

SCAFFOLDING STRATEGIES IN EMI BIOLOGY CLASSROOMS: A MIXED-METHODS CASE STUDY

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Abstract: *The adoption of English as a Medium of Instruction in Algerian higher education has created pedagogical and linguistic challenges, particularly in science disciplines. Therefore, this study explores how scaffolding strategies are enacted and perceived in EMI biology classrooms at Ziane Achour University of Djelfa. To this end, an exploratory mixed-methods case study design was employed. Data were collected through a student questionnaire (N = 45), instructor interviews (N = 4), and classroom observations. Subsequently, quantitative data were analysed descriptively, while qualitative data were analysed thematically. Overall, the findings suggest that students and instructors perceived scaffolding strategies as supportive of engagement with biology content taught in English. In particular, vocabulary support, visual resources, guided practice, and collaborative learning were reported as helpful. However, instructors also identified challenges related to limited training and institutional support. Consequently, although the findings are context-bound, the study provides insight into scaffolding practices in an emerging EMI context and highlights the importance of pedagogical support in EMI science education.*

Keywords: *Scaffolding; English as a Medium of Instruction (EMI); Biology education; Mixed-methods research; Content and Language Integrated Learning (CLIL); Higher education*

1. Introduction

In recent years, the adoption of English as a Medium of Instruction (EMI) has gained momentum across global universities, particularly in regions where English is not the first language. This shift reflects broader educational reforms aimed at enhancing global competitiveness and aligning academic standards (Braun & Clarke, 2006). In 2023, Algeria implemented a national EMI policy encompassing various disciplines, including biology. While the policy appears progressive, its execution reveals significant challenges. Many Algerian biology students face the dual burden of grasping complex scientific concepts while simultaneously navigating the intricacies of academic English. This situation often leads to reduced classroom engagement and limited conceptual understanding.

Furthermore, subject experts, though proficient in their fields, frequently lack the pedagogical training necessary to integrate language support effectively. To address these issues, scaffolding has emerged as a vital instructional approach. Grounded in Vygotsky's theory of the Zone of Proximal Development (ZPD),

scaffolding entails providing structured academic and linguistic assistance that gradually diminishes as learners gain proficiency. Within EMI settings, it serves a dual function, supporting comprehension of disciplinary content and fostering acquisition of specialized language (Huang, 2024).

This aligns with the Language for Specific Purposes (LSP) framework, which views language as intrinsic to subject mastery. Despite its global relevance, empirical studies on scaffolding in Algerian science education remain sparse. Although previous research has examined general attitudes toward EMI and student experiences (Rose & Yuksel, 2024), few have investigated how scaffolding strategies are applied or perceived in practice. Consequently, this study focuses on biology instruction at Ziane Achour University of Djelfa. It seeks to answer two research questions:

1. To what extent do scaffolding techniques enhance students' grasp of biological concepts, vocabulary development, and active participation?
2. How do instructors and learners evaluate the strengths and limitations of scaffolding in an EMI context?

By analyzing classroom realities, the study aims to offer practical insights for improving EMI implementation in linguistically diverse academic environments.

2. Review of Literature

2.1 Sociocultural Scaffolding in EMI Contexts

The theoretical foundation of scaffolding stems from Vygotsky's (1978) sociocultural model, particularly the ZPD, which emphasizes learning through social interaction and guided support. In practice, this involves breaking down tasks, modeling cognitive and linguistic processes, and providing cues to facilitate student understanding. In EMI classrooms, such support is indispensable. Scientific disciplines like biology demand not only comprehension of abstract ideas but also fluency in technical language (Chen & Wang, 2021). LSP-informed scaffolding techniques, including vocabulary previews, visual representations, and collaborative learning, offer essential scaffolding for navigating both linguistic and conceptual complexity.

2.2 Impact of Scaffolding on EMI Learning Outcomes

Recent empirical research underscores the positive influence of scaffolding on student achievement within EMI frameworks (Lai & Idris, 2025). Structured instructional support reduces cognitive overload, encourages academic language use, and fosters learner autonomy. When content and language are taught in tandem, students exhibit improved comprehension and sustained engagement (Umekita, 2025). Moreover, integrating linguistic guidance into content delivery equips learners with the tools needed for independent academic performance, reinforcing the centrality of scaffolding in EMI pedagogy.

