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Student Perspectives on How Medium of Instruction Impacts Science Education Comprehension: A Comparative Study of Two Public Universities

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ABSTRACT

Higher Education Institutional language policy regarding the medium of instruction (MI) may consider different factors, such as national goals and visions, learners' identity, the concept of globalization, finding better career opportunities, first language proficiency, and the native culture and content comprehension. The impact of the language policy on students' learning has been revisited in the literature over the years, raising important concerns about whether to select the national language of the country or a global one to access the advancement of knowledge. Therefore, this study compared the effects of MI in science education on students' subject matter comprehension in two different institutions: University A, utilizing English as a medium of Instruction (EMI), and University B, utilizing Arabic as a medium of instruction (AMI). Questionnaire surveys were conducted to explore the students' perceptions regarding the use of MI at their institution, while document analysis examined each institution's language policy. Descriptive and inferential statistics via SPSS were employed. Results indicated that students who received instruction in Arabic (University B) reported a more positive view of their subject matter comprehension. Independent samples t-tests revealed statistically significant differences in perception between University B (Arabic-medium) and University A (English-medium) students in comprehension ($p = 0.004$), teaching methods ($p < 0.001$), and academic experience ($p < 0.001$). Moreover, AMI served as the medium of communication, and the official documents did not specify the language of instruction. The results can assist in developing

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knowledge about the criticality of MI and its impact in educating well-informed and skilled graduates in Oman and potentially beyond.

Highlights

- This study provides an original contribution to EMI research in the Omani context.
- The findings offer insights that can guide language policy and curriculum development to better support students' transition to EMI programmes.
- Given the journal's focus, this study aligns well with its scope and readership.

Keywords: EMI; AMI; Science Education; Content Comprehension

1. Introduction

English as a medium of instruction (EMI) in higher education institutions (HEIs) is a growing global phenomenon. English is increasingly used as the main language for delivering content and communicating inside classrooms. EMI is the most popular mode of Content and Language Integrated Learning (CLIL), which aims to stress both content and language teaching. The approach originated in European countries[1] as a move to enhance citizens' competency and plurilingualism. Knight[2] argued that HEIs also count on EMI to enhance their rankings, which can attract more international students and increase staff and students' engagement in research publications.

A key focus of the research has been examining the cost and benefits of EMI on English language and content learning, including many studies in the European context have supported the adoption of this practice[1]. In the Middle East, Saudi Arabia is experiencing rapid growth in EMI across the kingdom. This serves as a main goal for the Saudi Ministry of Education, which is elevating the English language proficiency. However, Qatar is refraining from this practice and shifting to Arabic as a medium of instruction in many of its higher institutions since they believe that EMI has a negative influence on the Arabic language and Islamic culture[3]. Graham, Eslami & Hillman[4], in a sample of 57 undergraduate engineering students in Qatar, uncovered a variety of student views—positive, negative and neutral—towards EMI. This led them to conclude that English should be used as *a* medium of instruction rather than *the* medium of instruction. In Omani HEIs, there is a significant need to better understand EMI implementation. It is important to trace the driving motives behind such practice, students' perceptions of this approach and its impact on students' learning. It is also equally and substantially important to investigate the AMI and EMI dilemma in the Omani HEIs, which deliver similar programmes to reach a better understanding regarding the competency of their graduates. Therefore, this research aims to answer the following research questions:

> RQ1: What are students' perceptions and experiences of the effects of the medium of instruction on their comprehension of the subject matter of the science courses in University A and University B?
>
> RQ 2: What implications do EMI and AMI have on students' learning experiences?

2. Literature Review

The use of EMI has been a controversial issue in many contexts where English is used as a foreign language. Researchers have targeted the investigation of numerous issues in relation to the implementation of EMI in HEIs, including the concept of globalization, finding better careers, learner identity, first language proficiency, the native culture and content comprehension (e.g., Al-Bakri[5], Denman & AlMahrooqi[6], Aslan et al.[7], Paudel[8]). The position of English as a lingua franca (ELF) drives two varied scholarly viewpoints—the functionalist perspective and the critical linguists, which were used to reach a better understanding of the influence of the English language on the native cultures and the local languages[7]. While Canagarajah, as cited in AlBakri[5], adopted the functional perspective of utilizing English to serve one's needs, Phillipson and Pennycook (as cited in Al Bakri, 2013[9]) argued that the spread of English might marginalize the native culture and local languages[9]. Thus, while some researchers were interested in emphasizing

the value of using ELF worldwide, other researchers were concerned about the dominance of the English language and its consequences. Selvi[10] nonetheless sustains that EMI has become an essential topic while discussing English and globalization and that it is becoming a priority for governments.

2.1. Arabic and English Language Policies in Oman

Given the proliferation of EMI, the importance of protecting the status of other languages is a recurrent theme. Arabic is a distinctive language with a universal status due to its deep connection with Islam and its role as the language of the Holy Quran[11]. Arabic is the official language in Oman, which serves as a bridge between the diverse linguistic communities and the government[12]. It is the medium of instruction in public schools and a main subject in bilingual and international schools. A language policy document was proposed by the Omani State Council, which suggested establishing an Arabic language centre. This aims to promote Arabic language use for science and art and expand Arabic content on the internet[12]. Such initiatives are important as language policy represents authoritative decision-making regarding language status and development, influencing how languages are perceived and valued[13]. As stated in Oman Observer newspaper, Dr. Rayaa Al Mantheri, the chairperson of the special committee on the 'Language policies of the Sultanate, its realities, challenges and mechanisms to develop and activate them', emphasized that the Arabic language plays an important role in civilization development and aligns with the global trend of relying on mother languages to enhance cognitive growth and innovation[14].

