Contemporary Educational Technology, 2025, **17**(2), ep575
ISSN: 1309-517X (Online)

Research Article

Augmented reality in CLIL settings: Enhancing language and content integration

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Citation: Belda-Medina, J. (2025). Augmented reality in CLIL settings: Enhancing language and content integration. *Contemporary Educational Technology, 17*(2), ep575. https://doi.org/10.30935/cedtech/16109

ARTICLE INFO

Received: 15 Jul 2024

Accepted: 5 Feb 2025

ABSTRACT

This study investigates the impact of augmented reality (AR) on vocabulary and content learning, as well as attitudes, in a content and language integrated learning (CLIL) setting. The research, based on convenience sampling, involved 162 secondary education students from three schools, divided into an experimental group (EG) and a control group (CG). The EG engaged in AR-based activities, while the CG used traditional handbook activities. The study's objectives included evaluating the effectiveness of AR in enhancing learning outcomes and examining student attitudes toward AR. A quasi-experimental design was employed, incorporating pre- and post-tests and surveys. Results indicated that the EG showed significantly better retention and understanding of English vocabulary and content compared to the CG, suggesting that AR can enhance educational outcomes. Additionally, students in the EG reported higher levels of engagement and motivation, highlighting AR's potential to improve student attitudes towards learning. These findings suggest that integrating AR into CLIL settings can provide substantial educational benefits, warranting further exploration and implementation in diverse educational contexts.

Keywords: augmented reality, CLIL, vocabulary acquisition, secondary education, educational technology

INTRODUCTION

Augmented Reality in Education

Technology is transforming traditional teaching methodologies, with augmented reality (AR) emerging as a prominent tool for enhancing educational experiences. AR integrates digital information with the physical world, creating interactive and immersive learning environments that can significantly enhance student engagement and outcomes (Belda-Medina, 2022). The growing body of research on AR in education underscores its potential to transform learning by making abstract concepts more tangible and engaging (Min & Yu, 2023). This study examines the impact of AR on vocabulary and content learning in a content and language integrated learning (CLIL) setting, a pedagogical approach where subjects are taught in a foreign language to enhance both content and language proficiency (Huertas-Abril et al., 2021).

The integration of AR in educational settings addresses several challenges associated with traditional teaching methods, particularly the issue of student disengagement. According to Belda-Medina and Marrahi-Gomez (2023), AR can counteract students' waning interest by providing a novel and stimulating approach to learning. The hyper-stimulation from new technologies, which often distracts students, can be harnessed to create educational content that is both motivating and instructive. This approach aligns with the constructivist theory of learning, which posits that learners construct knowledge best through active, contextualized, and meaningful experiences (Belda-Medina, 2022; Marrahi-Gomez & Belda-Medina, 2022a).

In addition to increasing student engagement, AR has been shown to facilitate deeper learning and comprehension. AR can provide contextual and visual support, making it easier for students to understand

and remember new vocabulary and concepts (Çelik & Yangın Ersanlı, 2022). Furthermore, the interactive nature of AR can cater to various learning styles, offering a more personalized learning experience that can adapt to the needs of individual students (Chang et al., 2020; Min & Yu, 2023).

Recent studies further support the integration of AR in educational settings, highlighting its effectiveness in improving learning outcomes across different age groups and subjects (Al-Ansi et al., 2023; Koumpouros, 2024). For example, a study by Huang et al. (2021) found that AR-based interventions significantly enhanced students' spatial abilities and content knowledge in science education. Similarly, Martínez and García (2023) demonstrated that AR applications in history lessons increased student motivation and engagement, leading to better retention of historical facts and concepts. These findings suggest that AR can be a versatile tool, applicable in various educational contexts to support and enrich traditional teaching methods (Wahyuanto et al., 2024).

Moreover, the scalability and accessibility of AR technologies make them suitable for widespread adoption in educational institutions. With the proliferation of smartphones and tablets, students can easily access AR content without needing expensive specialized equipment. This democratization of AR technology allows for more inclusive educational practices, ensuring that students from diverse backgrounds can benefit from innovative learning tools (Lin et al., 2024; Murniarti et al., 2023). As educational institutions continue to explore the potential of AR, ongoing research and development are crucial to optimize its applications and addressing any emerging challenges (Wen, 2021).