2.3 EMI and CLIL: Differentiating Instructional Models

Although EMI and Content and Language Integrated Learning (CLIL) are often associated, they differ in key pedagogical priorities. CLIL explicitly incorporates language learning objectives into subject instruction, while EMI typically prioritizes content delivery, assuming sufficient language proficiency. In contexts like Algeria,

where this assumption may not be valid, scaffolding serves as a bridge. By adopting CLIL-inspired methods, such as explicit terminology instruction and language-focused classroom tasks, EMI educators can significantly enhance learner outcomes. Thus, scaffolding provides a cohesive framework for addressing the instructional gaps between the two approaches (Wang & Winstead, 2023).

2.4 Digital Tools and Post-Pandemic Scaffolding

Technological advancements have introduced innovative scaffolding opportunities, especially in the aftermath of the COVID-19 pandemic. Digital resources, including simulations, multimedia glossaries, and collaborative platforms, allow learners to interact with content at their own pace and revisit complex material as needed (Ouarniki & Alhasani, 2025). These tools have proven particularly effective in science education, where abstract ideas often require repeated exposure. Additionally, digital scaffolding fosters student autonomy and extends learning beyond traditional classroom boundaries, particularly in hybrid or resource-limited settings (Outemzabet & Sarnou, 2023).

2.5 Research Gaps in Algerian EMI Contexts

Although EMI has garnered increased attention in Algeria, current research predominantly explores general challenges or emotional responses. Investigations into specific instructional practices, especially scaffolding, remain limited. This oversight hampers the development of targeted training and informed policy-making. By examining real-world classroom applications of scaffolding in Algerian biology instruction, this study seeks to provide actionable recommendations for enhancing both teaching practices and institutional strategies in EMI contexts.

3. Methodology

3.1 Research Design

The current research utilised a convergent parallel mixed-methods case study, in which data collection in both quantitative and qualitative forms was carried out in one stage of the research process, followed by analysis in each case separately, then later combining them in the interpretation stage. The choice of this mixed method was informed by its ability to provide a broader understanding of scaffolding practices in EMI biology classrooms. Most importantly, the study was exploratory in nature. Rather than aiming to establish causal relationships or statistically generalisable outcomes, it sought to identify patterns, tendencies, and perceptions related to the use of scaffolding strategies in a newly implemented EMI context. Consequently, all findings are interpreted as context-specific and indicative, in line with methodological recommendations for small-sample, institution-bound educational research.

3.2 Research Context and Participants

The study was conducted at Ziane Achour University of Djelfa, a public Algerian university that began implementing EMI in selected science programmes following the national policy shift introduced in 2023. The Faculty of Biology was chosen as the research site because it was among the first faculties to adopt EMI and because biology courses present substantial conceptual and linguistic demands

for students.

3.2.1 Sampling Procedure

A purposive sampling strategy was used to ensure that all participants had direct and sustained experience with EMI instruction. This approach was considered appropriate given the exploratory aims of the study and the limited number of EMI biology courses available at the institution during the data collection period.

The participant group consisted of:

- Forty-five undergraduate biology students ($n = 45$) enrolled in the third-year EMI course *Cellular and Molecular Biology*. All students registered on the course were invited to participate through an in-class announcement made by the course instructor. Participation was voluntary, no incentives were offered, and no students who wished to participate were excluded. No formal refusals were recorded.
- Four biology instructors ($n = 4$) who taught at least one EMI course. Instructors were invited via direct email from the researchers, and all invited instructors agreed to participate. Although all instructors had strong disciplinary expertise, none had received formal training in EMI pedagogy or language-integrated instruction.

While the sample size is limited, it reflects the entire population of EMI biology instruction at the institution at the time of the study and is therefore appropriate for a qualitative-dominant, exploratory case study rather than for statistical generalisation.

All participants provided informed consent, and ethical approval was obtained from the university prior to data collection.

3.3 Data Collection Instruments

To address the research questions comprehensively and ensure methodological triangulation, three data collection instruments were employed: a student questionnaire, semi-structured instructor interviews, and classroom observations.