However, according to the Ministry of Higher Education, Research and Innovation, English is the main language of instruction for the major programmes offered by the HEIs[15]. The global status of the English language as a language of science and technology has led it to become Oman's only official language in this domain. The Omani government provides "political, economic, and legislative support" for the English language in Oman[12] (p. 43). The establishment of many ELT centres in Oman, such as the British Council, Hawthorn Muscat English Centre and Polyglot Institute Oman, also aim to enhance the status of English and support English language teaching in Oman[12]. However, the pace of change and quality of implementation are yet to be universally perceived as satisfactory. In Al-Riyami and Dayananda's investigation[16] about Omani parents' perceptions of using English as a medium of instruction, half of the participants believe that children do not have an adequate level of English to cope with EMI and some courses should be offered by AMI. Another study conducted by Scatolini[17] (p. 128) indicates that Omani students struggle with EMI as "learning has objectively been hampered by the language of instruction".

2.2. Using L1 as a Medium of Instruction

Recently, using English as a medium of instruction (EMI) in some HEIs in Oman has become a taken for granted practice despite the growing concern about the threat it causes for Standard Arabic. This unproblematized policy is at the expense of academic Arabic status as well as other academic difficulties that arise as consequences of low proficiency in English[18]. The unprecedented shift, therefore, from AMI to EMI tends to mislead people to the belief that science and English are intertwined, and that English is the most efficient language that can serve the purpose[19]. On this basis, English becoming the dominant language in academia may lead to the marginalization of Arabic and other local languages[20].

On the contrary, there have been several attempts to integrate bilingual programmes in education in some countries such as Burkina Faso, Cameroon, China, Ethiopia, Guatemala, the Philippines and South Africa[21]. In some of the previous case studies, researchers concluded that learners achieved better academic performance compared to their peers in monolingual second-language systems. Buhmann and Trudell[21] pointed out that active participation and positive attitudes were some crucial takeaways in systems where the mother tongue was the medium of instruction. Likewise, upon implementation of local languages as a medium of instruction in Zambia, for instance, it was found that learners developed a sense of ownership of the subject matter and ultimately improved academic achievements and performance[22]. Furthermore, a study carried out in Uganda revealed that "rapid achievement of permanent developmental function literacy is enhanced"[23] (p. 45). In sum, it appears that allowing nations to make full use of their bilingualism or multilingualism in academic contexts can be beneficial

in terms of fostering autonomy, motivation, and improved literacy.

The Gulf Cooperation Council (GCC) countries, like other nations, are faced with an escalating threat to the local language in competition with the English language—the language of science and technology. Therefore, to withstand the competition, it has been argued that higher education in these countries should empower research centres to use Arabic as a medium of instruction and communication and maintain Arabic programmes as a mainstream [19].

2.3. The Value of Using EMI

Despite the benefits of plurilingualism in academic contexts, the globally growing demand for EMI in HEIs has prevailed due to various context-dependent motives. An extensive study of EMI programmes across Europe revealed that most of these programmes seek to attract students worldwide and internationalize the labour market [24]. Another established reason for implementing EMI in HEIs is to allow individuals easier international access and mobility. Being equipped with an international language provides students with access across different regions of the world, breaking the first expected barrier of such a move—language [25]. Thai HEIs, for instance, are keen to implement EMI to foster professional graduates who are equipped with English language proficiency and can compete in the international market [26]. It is also expected that through EMI programs, students will develop their English proficiency as well as the mastery of knowledge of varying academic disciplines [27]. Simultaneously, the institutions themselves are gaining better international rankings, establishing their credentials and drawing more international students by adopting the EMI policy [28], which in turn assists HEIs to market their brand. Likewise, knowledge, by and large, is created, mediated and disseminated through the English language, being a global language. In a recent qualitative study of 40 undergraduate Indonesian business students, positive perceptions of EMI were predominant, while only a minority of students felt that it was a threat to Indonesian culture [29]. Similar results were observed by Zhang and Pladevall-Ballester [30] with students mostly noting the value in terms of language and content gains. Nevertheless, some differences between different academic subjects, namely International Trade students reacting slightly more positively to EMI than Film Production and Project Management, were observed. Therefore, the English language has been emphasized as a fundamental criterion for staffing and recruitment as well as an MI, enforcing English as the language for knowledge management processes and capitalizing on its value locally and globally. Multiple stakeholders, including many students, recognize its value.

2.4. Issues Related to Implementing EMI

Despite the positive picture held by both learners and teachers in varied contexts about EMI, many concerns surfaced, particularly in EFL contexts as well as elsewhere. One of the reported challenges is the low English language proficiency of both key stakeholders—teachers and students. Insufficiently competent in the English language, teachers fail to deliver the subject effectively. This failure can be partially attributed, according to J. Kim, E.G. Kim, and Kweon [31], to insufficient in-service training for those EMI teachers in HEIs. Likewise, students' low language proficiency limits students' comprehension of the content, creating a gap in their knowledge, which is often dealt with by using students' first language to explain disciplinary knowledge [32]. The mismatch between EMI national policies and classroom practice, making it challenging to measure the effectiveness of EMI as a strategy, is another dilemma facing EMI implementation [33]. The EMI policy states that to pursue higher education in any of the subject matters, the scientific ones, particularly, English must be the medium of instruction. However, due to students' low language proficiency, teachers are sometimes obliged to use the students' L1 to explain the course. Such regular practice negatively impacts the effectiveness of EMI use in the classroom.

It was also found that EMI teaching and learning were subjected to cultural challenges within one local context [34]. It was reported that in countries where languages are a minority, there was an escalating threat of cultural impact on the mother tongue language and culture. There was a growing concern in the Gulf countries regarding the status of the Arabic language if content subjects were taught in English. It was believed that the dominance of English jeopardized Arabic. For that same reason, Qatar changed the medium of instruction in some of its public and private HEIs [3,5]. Such phenomena are not limited to Arab-speaking contexts. In Uzbekistan, Malla [35] notes how some students perceive an increase in stress and a reduction in content knowledge due

to EMI policy. Another potential negative effect of the EMI is that it is thought to threaten the social-cultural identity of the learners[36]. Although the literature seems to vary significantly on how serious this potential threat is perceived, it was witnessed that students, generally, were oblivious to such a threat as reported by Elyas[37], Solloway[38], and Fahmy & Bilton[39].

