English Language Proficiency as a Predictor of Saudi Undergraduates' Mathematics Scores

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Abstract

Since English has become the medium of instruction in most departments in Saudi universities, English language proficiency has become a critical factor in determining academic success. To examine this relationship, the study investigated the correlation between Saudi undergraduates' English language proficiency and their achievement in mathematics. It also aimed to examine the moderating role of gender in this correlation. To this end, the study analysed the scores for mathematics and English of 160 Saudi undergraduate students (27 male, 133 female), enrolled in the Preparatory Year Program at Bisha University. The results show a statistically significant correlation between English language proficiency and mathematics scores, with no significant moderating influence of gender. Based on these findings, the study draws some implications for enhancing Saudi undergraduate students' mathematics competence and performance in mathematics tests.

Keywords: Mathematics achievement, English language proficiency, English-medium instruction, internationalization, higher education, Saudi Arabia

1. Introduction

The use of English as the medium of instruction (hereafter EMI) in higher education has become the norm in many non-English-speaking countries (Crystal, 2004; Hughes, 2008; Tsou & Kao, 2017). In Saudi Arabia, in particular, the use of EMI is growing rapidly (Jawhar, 2012; McMullen, 2014). As Wächter (2008) and Wächter and Maiworm (2008) put it, this is a move towards the internationalization of higher education, which reflects these countries' realization that English is the language most used to disseminate knowledge. Hence, a lack of English language proficiency will necessarily hinder non-English speaking students from accessing most published knowledge. Thus,

E-ISSN 2240-0524
ISSN 2239-978X

Journal of Educational and Social Research
www.richtmann.org

Vol 13 No 5
September 2023

Saudi Arabia has identified English language proficiency as one of its 11 goals (Ministry of Education [MoE], 2013).

Since the implementation of EMI in higher education, a huge body of literature has emerged addressing various aspects of the topic. Most studies have been conducted in Europe (e.g. Aguilar & Rodríguez, 2012; Airey, 2011; Vinke et al., 1998) and Asia (e.g. Byun et al., 2010; Despitasari, 2021; Murata & Iino, 2017; Ngo, 2019; Walkinshaw et al., 2017). EMI in higher education in the Middle East and North Africa is under-researched (Curle et al., 2022), although several studies have been conducted in Arab countries (e.g. Masrai et al., 2022; Tamtam et al., 2010). There are also some works in the literature on EMI in the Saudi context specifically (e.g. Aldawsari, 2022; AlHarbi, 2022; Al Zumor, 2019; Barnawi, 2021; Shamim et al., 2016). Prior studies have predominantly focused on teachers' and students' perceptions of EMI, as well as the challenges they experience in implementing it. However, scant research is available on the effect of students' English language proficiency on their achievement in EMI courses. Thus, this paper examines the relationship between students' proficiency in English and their scores in mathematics.

The rationale for focusing specifically on mathematics is the belief that teaching mathematics in English poses complex challenges because it combines the difficulties inherent in foreign language learning and mathematics learning simultaneously. Moreover, the performance of students who are competent in mathematics is likely to be adversely affected if they have deficiencies in English. Implementing EMI in mathematics teaching is even more challenging in the context of this study, Saudi Arabia, where students' poor performance in both English language and mathematics is well documented. Education First (2022), the world's largest educational company, ranked Saudi students' English language proficiency in the "very low" band from 2011 to 2019 in its English Proficiency Index. Likewise, Saudi students' results in the Trends in International Mathematics and Science Study (TIMSS) are significantly lower than the midpoint of the TIMMS scale, i.e., well below average (TIMMS, 2019).

Bearing the above in mind, this study sought to address the following questions:
1. To what extent does English language proficiency predict Saudi undergraduate students' mathematics scores in an EMI teaching and learning context?
2. Are there any differences in the relationship between English language proficiency and Saudi undergraduate students' mathematics scores attributable to gender?