3.3.1 Student Questionnaire

A structured questionnaire was administered to students at the end of the semester. The instrument consisted of three sections:

- Section A collected demographic information (age and gender) and students' self-reported English proficiency.
- Section B included 5-point Likert-scale items measuring students' perceptions of specific scaffolding strategies (e.g., vocabulary pre-teaching, visual support, guided practice, and collaborative learning).
- Section C comprised open-ended questions inviting students to reflect on the most and least effective scaffolding practices experienced during the course.

The questionnaire was piloted with a group of ten students who were not included in the main sample to ensure clarity, linguistic appropriateness, and contextual relevance. Minor wording revisions were made based on pilot feedback, while no structural changes were required.

Internal consistency analysis conducted on the main dataset yielded a Cronbach's alpha of 0.84, indicating satisfactory reliability for exploratory educational research.

It is acknowledged that questionnaire data rely on self-reported perceptions, which may be influenced by social desirability or recall bias. This limitation is explicitly addressed in the Discussion section.

3.3.2 Semi-Structured Instructor Interviews

Semi-structured interviews were conducted with the four participating instructors to explore their instructional practices, pedagogical decision-making, and perceptions of scaffolding in EMI biology courses.

The interviews were conducted primarily in English, which is the language of instruction for the courses, with occasional clarification in French when requested by participants to ensure accurate expression of ideas.

Interview questions focused on:

- types of scaffolding strategies employed,
- rationales for instructional choices,
- perceived challenges of EMI teaching,
- and institutional support and training needs.

Each interview lasted between 30 and 45 minutes, was audio-recorded with participants' consent, and transcribed verbatim for analysis.

3.3.3 Classroom Observations

Six EMI biology lectures were observed by one of the researchers using a pre-designed observation checklist developed specifically for this study. The checklist was informed by existing EMI and CLIL literature and focused on observable scaffolding practices rather than on evaluative judgments of teaching quality.

The checklist included six domains:

1. Vocabulary pre-teaching
2. Use of visual and multimodal resources
3. Guided practice and modelling
4. Collaborative learning activities
5. Scaffolded questioning
6. Strategic use of students' first languages (Arabic and/or French) as supportive resources

To enhance procedural consistency, the checklist was trialed during two preliminary observations that were not included in the final dataset. All observations were conducted by the same researcher to minimize variability in interpretation.

Observation data were used for triangulation purposes and to contextualize questionnaire and interview findings rather than as an independent measure of instructional effectiveness.

It is recognized that classroom observation may influence participant behavior due to the Hawthorne effect, whereby individuals modify their actions because they are aware of being observed. This issue is addressed as a methodological limitation in the Discussion section.

3.4 Data Analysis Procedures

3.4.1 Quantitative Analysis

Questionnaire data were analyzed using SPSS (Version 26).

Given the exploratory nature of the study and the relatively small sample size, the analysis was deliberately limited to descriptive statistics, including frequencies, means, and standard deviations.

No inferential statistical tests were conducted, and all references to inferential analysis were removed to ensure consistency between the Methods and Results sections. The quantitative findings are therefore presented as descriptive trends rather than as statistically generalizable outcomes.

3.4.2 Qualitative Analysis

Qualitative data from open-ended questionnaire responses, instructor interviews, and classroom observation notes were analysed using thematic analysis, following Braun and Clarke's (2006) six-phase framework: familiarization with the data, initial coding, theme development, theme review, theme definition, and reporting.

To enhance analytical rigor, two researchers independently coded the data. Coding discrepancies were discussed and resolved through consensus, thereby improving consistency and trustworthiness. Observation data were used to corroborate and enrich themes emerging from student and instructor narratives.

3.5 Trustworthiness and Rigor

Several strategies were implemented to enhance the methodological rigor of the study.

Triangulation across data sources (questionnaires, interviews, and observations) strengthened the credibility of the findings. Member checking was conducted with instructor participants to confirm the accuracy of interpreted meanings, and peer debriefing between the researchers supported reflexivity and analytical transparency.

For the quantitative component, rigor was supported through pilot testing and internal consistency analysis. Collectively, these procedures contribute to methodological transparency while remaining appropriate to the study's exploratory scope and contextual focus.

4. Results

This section discusses the study's findings in terms of the two research questions that guided it.

Data for this study came from student questionnaires, instructor interviews, and classroom observations. In keeping with the mixed-methods design, quantitative data is presented descriptively, whereas qualitative data is presented thematically. What is more important is that all data sources complement one another in offering an in-depth and contextualized description of EMI biology classroom scaffolding.