2.5. Students' Perceptions of Using EMI

Despite not generally perceiving EMI as a threat, many students nonetheless have shown an awareness of its limitations. In Al Bakri's study[5], where she focused on students' perspectives, she found that students understand the utilitarian value of EMI policy; however; they believe that the use of Arabic as a medium of instruction (AMI) would have elevated their comprehension of the subject matter. These findings align with the findings of Al-Mahrooqi and Denman[6], where the students emphasized that the use of AMI would have enhanced their content understanding. However, Fahmy and Bilton[39] reported that Omani students emphasized how experiencing EMI enabled them to gain a better understanding of English culture and English-speaking people. Likewise, Al-Ansari and Lori[40] asserted that the Bahraini students who went through EMI hold a better attitude toward English culture and English-speaking skills than their counterparts who completed their higher education using AMI. A parallel study conducted by Wanphet and Tantawy[27] at a university in the UAE reported a corresponding finding. Despite some of the challenges encountered, students approved of the use of the EMI policy in higher education in the UAE. Various elements can be investigated by comparing AMI to EMI, yet students' content understanding and sense of belonging can be of high importance and relevance to the decision of implementing AMI or EMI.

2.6. Statement of Problem and Gaps in Research

As aforementioned, EMI is implemented for the sake of targeting both language learning and content knowledge, which is largely disseminated in the English language. However, in the Omani context, there is no consensus on the feasibility of such practice, and there is no clear direction from the government; some HEIs do implement EMI while others are still counting on AMI. Al Bakri[5] reported that there is a scarcity of research into EMI in the Omani context. This is alarming since the position of a foreign language as a medium of instruction in HEIs should be regularly revisited to examine its achievement of its listed objectives and investigate the negative consequences of such practice, if any. Fahmy and Bilton[39], Al-Mahrooqi and Denman[6] and Holi Ali[41] examined the use of EMI in the Omani context and reported its benefits and challenges. However, there is not a single study that compares students' perceptions of the implementation of AMI and EMI in two different Omani HEIs where the targeted content knowledge is almost alike. Similarly, up until the moment of writing this research, there has not been a single study that explored the students' views and perceptions of the MI effect on their comprehension of the subject matter in their selected programmes of study.

This research intends to investigate students' perceptions of the MI used in two different HEIs on students' comprehension of the subject matter. Likewise, the language policy of MI, if any, in both institutions will be explored. The study intends to fill the research gap by shedding light on the language policy adopted in Oman at different HEIs in relation to the medium of instruction. The rationale, or lack of it, behind the selection of a particular language as the medium of instruction will be examined. Whether policy success or failure has to do with language learning, learner identity or content competence will also be considered. Indeed, investigating the issue of MI through the students' perspective is significant to any future decisions in relation to the language policy of HEIs' medium of instruction, whether in science education or otherwise.

3. Methodology

This research employed an exploratory mixed-methods approach to compare two higher education institutions, focusing on students' perceptions of how selected media of instruction affect their comprehension of subject matter. Constructing understanding from the participants' views in a comparative study has not been approached previously in Oman. Until this is achieved, a comprehensive picture of the issue and the impact of MI on comprehension will not be fully understood. It is a priority to review and justify the language policy, if any exists. A summary of the research design is highlighted in **Table 1**:

Table 1. Summary of the Research Design.

Question	Objective	Data Collection Method	Data Analysis Method
RQ 1: What are students' perceptions and experiences of the effects of the medium of instruction on their comprehension of the subject matter of the science courses in University B and UNIVERSITY A?	Explore	Survey Questionnaires	Descriptive statistics Inferential Statistics
RQ 2: What implications do EMI and AMI have on students' learning experiences?	Investigate/ resonate	Documentary on Language policy	Documentary and Thematic Analysis

3.1. Participants and Sites

Two HEIs, University A and University B, were selected as the primary sites for study, as both institutions offer science education and prepare the science teachers needed in the Omani schools. A purposive sampling technique was employed. While University A employs EMI in science education, University B adopts Arabic as a language of instruction for the same majors. At University A, students enrol in the Centre for Preparatory Studies to complete the requirements of the Foundation Programme before beginning their 4-year specialization programme. This programme aims to enhance their English proficiency and academic skills as English is the language of instruction in most specializations, including science. Students must take an English placement test, which streams them into six different levels. The lower levels encompass English language skills, while the upper levels cover academic and research skills as well as science-based readings and writings. In contrast, University B students begin their specialization immediately and they are expected to graduate in four years. University B typically has 150 students annually, evenly split among Physics, Chemistry, and Biology. University A enrolls about 60–70 students for each specialization. In this study, 152 students from University B and 162 from University A participated, representing various years and science specializations.

The perceptions of stakeholders at both sites regarding the MI effects on comprehension of the subject matter is of paramount importance. Therefore, students' views were explored via survey questionnaires distributed at both sites.

3.2. Data Collection and Analysis Methods

Quantitative and qualitative data collection and analysis methods were employed to address the research questions. Participant and site data were gathered through survey questionnaires, providing quantitative insights. Additionally, documents related to the MI institutions' language policy were collected and analysed using thematic analysis as part of the qualitative approach.