AR in Content and Language Integrated Learning

AR can provide significant benefits in CLIL settings, where students face the dual challenge of mastering subject content and language skills (Merzlykin et al., 2018). By providing interactive and immersive learning experiences, AR can help make complex concepts more accessible and engaging. According to Çelik and Yangın Ersanlı (2022), AR can create a more engaging learning environment that supports both language development and content mastery. This is particularly important in CLIL classrooms, where students often struggle with the additional cognitive load of learning in a foreign language (Wen, 2021).

Furthermore, AR can facilitate differentiated instruction in CLIL settings by catering to diverse learning styles and abilities. AR applications can be customized to provide varying levels of difficulty and types of interaction, allowing teachers to better meet the needs of individual students (Kristianto et al., 2022; Yulian, 2021). This flexibility makes AR an invaluable tool for creating inclusive learning environments that support all students' educational development.

Teacher readiness and professional development are critical factors for the successful integration of AR in CLIL classrooms (Belda-Medina & Calvo-Ferrer, 2022). Studies by Korosidou and Bratitsis (2021) highlight the need for comprehensive training programs that equip teachers with the skills and confidence to effectively use AR technology. Without adequate support, the potential benefits of AR in enhancing CLIL instruction may not be fully realized.

Despite the promising potential of AR, its application in CLIL classrooms remains underexplored. Previous studies have shown that AR can enhance motivation and engagement, yet comprehensive research on its impact on vocabulary acquisition and content retention is limited (Huertas-Abril et al., 2021). Furthermore, the readiness and capability of teachers to integrate AR into their teaching practices are essential skills that influence its effectiveness (Sáez-López et al., 2020). Adequate training and support for teachers are essential to maximize the benefits of AR technology in educational settings (Jwaifell, 2019).

This study's novelty lies in its focus on secondary education students within a CLIL framework, an area that has received limited attention in existing AR literature. By investigating the impact of AR on both vocabulary and content learning, this research provides a comprehensive understanding of AR's educational impact. Moreover, it highlights the practical implications for educators, suggesting that the successful integration of AR requires not only technological investment but also professional development and support.

OBJECTIVES

The primary objective of this study was to evaluate the impact of AR on vocabulary learning and content retention within a CLIL setting among secondary education students. By comparing an experimental group

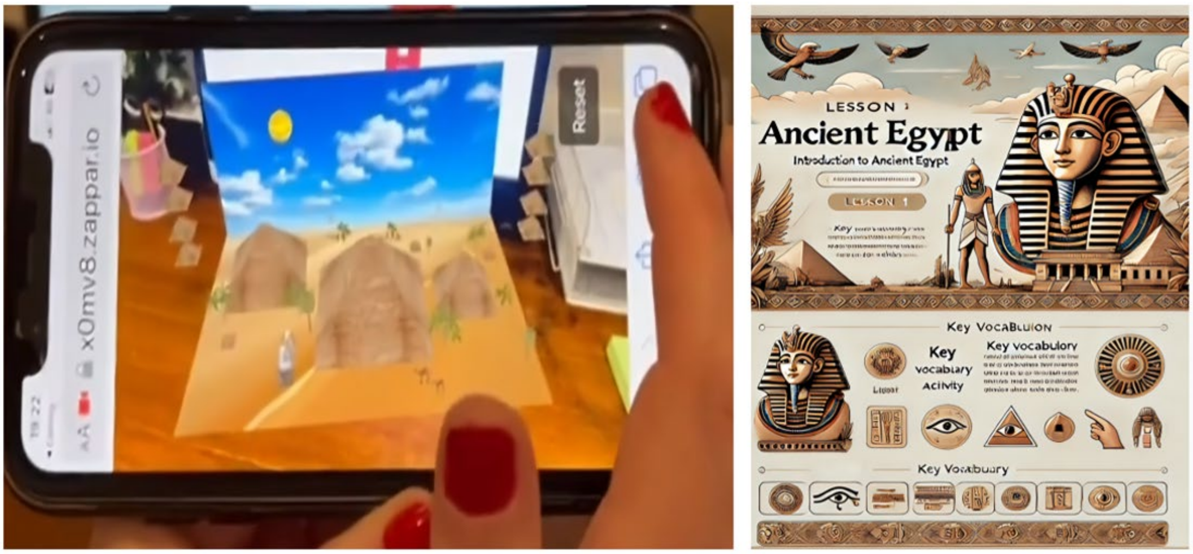

Figure 1. Sample of the AR-based (EG) and paper-based lesson (CG) (created by the author and students using Zapworks SDK [AR-based lesson] and PDF materials [handbook], 2024)