4.1 Quantitative Findings: Student-Reported Perceptions of Scaffolding

First, questionnaire data offer an overview of how students perceived the scaffolding strategies implemented in their EMI biology course.

Table 1 presents the number and percentage of students who reported agreement or strong agreement with statements related to specific scaffolding practices.

Table 1. Overview of student agreement with scaffolding strategies in EMI biology (Likert scale).

Scaffolding Strategy	Agree or Strongly Agree (%)
Pre-teaching vocabulary helped me understand biology concepts.	41 (91%)
Visual aids make complex ideas easier to grasp.	39 (87%)
Group activities helped me learn better.	37 (82%)
Step-by-step instruction supported application of new knowledge.	36 (80%)
I felt more confident participating due to these strategies.	38 (84%)

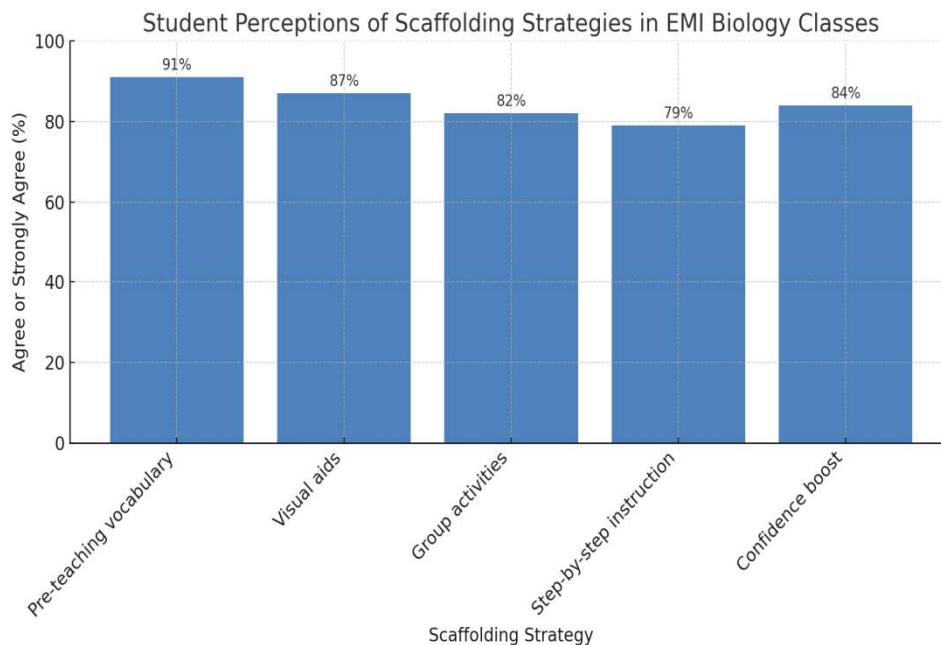


Figure 1. Student Perceptions of Scaffolding Strategies in EMI Biology Classes (N = 45).

Table 1 shows the percentage of students who either agreed or strongly agreed with Each scaffolding strategy was listed on the 5-point Likert-scale questionnaire. It can be seen from the results that the overall perception of using scaffolding strategies in the EMI biology classes is very high.

These results indicate a very positive student response to scaffolding, particularly with regard to pre-teaching vocabulary and visual or multimodal scaffolding.

Students emphasized how such scaffolds had made biological processes more accessible while decreasing linguistic difficulty in terms of content matter engagement.

Gender- and English-level comparisons revealed small and descriptive differences rather than statistically tested contrasts:

- Female students (n = 28) indicated a slightly higher mean level of appreciation

($M = 4.43$, $SD = 0.48$) compared to male students ($n = 17$; $M = 4.21$, $SD = 0.61$). Students who self-identified as having medium or higher English proficiency ($n = 30$) reported greater appreciation for reflective and strategic scaffolding supports (e.g., journaling, sentence frames), whereas students with lower confidence in English reported greater reliance on visual supports, bilingual explanation, and peer support. These variations suggest that scaffolding effectiveness may differ according to learners' linguistic profiles, underscoring the need for differentiated scaffolding practices in EMI settings.

4.2 Qualitative Findings: Teacher and Classroom Insights

Five broad themes emerged from the qualitative data obtained through instructor interviews and classroom observations.