Documents related to language policy were collected from University A and University B. Documents are public meeting minutes or newspapers, as well as private or not widely circulated to the public, offering written evidence and/or guidelines or regulations for an institution [42]. For this research, language policy documents stating the rationale for selecting MI and whether it aligns with the national or institutional vision and plans, if any, were surveyed on the HEI website, and requested from the top management office (e.g., University head office, Science college/department and/or in the current Oman's vision (e.g., Oman Vision 2040) if aligning with the national goals and vision. These documents were analysed thematically by highlighting keywords, e.g., Language policy, language of teaching, MI, rationale, science education.

Survey questionnaires are an effective method for gathering substantial data on perceptions and attitudes in a short timeframe, particularly with technological advancements and software such as Google Forms or Microsoft Forms facilitating the process [42]. The questionnaire utilised employs a multi-item agreement scale to assess perspectives regarding the impact of MI on students' comprehension. It examines students' perceptions of MI's influence on 1) comprehension of content, 2) teaching approaches and methodologies employed, 3) the pursuit of additional information, 4) research collaboration and partnership, 5) attitudes toward academic achievement, and 6) English proficiency and related academic benefits.

Data collected from the questionnaire was analyzed utilizing **descriptive statistics**, including the correlation coefficient to explore the reliability between the different factors, namely in the scale. Mean and standard deviation facilitated

the comparison between two MI choice effects on comprehension of the subject matter. The **SPSS** software package was used to carry out statistical analysis [42,43].

3.3. Ethical Considerations

Data collection, analysis, processing and publication abide by the global and national ethical considerations and regulations. Ethical approval for this study was secured from the research ethics committee at University B, guaranteeing that both institutions were informed of the studys' rationale and the scope of data collection. The consent process ensured that students received comprehensive information regarding the projects' objectives and the extent of their involvement, which was clearly outlined in the survey materials. Participants were assured that their participation was voluntary and that confidentiality and anonymity would be maintained throughout the research. Likewise, data were stored in a password-protected device and sharing of data via publication and participation in conferences follows the same procedure [42].

4. Findings and Analysis

This study aimed to compare the perception of students in two academic institutions: University B, where instruction is conducted in Arabic and University A, where instruction is conducted in English. The comparison covered various dimensions, including comprehension of the course content, teaching methods and strategies, access to information and research resources, research collaboration and partnership with various institutions, academic experience and student attitude, and English proficiency.

This section is organised into different sub sections, including institutional policy comparison, descriptive analysis of students' responses, reliability and correlation analysis between variables, Structural Equation Modelling (SEM) Analysis, and Comparative Analysis: University B vs. University A students.

4.1. Institutional Policy Comparison

Table 2 compares academic policies at University A and University B, including language policies, grading systems, and credit hour requirements. While both institutions employ a four-point grading scale, and credit distributions are generally aligned, University B science programs require 132 credit hours compared to University A's 122–125. Notably, neither institution has a formal, publicly stated language policy governing the medium of instruction, although Arabic is the dominant language for internal communication.

Table 2. Comparison of academic policy in UNIVERSITY A and University B.

	University A	**University B**
Language Policies	The institution's official channels indicate that Arabic is the medium of communication within the different units. However, there is no mention or indication of the existence of a language policy regarding the medium of instruction.	Arabic is the main medium of communication. There is no policy specifying the medium of instruction.
Grading Scheme	A 4 point-scale and all grades have a numeric value.	A 4 point-scale and all grades have a numeric value.
Degree Plan	**University A**	**University B**
Biology/ Credit hours	Semester 1: 18 hrs Semester 2: 17 hrs Semester 3: 17 hrs Semester 4: 17 hrs Semester 5: 18 hrs Semester 6: 15 hrs Semester 7: 14 hrs Semester 8: 9 hrs Total: 125 hrs	Semester 1: 18 hrs Semester 2: 14 hrs Semester 3: 18 hrs Semester 4: 18 hrs Semester 5: 18 hrs Semester 6: 17 hrs Semester 7: 14 hrs Semester 8: 15 hrs Total: 132 hrs
Physics/ Credit hours	Semester 1: 15 hrs Semester 2: 15 hrs Semester 3: 16 hrs	Semester 1: 17 hrs Semester 2: 16 hrs Semester 3: 17 hrs

Table 2. *Cont.*

Degree Plan	University A	University B
Physics/ Credit hours	Semester 4: 16 hrs Semester 5: 16 hrs Semester 6: 15 hrs Semester 7: 14 hrs Semester 8: 14 hrs Total: 122 hrs	Semester 4: 18 hrs Semester 5: 16 hrs Semester 6: 18 hrs Semester 7: 14 hrs Semester 8: 16 hrs Total: 132 hrs
Chemistry/ Credit hours	Semester 1: 15 hrs Semester 2: 15 hrs Semester 3: 15 hrs Semester 4: 16 hrs Semester 5: 16 hrs Semester 6: 16 hrs Semester 7: 14 hrs Semester 8: 15 hrs Total: 122 hrs	Semester 1: 17 hrs Semester 2: 16 hrs Semester 3: 18 hrs Semester 4: 17 hrs Semester 5: 16 hrs Semester 6: 18 hrs Semester 7: 13 hrs Semester 8: 17 hrs Total: 132 hrs

4.2. Descriptive Analysis of Student Respondents

A total of 316 studentsparticipated in the study: 130 males (41.1%) and 186 females (58.9%) (see **Table 3**, **Figure 1,** and **Figure 2**). The academic majors were distributed as follows: Biology (35.8%), Physics (32.6%), and Chemistry (31.6%). Students were enrolled across academic years: 22.8% in Year 1, 11.7% in Year 2, 25.9% in Year 3, and 39.6% in Year 4. GPA distributions show that 8.9% had a GPA below 2.0, 42.1% ranged between 2.0 and 3.0, and 49.1% exceeded 3.0. Institutional representation was nearly equal, with University A comprising 51.9% and University B 48.1% of the sample.

4.3. Reliability and Correlation Analysis

The dataset yielded a high Cronbach's Alpha value of 0.934, indicating strong internal consistency across survey items.