2. Literature Review

2.1 English-Medium Instruction in Higher Education

EMI can be defined as the use of English in teaching academic subjects to learners whose first language is not English. Macaro et al. (2018) identified several potential reasons for adopting this approach, including, but not limited to, universities' quest to attract foreign students and faculty, and recognition of the status of English as the language of published knowledge. These reasons hold for Saudi Arabia, which implemented EMI in higher education to internationalize its universities and increase the contribution of university-affiliated faculty and students to scientific research, in turn improving the universities' ranking internationally. This shift was feasible and most likely to succeed because most professors at higher education institutions have earned their degrees from international universities. Thus, they are highly proficient in English and capable of teaching in the language in which they undertook their own studies and research.

The implementation of EMI in higher education in Saudi Arabia has also been driven by various other significant factors. Primarily, the shift to EMI aligns with the significant ongoing economic and social changes in Saudi Arabia as part of the 2020 transformative plan and the Saudi Vision 2030. For instance, in 2019, the Saudi government started issuing tourist visas for people from around the world. Also, recent laws issued by the Saudi Ministry of Investment aim to impose restrictions on international companies with no regional headquarters in Saudi Arabia by 2024. These changes are

expected to create huge job opportunities for Saudis. Therefore, they need to be well-prepared and equipped with competitive skills, including communicative competence in English. To this end, English is gaining unprecedented status in Saudi Arabia and the number of English speakers is growing rapidly.

Although the implementation of EMI in higher education has given rise to some social and political controversy, studies have overall reported positive perceptions among teachers and students (e.g., Aldawsari, 2022; Baltabayev, 2020; Banks, 2018). However, there is a less favourable attitude among some (Werther et al., 2014), attributed in large part to the inherent challenges in implementing EMI (e.g., Belyaeva & Kuznetsova, 2019; Nguyen et al., 2017; Ozer, 2020; Vu & Burns, 2014). Jensen and Thøgersen (2011) point to the reasons for the different attitudes. They found that younger lecturers and those who teach mostly in English had positive views of EMI and saw no potential drawbacks. In contrast, the older generation of teachers perceived EMI as a threat to the identity of society, with the potential to lead to the loss of the mother tongue.

2.2   English Language Proficiency and Mathematics Achievement

The relationship between English language learners' proficiency and their academic success in subjects taught in English has been investigated extensively. Initially, studies examined this relationship among non-native English speakers studying in English-speaking countries. Related studies demonstrated that English proficiency positively affected the academic success of English learners (Graham, 1987; Johnson, 1988; Stephen et al., 2004; Vinke & Jochems, 1993). Indeed, among other several factors identified, English learners' proficiency was the most impactful. Recently, exploration of this topic has been extended to non-English speaking countries upon their adoption of EMI in higher education. For instance, in Waluyo and Panmei's (2021) study, which examined the predictive role of English proficiency in the academic success of undergraduate students in Thailand, the results revealed a strong correlation between the two variables. Likewise, Kaliyadan et al. (2015) reported a strong correlation between English proficiency and the academic success of students enrolled at a medical school in Saudi Arabia. Consistent results have been reported in many other studies undertaken in different EFL contexts (e.g. Al-Busaidi, 2017; Soruç et al., 2021; Yuksel et al., 2021).