4.2.1 Scaffolding Builds Comprehension

All four instructors reported employing vocabulary scaffolding, sequenced structuring, and simplified language to facilitate content comprehension. They emphasized the importance of breaking complex biological concepts into manageable components. "When I pre-teach significant vocabulary prior to lecture, students track much more easily – they're not lost in translation." – Instructor A

"We attempt to simplify, but we still capture the essence of biology. That's difficult, but scaffolding enables us to do that." – Instructor C

Students' responses echoed these perceptions:

"I used to learn words without knowing. But now, with example and explanation by the teacher, I finally know the meaning." – Student 24

Students further emphasized the role of vocabulary pre-teaching in preparing them cognitively for lessons:

"Earlier, I didn't know what 'mitochondria' was. But when our teacher provided us with a definition and picture, it made sense for the first time." – Student 16

"Pre-teaching primes us. I am better prepared to learn if I already know the key words." – Student 22

4.2.2 Visual Aids and Multimodal Tools to Enhance Learning

The use of visual scaffolding techniques is observed in the classrooms. Tutors use PowerPoint presentations, scientific images, YouTube videos, or pictures drawn on the board to make abstract biological concepts easier to understand.

"Without graphics and animation, I believe that 60% of my class would be confused. Graphics are stronger than my English." – Instructor D

Students were firmly linking visualization functions to understanding and recalling: "Videos help when we can't read the words. I look again at home." – Student 3

"I remember the shape of DNA, not from the lecture, but from the color-coded picture shown in class." – Student 29

"When I look at a diagram, it's a quick route to the information. Even if I don't get what the sentence means, the picture does." – Student 10

"Animations are particularly useful for hard stuff such as enzymes. I've re-watched it at home to remind." – Student 35

Classroom observations confirmed instructors' frequent pause of the slides to explain visual elements and invited students to identify parts of diagrams provided further reinforcement for visual-verbal integration.

4.2.3 Guided Practice Reduces Cognitive Load and Increases Confidence

Model examples, guided worksheets, and laboratory demonstrations allowed for incremental learning, following in the tradition of the "I Do – We Do – You Do" teaching progression. "When I model first, then we model together, students feel safe. Then they do it on their own with more confidence." – Instructor B

Observational notes revealed that instructors paid close attention to laboratory demonstrations and practised collectively before independent execution. Students themselves valued this structured approach:

"I'm scared to answer by myself when asked, but once we try it together, I know I can do it." - Student 7

"Whatever we practice step by step, I never panic. I hear better and I remember more." – Student 31

4.2.4 Challenges

Although they showed strong adherence to scaffolding techniques, the instructors face some challenges, which include:

- Insufficient training in EMI and scaffold-oriented pedagogy
- Information overload and lack of time
- Unpredictable access to projectors, internet, and multimedia resources
- A lack of departmental coordination and EMI-specific guidelines. "We're supposed to be teaching biology in English, but no one is instructing us on how to do that," I learned from YouTube." – Instructor D

"Sometimes I intend to use a video, but the projector will not work. Then I have to speak with it, and that is difficult." – Instructor C

"I believe that scaffolding does work, but without training and resources, we do the best that we can." – Instructor B

"We don't have enough time to cover all the scaffolding activities. We have to decide what to omit." – Instructor B

4.2.5 Collaborative Tasks Develop Language Practice and Engagement

Activities such as pair explanation, think-pair-share, and mini-presentations enabled students to interact with biological concepts as they developed their English language proficiency.

"Students explain it better to one another than I do. Sometimes in Arabic, sometimes in English, but they manage." – Instructor A

"I am shy to speak in class, but if I speak in groups, practice in English is easy." – Student 14

"In pairs, we tell each other in English and sometimes in Arabic. No one gets left behind this way." – Student 18

"In group work, we use words. My friend told me about 'osmosis' using an example. "And now I will never forget." – Student 20

This theme emphasizes peer-mediated scaffolding, especially in EMI classrooms where scaffolding by teachers might not be accessible to everyone.

Such descriptions highlight the value attached to the need for institutional support, professional development, as well as practical follow-through in ensuring the success of teaching in EMI.

Indeed, the quantitative results show the strong support of students for scaffolding techniques in EMI biology classes, especially in the form of vocabulary previews

and visual support. The qualitative results further support these findings and add depth in showing the scaffolding role in ensuring comprehension, building confidence, and promoting student participation, apart from showing the supporting and constraining factors in the context of EMI classes.