Correlation analysis revealed a significant positive relationship between comprehension of course content and teaching strategies (r = 0.537) (see **Table 4**). Comprehension also positively correlated with students' engagement in research collaboration (r = 0.503) and information seeking (r = 0.515). Teaching methods correlated with students' academic attitudes (r = 0.574), highlighting the pedagogical impact on student perception and motivation.

English proficiency showed moderate correlations across all variables, with the strongest link to teaching methods (r = 0.370), suggesting that language competence modestly contributes to academic experience.

4.4. Structural Equation Modelling (SEM) Analysis

The SEM analysis provided additional insight into the interrelationships among the six themes (see **Figure 3**). Notable findings include:

- Comprehending course content significantly influences research collaboration (Estimate = 0.180, CR = 5.251, $p < 0.001$).
- Searching for further information strongly predicts research engagement (Estimate = 0.426, CR = 9.482, $p < 0.001$).
- Teaching methods substantially impact both research collaboration (Estimate = 0.482, CR = 8.765, $p < 0.001$) and English proficiency (Estimate = 0.193, CR = 5.165, $p < 0.001$).
- Students' academic attitudes are significantly shaped by the quality of teaching methods (Estimate = 0.955, CR = 11.953, $p < 0.001$).

The SEM model shows that these themes have important links with one another; themes pertaining to instruction and teamwork predict a significant impact on other domains such as student attitudes, understanding of the material, and the search for further knowledge, as shown in **Figure 3** and **Table 5**.

Table 3. Demographic characteristics of students.

Characteristics		Frequency (*n*)	Percentage (*n*%)
Gender	Male	130	41.1
	Female	186	58.9
	Total	**316**	**100**
Academic Major	Chemistry	100	31.6
	Physics	103	32.6
	Biology	113	35.8
	Total	**316**	**100**
Academic year	First	72	22.8
	Second	37	11.7
	Third	82	25.9
	Fourth	125	39.6
	Total	**316**	**100**
GPA	Under 2	28	8.9
	Under 3	133	42.1
	Above 3	156	49.1
	Total	**316**	**100**
Institution	University B	152	48.1
	University A	164	51.9
	Total	**316**	**100**

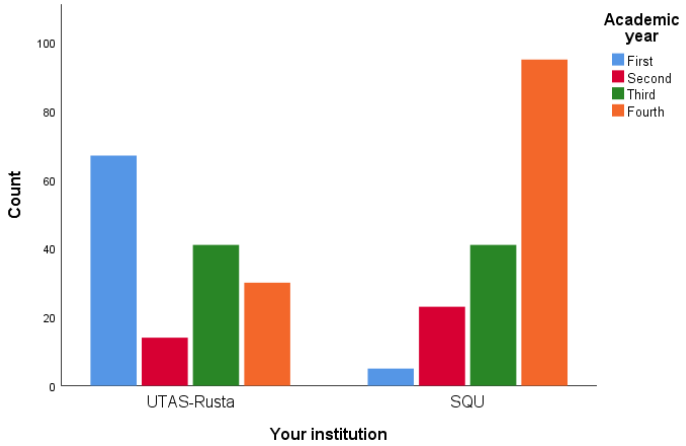

Figure 1. Students' Academic year by institution.

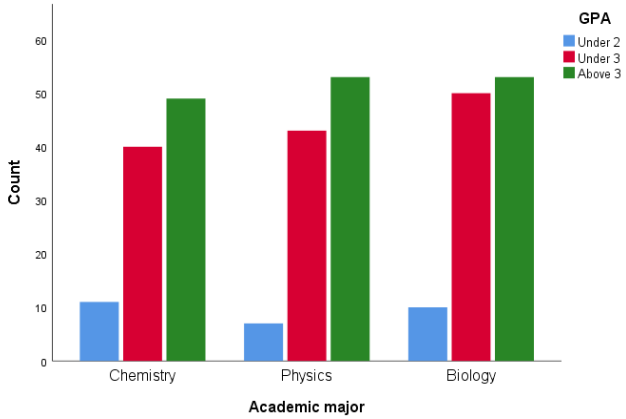

Figure 2. Students' GPA by Academic Major.

Table 4. Correlation analysis among questionnaire themes.

Correlations Coefficients	Comprehending the Course Content	Teaching Methods and Approaches Used	Searching for Further Information	Research Collaboration and Partnership with Various Institutions	Students' Attitude towards Their Academic Experience
Comprehending the course content	1				
Teaching methods and approaches used	0.537**	1			
Searching for further information	0.442**	0.515**	1		
Research collaboration and partnership with various institutions	0.432**	0.503**	0.541**	1	
Students' attitude towards their academic experience	0.597**	0.574**	0.487**	0.481**	1
Proficiency in English brings many academic benefits	0.294**	0.370**	0.210**	0.295**	0.359**

