.

5.3. Proficiency threshold for challenges

The findings of this study revealed that there was a statistically significant effect of CEFR level in both academic subjects. In other words, both International Relations and Electronic Engineering students experienced significantly different levels of linguistic-related challenges in each skill when at a lower proficiency compared to a higher proficiency. These results are consistent with claims as purported in previous studies (Aizawa et al., 2020; Sultana, 2014); that lower-level English proficiency presumed more linguistic challenges when studying through EMI. Examination of the nuances in the data revealed that there was no clear proficiency threshold that Electronic Engineering students needed to meet in order for challenges to significantly decrease. This finding is in line with Aizawa et al.(2020), who investigated students studying International Business. Our study also contained a sample from a Social Science subject (International Relations); however, with this sample, a clear proficiency threshold was evident. After a student reaches a B2 level of English proficiency in Social Science subjects, they experience significantly less academic linguistic-related challenges in their EMI studies.

Interestingly, Harsh and her colleagues (Harsch, 2018; Harsch, Ushioda, & Ladroue, 2017) also proposed B2 as a suitable threshold for entrance to academic studies in higher education institutions for international students. In addition to this, in Content and Language Integrated Learning (CLIL) contexts, a language threshold of B2 of the Common European Framework of Reference for Languages (CEFR) has been established as a necessity, for instance, in Basque by the Basque Department of Education (Lasagabaster & Sierra, 2010). In other studies, a C1 level has been suggested as a meaningful threshold for EMI academic success at the university level (Schoepp & Garinger, 2016).

Nevertheless, based on the results of this study, we argue that a language threshold might only be present, depending on the academic subject studied. Discipline differences might play a mediating role in the determination of a language threshold. Future research should therefore take this into account when conducting replication studies and running similar such analyses. Therefore, a substantial original contribution of this study is the identification of a language proficiency threshold that might be helpful to mitigate student language-related challenges when studying Social Science subjects through English Medium Instruction.

6. Conclusion, implications, and limitations

This study was original in that it investigated whether the level of language-related challenge differs according to the academic subject (namely the Social Sciences and the Mathematical, Physical, and Life Sciences) and whether these challenges might be mitigated by four-year-long language development during EMI studies. The results have important implications. First, in both subjects, EMI students' English language proficiency significantly predicted academic language-related challenges. This is an important finding that underlines the key role that language proficiency plays when studying through EMI. EMI students should therefore receive continuous language support throughout the duration of their studies. Furthermore, we found that language development (or language gain) in English, after four years of exposure to EMI, significantly predicted the challenges of International Relations students but not those of Electronic Engineering. In other words, students who maintained and augmented their English language proficiency had less difficulty in following their courses in the Social Sciences, but this was not the case in the Mathematical, Physical and Life Sciences. For this reason, students studying MPLS subjects might need systematic language instruction support in order to have fewer language-related challenges compared to those studying Social Science subjects.

Finally, an evident threshold of proficiency was found in the Social Sciences: this was B2. In this division, our participants experienced significantly higher levels of linguistic-related challenges as their English language proficiency decreased. Therefore, contrary to a previous claim in the literature that no specific proficiency threshold exists (e.g., Aizawa et al., 2020), we propose, for the first time, that it is a B2 level in English in the Social Sciences that predicts students' academic language-related challenges. In Electronic Engineering, some differences between various proficiency levels were found, but there was no clear threshold. Therefore, the relative existence of a proficiency threshold should be evaluated carefully, bearing in mind the academic subject and division in EMI environments.

These findings have implications for EMI lecturer training. In order to mitigate a proficiency threshold effect, EMI lecturers, both in the Social Sciences and Mathematical, Physical and Life Sciences, should be equipped with accommodation strategies to improve and facilitate student comprehension. These may include linguistic accommodation strategies (e.g., using simpler grammar in sentences), paralinguistic accommodation strategies (e.g., using body language or gestures to emphasise important points in speech) or instructional routines (e.g., using audio-visual aids). These strategies have been shown to improve students' content comprehension (Brinton, 2003).

Though important these findings are, these results should be considered within the limitations of this study. Firstly, this study

focused on students' general English proficiency as opposed to academic language proficiency. Future research might replicate this study using students' academic language proficiency to discover if results are similar, different or even comparable.

Secondly, the sample of each academic division was not particularly large and was not selected entirely randomly. Future studies might randomly sample a larger number of students from additionally diverse divisions and also include a control group in the research design for a comparison of language gain.