5. Discussion

This section interprets the findings in relation to the research questions and relevant theoretical perspectives, while remaining consistent with the exploratory scope and methodological design of the study.

5.1 Perceived Role of Scaffolding in EMI Biology Learning

The findings of this study strongly suggest that scaffolding strategies enhance students' learning outcomes in EMI biology classes. As supported by existing literature (Meyer 2010; Airey 2011), the subjects of this study stated that pre-teaching vocabularies, visual aids, and guided practice helped them comprehend difficult biology concepts and participate in class more confidently. This is consistent with Vygotsky's (1978) contention that learners can perform more complex tasks under appropriate guidance in their Zone of Proximal Development (ZPD).

Most prominently, animations, flowcharts, and diagrams as visual aids were external cognitive tools that enabled students to make sense of abstract biological processes and thereby contributed to a reduction of perceived cognitive load. Moreover, the "I Do – We Do – You Do" approach, observed during class instruction, allows for the transition from passive reception to active production, with greater understanding as well as assurance. Especially, weaker English students reported greater perceived benefit from such a type of scaffolding, step-by-step structural assistance, which implies the need for language-level differentiation. Therefore, it is possible to conclude that scaffolding not only assists with academic understanding but also serves a principal affective role in the reduction of apprehension and increase in learner controls reflected in students' reported experiences.

5.2 Perceived Strengths and Constraints of Scaffolding Practices

In fact, both findings and teacher and student attitudes converged on the usefulness of scaffolding as a pedagogical strategy in EMI classrooms. Students appreciated visual assistance, group discussion, and task-explicit frames. Teachers recognized the pedagogical benefits of scaffolding but were concerned about its practicability due to institutional and logistical constraints.

In reality, for EMI to have effective scaffolding, it has to be based on pedagogical sensitization as well as institutional support. This is because, as was experienced by the tutors, they had to improvise learning to teach for EMI since they did not receive any training on EMI pedagogy, a condition that was also cited in a similar research conducted by Umekita in 2025. Additionally, answers from the students concerning peer participation underscore the significance of socially mediated learner approaches, which is one of the most significant aspects of Vygotskian Theory. By peer scaffolding, students had the chance to engage as well as make use of their academic English for conversation, which is done with minimal risks. Yet the results show that there were some systemic problems such as limited

digital tools, lack of training opportunities, and absence of institutionalized EMI templates. These factors impinge on the sustainable implementation of scaffolding and demonstrate the urgent need for policy-level support for EMI teachers.

5.3 Alignment with Sociocultural and CLIL-Oriented Perspectives

The findings of the study align with those of earlier empirical studies in other international EMI contexts (Chen, Li, & Wang, 2021). The study contributes new insights, though, by placing these findings in the specific under-researched Algerian context, where EMI is at the initial stage of implementation and scaffolding has yet to be institutionalized.

Theoretically, the results provide contextual empirical reinforcement for Vygotsky's ZPD and CLIL-based teaching, confirming scaffolding as a mediating mechanism that assists students in transitioning from dependence to greater independence in language and content learning. Notably, the effectiveness of scaffolding in this context is not based on very advanced English proficiency but on access to organized, responsive support that is contingent on students' needs. Additionally, the research stresses the place of interaction and guided participation in EMI classrooms. The teacher–student and peer–peer interactions noted operated as scaffolding events that supported understanding, in accordance with the sociocultural view of learning as a collective and contextualized process.

5.4 Pedagogical and Institutional Implications

Based on the understanding derived from the above case study, the findings suggest that scaffolding needs more emphasis as a pedagogical tool in the teaching of science in EMI contexts. For the teacher, the above strategies might be helpful in assisting students in coping with the challenges of EMI more confidently. From the institutional point of view, the above case study suggests that the value of EMI teacher training, the availability of digital tools, and pedagogical guidelines might be useful, although it should be noted that the above implications should be understood as suggestions rather than recommendations, as the above case study is more exploratory in nature.