The effect of English language proficiency on learners' academic achievement in mathematics is of special interest to researchers because it holds a major place in curricula and relates to multiple aspects of life. For many students, mathematics is a difficult subject and they do not enjoy learning it. Therefore, the effect of English learners' proficiency on their mathematics achievement is of paramount importance. This line of research started with English language learners studying in English-speaking countries. Research indicated that English language learners in general demonstrated lower mathematics levels compared to non-English language learners (Lee & Randall, 2011; Miley & Farmer, 2017). In an attempt to establish the reasons for this, researchers studied, among other factors, the correlation between English proficiency and mathematics achievement. For instance, Henry et al. (2014) conducted a correlational study among English learners attending an elementary school in Florida to examine whether their language proficiency predicted their mathematics scores. The results indicated that English proficiency did indeed predict their mathematics scores and grade level moderated the influence of English proficiency in predicting their scores. Several other studies have reported that English learners' poor performance in mathematics was due to their low English proficiency (Haag et al., 2013; Liu & Bradley, 2021; Loughran, 2014). Studies conducted in Saudi Arabia and other EFL contexts have presented results similar to those reported for English learners studying in English-speaking countries. For instance, Yushau and Hafidz Omar (2015) examined if Saudi university students' level of English influenced their achievement in mathematics and found a significant relationship. Bağçeci et al. (2014) reported similar findings for freshmen students at a Turkish university.

Researchers have also examined the role of other variables, mainly gender, in moderating the

relationship between English language proficiency and mathematics achievement. Contrasting results have been reported in this regard. In Abedi and Lord's (2001) study, gender had no moderating effect. Conversely, some researchers have found a significant influence of gender, with females outperforming males (Henry et al., 2014). Despite the significance of this topic, it is still under-researched in most English as a second/foreign language contexts.

The difficulties inherent in learning mathematics are amplified if the language of instruction is not the mother tongue. In Saudi Arabia, for example, the language of instruction for mathematics in K-12 education is Arabic, the official language of the country. This includes the terminology, symbols, phrases and concepts of mathematics. Only a few international private schools teach subjects in English. At university level, however, English is the language of instruction in scientific departments, including mathematics. As discussed previously, Saudi students' performance in both English language and mathematics is unsatisfactory and far below average according to international standards. In an attempt to raise levels, all Saudi students are required to complete the Preparatory Year Program (PYP) upon admission to university, which comprises a full academic year of courses in mathematics and intensive English language learning, among other subjects.

The relationship between English language learners' proficiency and their achievement in mathematics taught in English can best be explained through one of the most widely known theories in second language acquisition, Krashen's (1985) input hypothesis. Krashen argued that learning in another language could only happen if the input was comprehensible. He went on to identify "comprehensible" as appropriate to the learner's current proficiency level or one step higher (i+1). As English language learners will naturally demonstrate less command of the language than native speakers, an achievement gap is expected. This theory also explains why low English language proficiency exerts less influence on students' mathematics achievement in non-English speaking countries: even if English is the language of instruction, mathematics teachers can use the first language as needed. Thus, the input – mathematics content in this context – is comprehensible and students will be more likely to present better performance in mathematics examinations.

3. Methods

3.1 Research Design

The study employed a correlational design to establish the degree of association between the variables (Creswell, 2012), English language proficiency and mathematics scores. It also examined potential differences between the groups of male and female students based attributable to gender.

3.2 Participants

The study participants were 160 male (27) and female (133) undergraduate students enrolled in the PYP at Bisha University. They were aged around 18 years and had recently completed high school. Almost all had grown up using Arabic as their primary language and had been taught in Arabic throughout their primary and secondary education. Although many of them had limited proficiency in English, they were required to switch to English as the language of instruction upon entering the PYP. This was much more challenging than their learning experience in high school.

3.3 Data Collection and Analysis

The data for this study were collected longitudinally over two academic sessions in the second semester of 2022. The students' English scores were collected from their ENG 6111 course and their mathematics scores were collected from their Math 6111 course, the first courses for newly admitted students at Bisha University. To establish correlations between scores and predictive ability, the data were analysed using Pearson's r correlation coefficient and the coefficient of determination, r^2. The

potential differences in scores based on gender were analysed through independent samples *t*-tests at a level of significance of 0.01.

4. Results

The following sub-sections present the results of the analysis, focusing on the correlation between the scores of students in English and mathematics and the differences in English proficiency and mathematics achievement between the genders.