** significant at $p < 0.001$.

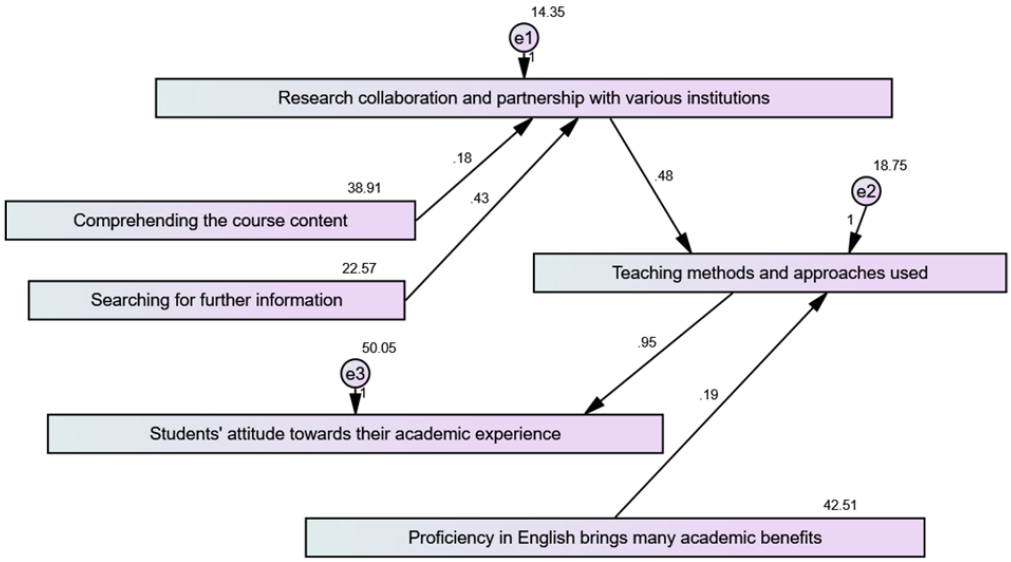

Figure 3. SEM estimated model for student's themes.

Table 5. SEM model for Students.

			Estimate	S.E.	C.R.	*P*-value
Theme 4	<---	Theme 1	0.180	0.034	5.251	***
Theme 4	<---	Theme 3	0.426	0.045	9.482	***
Theme 2	<---	Theme 4	0.482	0.055	8.765	***
Theme 2	<---	Theme 6	0.193	0.037	5.165	***
Theme 5	<---	Theme 2	0.955	0.080	11.953	***

Note: Where: Theme 1: Comprehending the course content, Theme 2: Teaching methods and approaches used, Theme 3: Searching for further information, Theme 4: Research collaboration and partnership with various institutions, Theme 5: Students' attitude towards their academic experience and Theme 6: Proficiency in English brings many academic benefits.
***: $p < 0.001$ (highly significant).

4.5. Comparison Analysis: University B vs University A Students

Comprehension of the Course Content

University B students reported significantly greater ease in understanding course content. Their experience included fewer difficulties with terminology and a higher degree of classroom participation. This is likely attributed to the use of Arabic as the medium of instruction (AMI), which minimizes linguistic barriers. In contrast, university A students, operating within an EMI framework, reported relying on digital resources and dictionaries for comprehension.

Teaching Methods and Strategies

Students from University B rated their instructors' teaching strategies more positively, particularly in areas such as verbal explanations, group work, translation, and use of differentiated materials. This suggests that AMI may afford greater pedagogical flexibility and responsiveness.

Access to Information and Research Resources

Both groups demonstrated awareness of supplementary information resources. University B students preferred using Arabic and indicated stronger access to local research networks. Conversely, University A students rated institutional research databases more favorably, reflecting perhaps a more established infrastructure.

Research Collaboration and Partnership

University B students indicated stronger institutional support for collaborative research, potentially supported by the accessibility of the Arabic medium. Meanwhile, University A students valued the international visibility offered by publishing in English, linking EMI with broader academic dissemination.

Academic Experience and Student Attitudes

Students at University B expressed more positive academic experiences, reporting enhanced class participation, strong rapport with instructors, and increased motivation, all linked to instruction in their native language. However, both groups expressed pride in Arabic as a marker of identity and culture.

Perceived Benefits of English Proficiency

University A students recognized the career advantages conferred by EMI, such as higher employability and professional mobility. On the other hand, University B students emphasized content mastery and national relevance, valuing Arabic as a bridge to professional readiness.

4.6. Statistical Significance in Group Differences

Independent samples t-tests showed statistically significant differences between University B and University A students in comprehension ($p = 0.004$), teaching methods ($p < 0.001$), and academic experience ($p < 0.001$). These results quantitatively support the qualitative insights discussed above (See **Table 6** and **Table 7**).

Table 6. Independent Samples Test between University A and University B students.

Topics	T	Df	Sig. (2-Tailed)	Mean Difference
Comprehending the course content	2.902	314	0.004*	2.01797
Teaching methods and approaches used	4.739	314	0.000**	2.68951
Searching for further information	1.840	314	0.067	0.98171
Research collaboration and partnership with various institutions	1.183	314	0.238	0.62115
Students' attitude towards their academic experience	5.847	314	0.000**	5.42025
Proficiency in English brings many academic benefits	−0.132	314	0.895	−0.09708

Note: (*) is statistically significant at the 0.05 level ($p < 0.05$); (**) is statistically significant at the 0.01 level ($p < 0.01$).

Table 7. Descriptive statistics of the variable.

Comparison	Your Institution	N	Mean	Std. Deviation	Std. Error Mean
Comprehending the course content	University B	152	47.5789	6.36997	0.51667
	University A	164	45.5610	5.98894	0.46766
Teaching methods and approaches used	University B	152	25.5066	5.11069	0.41453
	University A	164	22.8171	4.97387	0.38839
Searching for further information	University B	152	30.2500	5.52088	0.44780
	University A	164	29.2683	3.87868	0.30287
Research collaboration and partnership with various institutions	University B	152	21.8224	5.09655	0.41339
	University A	164	21.2012	4.22261	0.32973
Students' attitude towards their academic experience	University B	152	52.9934	7.75408	0.62894
	University A	164	47.5732	8.65356	0.67573
	University B	152	30.0066	6.97725	0.56593
	University A	164	30.1037	6.10804	0.47696

5. Discussion

This section discusses the key findings of the study in relation to the two research questions and situates them within the broader literature and theoretical framework of medium of instruction (MI) in higher education.

5.1. What Are Students' Perceptions and Experiences of the Effects of the Medium of Instruction on Their Comprehension of the Subject Matter in Science Courses at University A and University B?