5.5 Methodological Limitations

However, it should be noted that there are certain methodological limitations to the research that should be taken into consideration when interpreting the results of the study. For instance, the research was carried out in a single institution, and the number of participants was relatively small. This means that the results of the study cannot be generalised to EMI in general in Algeria and beyond. The results should be seen as contextual and exploratory in nature. The study also used a student questionnaire, which is based on perceptions. The perceptions of the participants may be threatened by self-report bias. However, the findings of the study should not be considered as objective learning outcomes. Third, the classroom observations may be threatened by the Hawthorne effect, where the teachers and students may change their behavior due to awareness of being observed. While multiple observations were conducted to reduce this effect, it cannot be entirely eliminated. Finally, because EMI is still at an early stage of implementation in the Algerian context, the scaffolding practices observed may reflect emergent and adaptive responses rather than stable or institutionalised instructional models. These limitations do not diminish the value of the study. Rather, they highlight

directions for future research, including longitudinal designs, multi-institutional studies, and the integration of objective learning measures alongside perception-based data.

6. Conclusion

This research aimed to examine the enactment and reception of scaffolding strategies in Ziane Achour University of Djelfa English as a Medium of Instruction (EMI) biology lessons in the overall framework of Algeria's new trend of English-medium tertiary education. Applying a mixed-methods case study methodology, the research produced both quantitative and qualitative data indicating that scaffolding is a very powerful teaching tool in EMI biology lessons. Specifically, the study demonstrates that scaffolding techniques such as pre-teaching technical terms, visual and multimodal support, guided practice, and cooperative learning are associated with increased students' understanding, interest, and confidence. The findings support Vygotsky's (1978) sociocultural theory, under which students learn more successfully advanced skills if supported in their Zone of Proximal Development (ZPD). Furthermore, the success of the observed scaffolding as perceived by participants is supported by global EMI and CLIL research affirming its cross-linguistic and cross-cultural worth. Most importantly, the research identified that both students and teachers acknowledge scaffolding as an indispensable support technique in EMI settings, especially in addressing language issues and high-cognitive-load material. The study also identified the most important pedagogical and institutional challenges, namely the absence of teachers' training, insufficient technological facilities, and lack of institutionalized EMI policy instruments that negatively impact the long-term practice of scaffolding techniques in Algerian higher education.

In general, the findings not only underscore the pedagogic effectiveness of scaffolding in EMI teaching environments but also highlight the need for systemic support to ensure its long-term sustainability. Through triangulation of theoretical insights, empirical findings, and practical suggestions, the research makes a positive contribution to the nascent debate concerning EMI pedagogy in the Global South.

7. Recommendations

With the results of this exploratory case study and the methodological limitations discussed earlier in mind, the following recommendations are proposed. These recommendations are offered as context-dependent suggestions rather than prescriptions.

7.1 Pedagogical Recommendations

First, EMI teachers, especially those in science-related subjects, may benefit from more intentional use of scaffolding techniques, which might include:

- Explicit pre-teaching of key vocabulary,
- Systematic use of visual materials,
- Guided practice with step-by-step instructions, and
- Opportunities for collaborative learning.

Second, scaffolding techniques may be differentiated according to students'

linguistic confidence levels and task complexity. For example, students with lower English proficiency levels may need more visual support, while students with higher proficiency levels may need more strategic scaffolding, especially for explanation, problem-solving, and academic discourse development.

Third, peer-mediated scaffolding should be encouraged, as it provides students with a low-risk environment to negotiate meaning, practise academic English, and build confidence through social interaction.

7.2 Institutional Recommendations

At the institutional level, the findings suggest the need for greater structural support for EMI implementation. In particular, universities may consider:

- offering professional development programmes focused on EMI pedagogy, scaffolding strategies, and language-aware teaching,
- developing clear EMI guidelines that acknowledge the dual demands of content and language learning,
- improving access to digital and technological resources that support multimodal instruction,
- and fostering collaboration between subject specialists and language professionals through communities of practice.

Such initiatives may help move scaffolding practices from individual, improvised efforts toward more coherent and sustainable instructional approaches.

7.3 Recommendations for Future Research

Finally, future research may extend the current study by utilizing larger-scale and multi-institutional approaches, enabling more comprehensive comparisons with EMI contexts in Algeria. Moreover, longitudinal approaches may shed light on the development of scaffolding practices with more consolidated EMI. Besides, incorporating both perception-based and objective approaches may create a more complete understanding of the relationship between scaffolding practices and student outcomes.

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Conflict of Interest

The authors declare no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

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