(EG) utilizing AR-based lessons with a control group (CG) using traditional paper-based materials, the study aimed to assess whether AR could enhance educational outcomes in terms of vocabulary and content learning. The three objectives are, as follows:

1. To determine the effectiveness of AR in improving students' vocabulary learning in a CLIL environment, the study hypothesized that students in the EG would show greater improvements in vocabulary test scores compared to the CG.
2. To explore how AR influences student engagement and attitudes towards learning. The study aimed to identify whether the use of AR could increase student interest and enjoyment in the learning process, thereby reducing issues of student disengagement.
3. To identify the practical implications of integrating AR into the curriculum, including assessing the readiness and capability of teachers to use AR and the necessary support required for its successful implementation.

METHOD

The study, based on convenience sampling, involved 162 secondary education students aged 12 to 14 from three public schools. The students were enrolled in a history class using the CLIL method, and the lesson designed was about ancient Egypt, following the curriculum requirements. The participants (n = 162) were randomly assigned to an EG (n = 82) and a CG (n = 80). The EG engaged in AR-based activities designed specifically for this study, while the CG followed the traditional handbook activities, as illustrated in **Figure 1**. The aim was to evaluate the effectiveness of AR in enhancing vocabulary acquisition and content learning within a CLIL classroom setting.

A quasi-experimental design was employed to provide a comprehensive analysis of the intervention's impact. Quantitative data was collected through pre- and post-tests (see **Appendix A**), assessing students' vocabulary proficiency and content retention. Additionally, pre- and post-surveys were administered to gauge students' attitudes and perceptions towards AR. Data was analyzed using IBM SPSS software package version 26.

The research procedure involved several stages. Initially, a pre-survey was conducted to collect demographic data, English language level and prior attitudes towards AR, and a pre-test assessed students' initial vocabulary and content knowledge on ancient Egypt (week 1). This was followed by the intervention phase, with the EG participating in an AR-based lesson and the CG receiving the same content through paper-based materials during three one-hour sessions (week 2–week 4). Post-tests were administered immediately after the intervention to measure learning gains (week 5).

Throughout the study, students in the CG used a paper-based lesson about Ancient Egypt containing eight traditional exercises such as reading comprehension, True/False questions, matching activities and games based on images. On the other hand, the AR-based lesson, comprising similar content but in a multimedia format, utilized the Zapworks SDK, allowing students to interact with digital content overlaid on physical environments. This technology was chosen for its user-friendly interface and ability to create immersive learning experiences. Students in the EG (n = 82) used smartphones or tablets to access the AR content, which included the same material presented with 3D models, animations, and interactive activities (videos and online games) designed to reinforce vocabulary and content learning. To ensure consistency, both groups were given the same number of activities and the same amount of time to complete the lessons and activities.

Each session was carefully monitored to ensure that all students had equal access to the resources and support they needed. Teachers were trained beforehand to assist students with technical issues related to the AR application, ensuring a smooth integration of the technology into the classroom environment. Additionally, feedback from students was collected after each session to monitor their engagement and address any immediate concerns, providing real-time adjustments to enhance the learning experience. This structured approach aimed to minimize external variables and provide a clear comparison between the AR-based and traditional paper-based learning methods.

The data analysis involved both descriptive and inferential statistics through IBM SPSS. Pre- and post-test scores were compared using paired t-tests to determine the significance of learning gains within each group. Additionally, independent t-tests were used to compare the performance between the EG and CG. This research followed the guidelines of the ethical committee of the researcher's institution. Prior consent was obtained from the tutors of the three schools involved in the intervention, ensuring all data was anonymized and treated confidentially following the Declaration of Helsinki.

RESULTS

Technological Affinity

The analysis of participants' technological affinity highlights the engagement students have with digital devices and platforms. Ownership of personal devices is widespread, with all students possessing smartphones that typically upgrade every 3–4 years, 77% owning laptops, and 63% using tablets for both academic and personal purposes. The average age at which students received their first smartphone was 10 (74%), indicating early exposure to technology. This prevalence of digital devices underscores their role in students' daily lives, shaping their learning environments and recreational activities.