Thirdly, relatively small to medium effect sizes of the findings might be considered another limitation. Although, this limitation should be considered within the four interrelated parameters as suggested by Cohen (1988: power, significance criterion, sample size, and effect size). He argues that "any one of them is a function of the other three, which means that when any three of them are fixed, the fourth is completely determined. (p.14)". Nevertheless, it is recognised that replication studies are needed to compare effect sizes in different contexts to enhance generalisability.

The investigation of EMI students' academic language-related challenges is still in its infancy. Future studies might investigate the relationship between language proficiency and academic language-related challenges in full EMI programmes, building on the findings of this study in a partial EMI context. Also, there are numerous factors that might affect students' English language proficiency gains that have not been taken into account in this study (e.g. out-of-class activities such as watching English language YouTube videos). Future research could take these factors into account. Finally, as this growing EMI body of literature continues to highlight, important context-specific differences exist (Aizawa et al., 2020; Curle et al., 2020); therefore, there is an urgent call for further research that investigates the relationship between EMI students' English proficiency, language gain and their academic language-related challenges in varied EMI settings, focusing particularly on international context comparison.

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CRediT authorship contribution statement

Adem Soruç: Conceptualization, Methodology, Software, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Supervision, Project administration. **Mehmet Altay:** Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Data curation, Writing – original draft, Supervision, Project administration. **Samantha Curle:** Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Supervision, Project administration, Visualization. **Dogan Yuksel:** Conceptualization, Methodology, Software, Formal analysis, Investigation, Data curation, Writing – original draft, Supervision, Project administration.

Declaration of competing interest

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.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.system.2021.102651.

Appendix: The EMI Challenges Scales

Academic Writing Skills.

1 Planning written assignments
2 Expressing ideas in correct English
3 Revising written work
4 Using appropriate academic style
5 Writing a bibliography/references section
6 Proofreading written work
7 Referring to sources in written work
8 Summarizing/paraphrasing ideas in sources
9 Organising ideas in coherent paragraphs
10 Expressing ideas clearly and logically
11 Linking ideas from different sources
12 Writing the introduction to an assignment
13 Writing the body of an assignment

14 Writing the conclusion to an assignment
15 Liking sentences smoothly

Academic Reading Skills.

1 Understanding specific vocabulary
2 Working out the meaning of difficult words
3 Reading carefully to understand a text
4 Reading quickly to find specific information
5 Identifying supporting ideas and examples
6 Reading quickly to get overall meaning
7 Identifying the key ideas of a text
8 Taking brief, relevant notes
9 Using your own words when taking notes
10 Understanding the organisation of a text

Academic Speaking Skills.

1 Speaking accurately (grammar)
2 Speaking clearly (pronunciation)
3 Presenting information/ideas
4 Participating actively in discussion
5 Communicating ideas fluently
6 Speaking from notes
7 Asking questions
8 Answering questions
9 Communicating ideas confidently
10 Using visual aids (e.g. PowerPoint)

Academic Listening Skills.

1 Understanding the main ideas of lectures
2 Understanding the overall organisation of lectures
3 Understanding key vocabulary
4 Taking brief, clear notes
5 Identifying supporting ideas and examples
6 Understanding lecturers' accents
7 Following a discussion
8 Identifying different views and ideas
9 Understanding questions
10 Understanding classmates' accents

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Adem Soruç is an Assistant Professor of applied linguistics in the Department of Education at the University of Bath. He is carrying out research on EMI, English as a Lingua Franca, Individual learner differences. He has published articles in reputable journals such as *System, ELT Journal, RELC Journal, International Journal of Applied Linguistics, TESL Canada,* as well as an authored book on Individual Differences from Palgrave Macmillan.

Mehmet Altay is an Assistant Professor of TEFL at Kocaeli University's Faculty of Education. Areas of interest include English Medium Instruction, Content-based Instruction, and Content and Language Integrated Learning. His work has been published in such journals as *System, Applied Linguistics Review, Participatory Educational Research,* and *Novitas-Royal*.

Samantha Curle is an Assistant Professor of applied linguistics and advanced quantitative research methods in the Department of Education at the University of Bath. Her EMI-related research has recently appeared in journals such as *Language Teaching, System, Studies in Higher Education, International Journal of Bilingual Education and Bilingualism,* and *Journal of Asia TEFL*.

Dgauksel is an Associate Professor of English Language Teaching at Kocaeli University's Faculty of Education. His research is published in journals such as *Applied Linguistics Review, System, International Journal of Applied Linguistics, Language Teaching Research, ReCALL,* and *Classroom Discourse.*