The findings reveal a clear divergence in student perceptions based on the institutional medium of instruction. University B students, learning via Arabic (AMI), reported short-term benefits of AMI, including significantly higher levels of comprehension, participation, and confidence in engaging with scientific concepts. In contrast, University A students studying under EMI expressed challenges in grasping terminology and concepts, often resorting to translation tools and supplementary resources. These results contribute to a better understanding of key factors influencing content learning.

Higher education institutions (HEIs) strive to provide students with positive academic experience to elevate their academic performance. The data analysis revealed a positive correlation between students' attitude towards their academic experience and their comprehension of the subject, teaching methods and approaches and their involvement in research or further explorations. Therefore, it is essential to ensure that students are competent in the subject matter and instructors should consider factors, which may hinder students' understanding, including the medium of instruction. As mentioned, low language proficiency can impede content comprehension, which may potentially lead to a negative academic experience [4,32,35]. Teaching methods also significantly influence students' attitudes, as one-size-fits-all, and heavy content-based lectures may not appeal to science students. This aligns with Burks [44], who stated that individualized learning for biology students and encouraging them to demonstrate their content understanding using untraditional means enhances students' content comprehension and mastery, which in turn increases the success rate and improves students' attitude. Academic subject-specific differences, as well as English language proficiency and contextual differences in diverse global settings, may account for divergences in the findings of studies [29,30,35]. However, it was noted that students who engage in further investigation and research involvement tend to have more positive academic experiences. In a similar vein, Kozlova and Atamanova [45] indicated that most students recognize research as a crucial component for their university studies.

University B students reported significantly better perceptions of course content comprehension, teaching methods and approaches, and overall academic experience compared to their peers at University A. As mentioned earlier, University B students receive their instruction in Arabic, their mother language, unlike University A students. This finding aligns with Al Bakri [5], who found that many students believe using Arabic enhances comprehension of the subject matter.

The present study supports the findings of several other EMI-based studies in HEIs. One reason for students' struggle with EMI is the lack of language proficiency identified by Cummins [46] as Cognitive Academic Language Proficiency (CALP). This type of proficiency is essential for university studies, as it enables students to read, analyze and respond to texts; however, it may take years to develop in a second language. A. Kocakulah, Ustunluoglu, and A.Kocakulah [47] support using the mother language in science courses as they believe that a foreign language is a barrier to conceptual understanding. They argue that students should have the capacity to discuss these topics comprehensively and relate them to everyday tasks to detect any scientific misconceptions. A large-scale study conducted by Prinsloo et al. [48] using the South African TIMSS 2011 dataset also found that half of the poor science scores were attributed to language. Similarly, Ouchaib [49] revealed that implementing a foreign or second language as a medium of instruction in science courses tended to lower students' subject comprehension and academic self-concept in his study. This was also supported by Malla [35] and Walt et al. [50], who argued that code-switching could be a useful pedagogical tool to enhance learner comprehension and internalization of the subject matter.

Therefore, it is crucial to work on a well-defined and well-structured language policy aimed at fostering effective learning and academic success in both institutions. Language

policy informs practical language regimes in education [28]. In EMI contexts such as University A, students with limited language proficiency may face challenges in comprehending the content matter. Thus, a clear language policy may provide structured language support programmes, such as preparatory courses, code-switching strategies or even additional courses in their native language. However, language policy makers should consider learners' language competencies, national identity and economic benefits.

5.2. What Implications do EMI and AMI have on Students' Learning Experiences?

The preceding discussion emphasises the short-term advantages of AMI in fostering balanced learning, as well as the long-term benefits of EMI for career advancement and engagement in global science. It also proposes bilingual or translational models as potential solutions to address both the medium of instruction selection and content comprehension. The use of Arabic in science instruction at University B was linked to improved pedagogical engagement, clearer teaching strategies, and greater comfort in academic discourse. Students perceived their instructors as more accessible and adaptive in teaching styles, which facilitated a positive learning environment. Meanwhile, EMI students at University A appreciated the long-term benefits of English, including employability and access to global knowledge, yet experienced reduced academic confidence and increased cognitive load.

The tension between immediate academic accessibility (afforded by AMI) and future professional gain (promised by EMI) reflects a well-documented dilemma in multilingual education policy [51,52]. These findings suggest that while EMI holds strategic value in globalised higher education systems, its implementation must be coupled with language support mechanisms and context-sensitive pedagogy to avoid disadvantaging students during critical learning stages.

5.3. Pedagogical Implications

The analysis underscores the importance of culturally and linguistically-responsive teaching. In AMI settings, instructors leverage students' linguistic familiarity to foster inclusive and participatory classrooms. In EMI environments, a need exists for explicit instruction, use of visuals, code-switching where appropriate, and scaffolding techniques to bridge linguistic gaps. These strategies align with Vygotsky's sociocultural theory, which emphasizes mediation in learning through language and social interaction. Furthermore, the limitations of EMI can be mitigated through high-quality instruction, as evidenced by a positive correlation between effective teaching strategies and academic attitudes ($r = 0.574$), as well as a significant SEM path linking pedagogy to academic attitude (Estimate = 0.955, CR = 11.953). These findings suggest that the quality of instruction can reduce challenges associated with language barriers. As a result, it is essential to provide science educators in EMI settings with targeted training to adapt their teaching methodologies accordingly.

5.4. Institutional Considerations

Policy-level decisions about MI must balance national identity, access to content knowledge, and global competitiveness. The absence of formal language policies in both institutions highlights a gap in institutional clarity. Developing bilingual education models or allowing for more flexible language use in early years while transitioning to EMI in advanced years may offer a pragmatic pathway. Therefore, this paper proposes a Bilingual Transitional Language Model (see **Figure 4**).