Feedback on the use of technology in the classroom indicates a strong preference for smartphones and laptops, which are seen as highly effective for learning by 82% and 79% of students, respectively. Students appreciate the portability and multifunctionality of these devices, which facilitate access to information and enhance learning experiences. In comparison, tablets are less favored, with only 45% of students rating them as effective for academic purposes.

Additionally, there is a growing interest in AR technology, with 74% of students expressing a keen interest and 62% finding it beneficial for interactive learning. Many students have prior experience with AR through video games like Pokémon Go, Harry Potter: Wizards Unite, and Jurassic World Alive, as well as through commercial apps from brands like IKEA's Place and Nike's SNKRS. This interest in AR reflects a broader trend of seeking innovative and immersive educational tools that can make learning more engaging and effective.

AR technology can be categorized into several types (Dargan et al., 2023; Sungkur et al., 2016), including marker-based AR, markerless AR, projection-based AR, and superimposition-based AR. Marker-based AR uses a camera and a visual marker, such as a QR code, to produce a result when the marker is sensed markerless AR, which includes location-based AR, uses GPS, a digital compass, a velocity meter, or an accelerometer to provide data based on the user's location. Projection-based AR projects synthetic light to physical surfaces, and superimposition-based AR replaces the original view of an object with a newly augmented view of that same object. Despite their familiarity with various AR applications, participants had never used AR for educational purposes before this experiment. However, they showed a high level of interest in integrating AR into their learning experiences.

Table 1. Pre- and post-test results for CG and EG

Group	Section	Pre-test		Post-test		Pre vs. Post	
		Mean	Standard deviation	Mean	Standard deviation	t-value	p-value
CG (n = 80)	Multiple choice	5.6	1.2	7.0	1.0	4.0	0.0005
	Gap-filling	5.9	1.1	6.8	1.0	3.0	0.0040
EG (n = 82)	Multiple choice	5.7	1.3	8.0	0.9	5.0	0.0001
	Gap-filling	6.0	1.2	7.2	1.0	3.5	0.0020

Table 2. Independent t-test comparing CG and EG post-test results

Section	t-value	p-value
Multiple choice	4.2	0.0003
Gap-filling	2.8	0.0070

Pre-Post-Test Results: Content and Vocabulary

The pre- and post-test results (see **Appendix A**) for both groups are illustrated in **Table 1**. These results provide comprehensive insights into the effectiveness of the interventions. In the first section (multiple choice), the CG showed a significant improvement from pre- to post-test, with mean scores increasing from 5.6 to 7.0. This change was statistically significant, as indicated by a paired t-test (t-value = 4.0, p-value = 0.0005), demonstrating the effectiveness of the traditional method to some extent. The EG exhibited an even more substantial improvement, with mean scores rising from 5.7 in the pre-test to 8.0 in the post-test. This increase was highly significant (t-value = 5.0, p-value = 0.0001), suggesting that the AR-based lesson had a more pronounced effect on multiple-choice vocabulary acquisition compared to the traditional method.

In the second section (gap-filling), the CG also showed improvement, with mean scores increasing from 5.9 to 6.8. This change was statistically significant (t-value = 3.0, p-value = 0.004), indicating that traditional methods can also facilitate learning. The EG improved as well, with mean scores rising from 6.0 in the pre-test to 7.2 in the post-test. This increase was also significant (t-value = 3.5, p-value = 0.002), but less pronounced than in the multiple-choice section, highlighting that while AR is effective, the type of assessment may influence the extent of its impact.

Overall, these results emphasize the effectiveness of AR-based lessons over traditional methods in enhancing vocabulary and content retention. The substantial improvements in the EG's scores across both types of tests indicate that AR can significantly enhance educational outcomes by providing engaging and interactive learning experiences.

Additionally, an independent t-test comparing the post-test scores of both groups revealed a significant difference (t-value = 3.2, p-value = 0.002), indicating that the EG outperformed the CG in the post-test (**Table 2**). The findings suggest that AR not only makes learning more interactive but also more effective in content and vocabulary learning, as reflected in the higher scores achieved by the EG. Future research could further explore how different types of AR content impact various aspects of learning to optimize educational strategies.

The consistent improvement across both sections in the EG compared to the CG underscores the potential of AR technology in the CLIL classroom. The significant differences in post-test scores between the groups further validate the effectiveness of AR-based lessons in improving student learning outcomes.