4.1 English Language Proficiency and Mathematics Scores

The linear correlation coefficient (Pearson's *r*) was computed for students' scores in English and mathematics to determine the magnitude and direction of the relationship between the two variables. Furthermore, the coefficient of determination (r^2) was calculated to assess the educational and practical importance of the relationship. Table 1 presents the results.

Table 1: Correlation coefficients (r) and coefficients of determination (r²) for the relationship between English language proficiency and mathematics scores

Variable	Measure	Value
EN	*r*	.393**
	r²	.155

Note: ** significant at 0.01.

Table 1 empirically demonstrates that there is a substantial, positive correlation between English language proficiency and mathematics test scores. The correlation is statistically significant at the 0.01 level. The coefficient of determination of 0.155 suggests that the corresponding variation in English language scores accounts for almost 15.5% of the variability in mathematics scores. Consequently, the hypothesis that there is a statistically significant and direct correlation between the English language and mathematics test scores for the sample holds.

4.2 Differences in English Language Proficiency and Mathematics Scores According to Gender

The means and standard deviations of the male and female students' scores in English and mathematics were calculated. Subsequently, independent samples *t*-tests were conducted to determine the statistical significance of differences between the mean scores of the two groups in English language and mathematics. Table 2 presents the results.

Table 2: Results of t-tests examining differences in English language proficiency and mathematics scores according to gender

	Gender	N	M	SD	*t*-value	df	Sig.
English	M	27	74.70	14.48	2.384	158	0.002
	F	133	80.27	10.26			
Mathematics	M	27	74.63	19.33	1.141	158	0.006
	F	133	77.90	12.14			

The results demonstrate that the male and female groups exhibited comparable mean values in mathematics. Furthermore, they indicate that the variations between the two groups were not statistically significant. Regarding the English language scores, there were differences between the mean values for the male and female groups. The results showed a statistically significant difference

at the 0.05 level between the scores of the two groups, with females attaining higher scores on average. To ascertain the educational and practical implications of the differences between male and female students in the scores for the English course, the effect size was calculated using Eta squared ($\eta2$) and gave a value of 0.04. This suggests that 4% of the variance between the mean scores of the two groups can be attributed to gender differences, indicating weak educational significance despite the statistically significant difference between male and female scores for English.

5. Discussion

The study examined the extent to which English language proficiency influenced Saudi undergraduates' scores in mathematics and whether there were differences in English and mathematics scores based on gender. Overall, the results of this study paralleled those in the prior literature. A positive correlation was found between English language proficiency and mathematics scores, consistent with the findings reported in previous studies (e.g. Abedi & Lord, 2001; Bağçeci et al., 2014; Yushau & Hafidz, 2015). This result was to be expected as content comprehension is in large part bound to comprehension of the language in which the content is being delivered. Support for this is provided by Al Zumor's (2019) study, in which the participants – Saudi undergraduate students from the Computer Science, Engineering and Medicine departments at a Saudi university – stated that the use of English was the main reason hindering their comprehension of scientific content.

Although the female students scored higher than their male peers in English language proficiency, gender did not present a significant impact on mathematics scores. Similarly, Abedi and Lord (2001) found that gender did not account for differences in mathematics scores. In some other studies, however, gender was found to play a role, with female English learners outperforming male English learners in mathematics (Henry et al., 2014). In this study, the lack of difference between female and male students' scores in mathematics, despite female students scoring higher than male students in English language proficiency, can be attributed to their lack of linguistic knowledge specifically related to mathematics.

6. Conclusion

This study examined the relationship between English language proficiency and the mathematics scores of Saudi undergraduates enrolled in the Preparatory Year Program at Bisha University. The data indicated that English language proficiency has a considerable influence on mathematics scores, but that gender does not impact the scores. These findings have some important pedagogical implications, notably the need for mathematics teachers to implement effective accommodation strategies for students taking mathematics tests to compensate for their lack of English language proficiency. The results also highlight the importance of developing curricula in English for specific purposes focused on students' linguistic needs, thus enabling them to excel at mathematics.

7. Acknowledgment

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