This model is implemented into three different phases:

- **Pre-Implementation: Conditions for Success**

This phase involves discussion of a clearly articulated language policy that underpins the chosen instructional model must be adopted and in place, followed by discussion of theoretical foundations that support bilingual transactional EMI approach, including 1978 Vygotsky Sociocultural Theory, Cummins' Interdependence Hypothesis, Cummins [46], and Paris & Alim's Culturally and Linguistically Sustaining Pedagogy [53]. An effective implementation of the approach requires comprehensive orientation and training programmes for academic staff, adequate infrastructure to support the implementation of the approach and awareness-raising sessions for students to foster understanding and engagement.

- **Implementation Phases in a Four-Year BA or B.Ed Programme**

Year 1: Instruction is primarily delivered in the mother tongue, with English integrated into key theories and subject matter concepts. Students enroll in English for Academic

Purposes (EAP) and English for Specific Purposes (ESP) courses.

Year 2: English is introduced more substantially, with teachers delivering full lectures in English on a biweekly basis. Students undertake a second ESP course.

Year 3: English-Medium Instruction (EMI) is further integrated, with weekly lectures and assessments conducted in English accounting for half of the scheduled time.

Year 4: The majority of content, including teaching and assessment, is delivered in English. Arabic is used selectively to clarify complex concepts and provide scaffolding as needed.

- **During and post-implementation**

A process of reflection and assessment is going throughout the process, followed by review and improvement to enhance and develop the adopted approach

Several benefits are expected from the adoption of the Bilingual Transactional Language Model of EMI, including proficiency in both the mother tongue and English, enhanced employment prospects and improved access to a broad range of knowledge and resources.

Overall, the findings suggest that while Arabic as an MI supports immediate comprehension and academic engagement, English offers long-term academic and professional opportunities. A hybrid or transitional approach, supported by pedagogical and policy frameworks, could better accommodate learners' linguistic realities while preparing them for a globalized future.

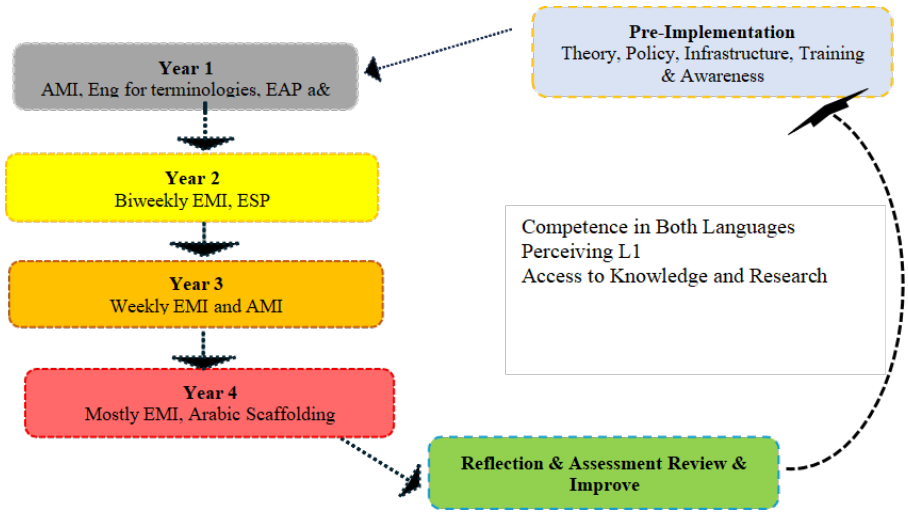

Figure 4. A Bilingual Transactional Language Model.

6. Conclusions and Recommendations

The study has filled a research gap by comparing the perceptions of students in two Omani HEI settings: one where EMI was predominant and one where AMI was predominant. The findings of this study indicate the significant role that the medium of instruction plays in content comprehension and students' academic experience satisfaction. University B students who received instructions in Arabic reported immediate and short-term benefits of AMI, including better content comprehension and academic experience compared to their peers at University A. The findings support existing research, which indicates that language barriers in EMI settings can hinder students' comprehension and engagement. They also align with research highlighting the value of using native language not only for the sake of processing complicated concepts but also advocating multilingualism and maintaining minor cultures.

This study also emphasizes the importance of a clear language policy, which indicates and justifies the language of education. Students and parents have the right to understand why a specific language is being used as a medium of instruction in various institutions. However, counting on a foreign language such as English obliges HEIs to provide the needed language support to facilitate students' interaction with their programme content. This language support should not be limited to a foundation programme but should be provided throughout students' academic years. EMI instructors would

also benefit from some support in constructing EMI classes and using appropriate and engaging strategies, which allow students to share their viewpoints and build connections with reality.

This study also recommends assessing the feasibility of bilingual instruction and integrating code-switching strategies. Future studies can replicate the present study to further understand how generalizable the findings may be. Studies could also incorporate more mixed research methodologies, combining quantitative data with qualitative insights from classroom-based observations and focus groups with students and teachers.

Author Contributions

M.A.S.: Initiated the idea of the research, applied for the PGR fund and carried all the administrative tasks, including assigning roles to the team members and coordinating the data collections with the targeted institutions and research assistants. Contributed to structuring, drafting and finalizing the paper, as well as, analysing and discussing the collected data. S.A.A.: Assisted in writing the PGR proposal and obtaining the necessary approvals from the college and from the targeted institutions. Contributed to structuring, drafting and finalizing the paper, as well as, analysing and discussing the collected data. D.A.S.: Contributed to structuring, drafting and finalizing the paper, as well as, analysing and discussing the collected data. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

Data collection, analysis, processing and publication abide by the global and national ethical considerations and regulations. Ethical approval was obtained from the research ethics committees at both institutions, ensuring that students are well-informed about the project objective and extent of their participation in the research.

Informed Consent Statement

Participants were assured that their participation was voluntary and that confidentiality and anonymity would be maintained throughout.

Data Availability Statement

The data that support the findings of this study are not yet publicly available, as the authors intend to use them for subsequent publications. However, the data may be made available upon reasonable request by contacting the corresponding author.

Conflict of Interest

The authors declare that there is no conflict of interest.

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