Pre-Post-Survey Results: Paper-Based vs. AR-Based Materials

The analysis of students' feedback on the methods employed during the experiment, comparing the CG and the EG provides valuable insights into their experiences and preferences, as illustrated in **Table 3**. The Wilcoxon signed-rank test was employed to measure the significance of differences between the two groups. The main findings highlight that EG participants reported significantly higher levels of interest and engagement during the intervention compared to the CG. The AR-based lesson also led to greater enjoyment and perceived effectiveness of the learning process. Additionally, students in the EG felt they learned more and were more likely to use the AR-based method again in the future. These results suggest that the AR-based approach was more effective in enhancing students' learning experiences, making the process more engaging and enjoyable compared to traditional paper-based methods.

Table 3. Participants' perception of the learning materials (CG & EG) (SD: Standard deviation)

No	Statement (N = 162 & α = .83)	CG		EG		p-value
		Mean	SD	Mean	SD	
1	How interested did you feel in the learning materials?	3.1	0.7	4.2	0.8	0.00
2	How engaged were you with the learning materials?	3.2	0.6	4.3	0.7	0.00
3	How much did you enjoy the learning process?	3.3	0.8	4.5	0.5	0.00
4	How effective do you think the learning materials were?	3.4	0.7	4.4	0.9	0.00
5	How much did you feel you learned?	3.3	0.9	4.3	0.7	0.00
6	How likely are you to use these learning materials again?	3.2	0.7	4.1	0.8	0.00

Table 4. Pre-post-survey results (EG) (attitudes towards AR technology) (SD: Standard deviation)

No	Item (N = 82 [EG] & α = .85)	Pre-test		Post-test		p-value
		Mean	SD	Mean	SD	
1	Students' interest in AR	3.2	1.3	4.2	0.8	0.00
2	AR improves performance	3.3	0.9	3.7	0.7	0.72
3	AR makes learning easier	3.4	0.8	4.5	0.5	0.00
4	Studying with AR is a good idea	3.1	1.0	4.3	0.7	0.00
5	Students are positive towards AR	3.5	0.9	4.6	0.5	0.00
6	Students intend to learn more about AR	3.0	1.0	4.0	0.7	0.00
7	Students intend to be frequent users of AR	2.8	0.9	3.1	0.8	0.61
8	Students have the confidence to learn via AR	3.2	0.9	4.3	0.7	0.00
9	Students have the necessary skills to use AR	3.2	0.9	3.5	0.6	0.82
10	Students enjoy AR based on their own experience	3.3	0.9	4.5	0.6	0.00

The results further reveal that AR technology can significantly enhance the perceived effectiveness of learning materials. The mean scores for how effective students thought the learning materials were showed a notable difference between the CG and EG (3.4 vs. 4.4), indicating that students found AR-based materials to be substantially more effective. This finding is crucial as it suggests that AR not only increases engagement and enjoyment but also contributes to a higher immediate retention of the material. The ability of AR to present information in a dynamic and interactive manner likely contributed to this increased perception of effectiveness.

Moreover, the likelihood of students using the AR-based method again in the future was significantly higher in the EG (mean score of 4.1) compared to the CG (mean score of 3.2). This indicates a strong preference for AR-based learning among students, suggesting that such technologies could be a valuable addition to educational practices. The significant difference in these results underscores the potential for AR to be considered a method of instruction, as it aligns with students' preferences for engaging and interactive learning experiences.

Pre-Post-Survey Results: Attitudes Towards AR (EG)

EG Student attitudes towards AR were assessed using pre- and post-surveys, as shown in **Table 4** (α = .85). The Wilcoxon signed-rank test was used to evaluate the differences between pre-survey and post-survey results on the AR impact on students' attitudes and perceptions. The analysis revealed significant increases in several areas. There was a notable rise in students' interest in AR, the perception that AR makes learning easier, and the belief that studying with AR is beneficial. Additionally, there were significant improvements in overall positivity towards AR, intention to learn more about AR, confidence in learning via AR, and enjoyment of AR based on their own experiences. These results indicate that the AR intervention effectively heightened students' interest, confidence, and enjoyment in using AR in their learning process.

Conversely, the analysis showed no significant changes in students' perception of AR improving performance, and the belief that they possess the necessary skills for using AR. This suggests that while AR was well-received and had a positive impact on several aspects of students' learning experiences, it did not significantly change their perceptions regarding frequent use or their self-assessed skills in AR as it was already high before the intervention.

The data also indicates that students found AR to be a highly engaging and enjoyable tool for learning, which aligns with findings from previous studies (e.g., Min & Yu, 2023). The substantial increase in students' confidence to learn via AR highlights its potential to empower students by providing them with interactive and immersive learning experiences that traditional methods may lack. These aspects are crucial as they contribute to a more positive learning environment, potentially leading to better academic outcomes in the long term (Çelik & Yangın Ersanlı, 2022).

Moreover, the significant rise in the intention to learn more about AR suggests that such technologies can spark curiosity and a willingness to explore new learning tools among students. This can be particularly beneficial in fostering a culture of continuous learning and adaptability, which are essential skills in the modern educational landscape. The unchanged perception regarding the frequency of AR use and self-assessed skills underscores the importance of sustained exposure and practice with AR technologies to fully integrate them into students' learning practices over time.

DISCUSSION

The findings demonstrate the significant impact of AR on vocabulary and content learning in a CLIL setting. The EG utilizing AR-based lessons outperformed the CG that used traditional paper-based methods, particularly in the multiple-choice section. This aligns with previous research by Huang et al. (2021), which highlights AR's potential to enhance student progress and make learning experiences more immersive and effective (Çelik & Yangın Ersanlı, 2022; Martínez & García, 2023). The increase in post-test scores in the EG indicates that AR can significantly improve learning outcomes by providing interactive and engaging educational content, in line with previous research (Marrahi-Gomez & Belda-Medina, 2024).

These results have several implications. The positive student attitudes towards AR, as evidenced by the significant improvements in engagement and enjoyment, suggest that integrating AR into the curriculum could address issues of student disengagement often associated with traditional teaching methods. This finding is consistent with the works of Huertas-Abril et al. (2021) and Marrahi-Gomez and Belda-Medina (2022b), who found that AR could counteract waning student interest by offering a stimulating and motivating approach to learning.

Additionally, AR has been shown to facilitate deeper comprehension of complex subjects by providing visual and interactive content (Azimova & Solidjonov, 2023). Furthermore, the adaptability of AR technology allows for personalized learning experiences that cater to individual student needs (Zain, 2023). Lastly, the integration of AR in educational settings can foster collaborative learning environments, encouraging students to engage with peers in more meaningful ways (Gómez-Trigueros & Yáñez de Aldecoa, 2021).

However, the study also highlights several challenges and areas for further research. Despite the overall positive reception of AR, some students still preferred traditional methods, indicating the need for a blended learning approach. Additionally, the lack of significant changes in students' perceptions of their performance and frequent use of AR suggests that while AR is effective, it may not yet be fully integrated into students' learning routines. This underscores the importance of teacher training and support in the effective use of AR technologies, as emphasized by Sáez-López et al. (2020) and Jwaifell (2019). Ensuring that educators are well-equipped to incorporate AR into their teaching practices is crucial for maximizing its benefits and sustaining its use in educational settings.

Moreover, the findings reveal that while AR significantly enhances immediate learning outcomes, its long-term impact on knowledge retention remains to be thoroughly investigated. This opens a pathway for future research to explore how sustained use of AR can influence long-term academic performance and retention of learned content. Studies focusing on different subjects and educational levels would provide a broader understanding of AR's versatility and effectiveness in various educational contexts (Solak & Cakir, 2015).

Furthermore, the differential impact of AR on various learner demographics, such as age, learning styles, and prior technological proficiency, warrants detailed examination. Tailoring AR experiences to better suit diverse learner needs could potentially enhance its efficacy. Thus, ongoing research and iterative improvements in AR educational tools are essential to address these variables and optimize AR's application in educational settings (Wojciechowski & Cellary, 2013).

CONCLUSION

This study demonstrates the benefits of integrating AR into a CLIL environment. The data revealed that students in the EG, who engaged with AR-based lessons, showed significantly higher improvements in vocabulary and content learning compared to the CG, who used traditional paper-based materials. These results highlight AR's capability to create more engaging and immersive educational experiences, thereby facilitating better learning outcomes (Zain, 2023).

The positive student feedback towards AR underscores its potential to address common issues of disengagement associated with traditional teaching methods. Students reported higher levels of interest, engagement, and enjoyment when learning with AR, which aligns with the findings of Huertas-Abril et al. (2021). This study also reinforces the constructivist theory of learning, which advocates for active and meaningful educational experiences (Gómez-Trigueros & Yáñez de Aldecoa, 2021). Consequently, integrating AR into educational curricula could significantly enhance student motivation and learning effectiveness.

Furthermore, this study met its primary objectives. By assessing vocabulary learning and content retention, the research confirmed that AR significantly enhances these aspects compared to traditional materials. The comprehensive analysis of student engagement and attitudes provided valuable insights, showing increased motivation and enjoyment among students using AR. These findings suggest that AR can be an effective tool to combat student disengagement and promote a more interactive learning environment.

Despite these promising results, the study has several limitations. The sample size was limited to secondary education students from three public schools, which may impact the generalizability of the findings. Additionally, the study focused on short-term learning gains without assessing long-term retention of vocabulary and content knowledge.

Future research should explore the long-term impacts of AR on learning and its effectiveness across diverse educational settings and age groups. Furthermore, it is essential to investigate the optimal balance between AR and traditional teaching methods to cater to varied learning preferences.

Funding: This article is part of a research funded through the EDUC-AR Project by the Generalitat Valenciana–Conselleria de Innovación, Universidades, Ciencia y Sociedad Digital, Spain (ref. CIAICO/2022/079).

Ethics declaration: This study followed the guidelines of the ethical committee of the researcher's institution https://bit.ly/UA-EthicsCommittee. Prior consent was obtained from the tutors of the three schools involved in the intervention, ensuring all data was anonymized and treated confidentially following the Declaration of Helsinki.

Declaration of interest: The author declares no competing interest.

Data availability: Data generated or analyzed during this study are available from the author on request.

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APPENDIX A

English Vocabulary and Content Test: Ancient Egypt

A. Multiple choice questions (1–10)

1. The process of preserving a body after death in ancient Egypt is called:
   (a) Embalming (b) Mummification (c) Preservation (d) Taxidermy
2. The river that was central to ancient Egyptian civilization is:
   (a) Amazon (b) Nile (c) Tigris (d) Euphrates
3. The writing system used by ancient Egyptians is known as:
   (a) Cuneiform (b) Alphabet (c) Hieroglyphics (d) Latin
4. The ruler of ancient Egypt was known as:
   (a) Emperor (b) King (c) Pharaoh (d) Sultan
5. The famous ancient Egyptian queen known for her beauty and political acumen was:
   (a) Cleopatra (b) Nefertiti (c) Hatshepsut (d) Isis
6. The massive structures built as tombs for the pharaohs are called:
   (a) Ziggurats (b) Pyramids (c) Temples (d) Mausoleums
7. The ancient Egyptian sun god was:
   (a) Osiris (b) Anubis (c) Ra (d) Horus
8. The capital city of ancient Egypt during the Old Kingdom was:
   (a) Thebes (b) Memphis (c) Alexandria (d) Giza
9. The ancient Egyptian book of spells and charms used to navigate the afterlife is known as:
   (a) Book of the Dead (b) Book of Life (c) Book of Ra (d) Book of Spells
10. The process by which the Nile River flooded and deposited fertile soil was called:
   (a) Erosion (b) Inundation (c) Irrigation (d) Cultivation

B. Gap-filling questions (11–20)

1. The _________ is a mythical creature with the body of a lion and the head of a human, often associated with Egyptian pyramids [Sphinx].
2. _________ was a female pharaoh who expanded trade and built impressive monuments [Hatshepsut].
3. The _________ of Giza are one of the Seven Wonders of the Ancient World [Pyramids].
4. _________ was the god of the underworld and judge of the dead [Osiris].
5. _________ was the wife of Osiris and mother of Horus, often depicted as the ideal mother and wife [Isis].
6. The _________ is a tall, four-sided, narrow tapering monument which ends in a pyramid-like shape at the top [Obelisk].
7. _________ was the famous boy king whose intact tomb was discovered in 1922 by Howard Carter [Tutankhamun]
8. The _________ is a ceremonial boat used to transport the deceased pharaoh across the Nile. [Barque].
9. _________ is the term for the spiritual part of an individual in ancient Egyptian belief that survived after death and could reside in a statue [Ka].
10. _________ is the name of the ancient Egyptian writing material made from reeds [Papyrus].