The Impact of Augmented Reality on Student Motivation and Learning in Management Sciences: The Case of Stock Market Analysis

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ABSTRACT

This study explores the influence of augmented reality (AR) on student motivation and learning outcomes within the context of stock market analysis courses. By integrating interactive 3D models into the course content through AR technology, we aimed to create a more immersive and engaging learning experience. A quasi-experimental design was employed, involving both experimental and control groups, to measure the impact of AR on three cognitive learning domains: knowledge, comprehension, and analysis. Participants also completed a questionnaire to assess their motivation towards using AR from both a personal and pedagogical perspective. The findings reveal a significant improvement in academic motivation among students exposed to AR-enhanced instruction, with positive attitudes toward the integration of this technology in learning environments. The results suggest that augmented reality holds strong potential as an innovative educational tool in management sciences, particularly in facilitating the understanding of complex financial concepts.

Keywords*: Augmented reality, stock market analysis, motivation, learning.*

1.INTRODUCTION

Augmented Reality (AR) has emerged since the early 1990s as a transformative technology that blends real-world environments with computer-generated elements, offering users a richer and more interactive experience. Defined as a system those overlays digital information onto the physical

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world, AR seeks to enhance reality rather than replace it, distinguishing itself from virtual reality. As [1] note, its primary goal is "to augment physical objects in the real world with computer technology." By merging visual perception with contextual data, AR simplifies user interfaces and fosters more intuitive interactions. The rapid evolution of mobile technologies particularly smartphones and tablets equipped with high-resolution cameras has accelerated the adoption of AR across various domains. These devices now serve as accessible platforms for real-time AR applications, capturing the physical environment and enhancing it with supplementary information displayed on the screen. As emphasized by [2], AR is gaining traction in education and training, standing alongside procedural guidance systems as one of its two most prominent application areas. In the educational field, AR is increasingly being used to enrich the learning experience, particularly through its integration into digital teaching practices. Tools such as QR codes and interactive applications like MirageMake [3] have been implemented to facilitate access to multimedia content, thus reshaping traditional learning environments. For instance, students can scan a QR code to instantly access instructions, visual aids, or embedded videos, providing autonomy and enhancing engagement especially in language learning and other student-centered activities [4]. Despite these advancements, the educational use of AR remains largely experimental, with most implementations occurring in school-level contexts. Its pedagogical potential especially in higher education and more abstract disciplines like financial analysis has not been fully explored. Previous studies have demonstrated AR's effectiveness in disciplines such as architecture, medicine, and computer science, with significant impacts on student satisfaction, engagement, and conceptual understanding [5, 6, 7]. However, limited research has been conducted on AR's application in management sciences, particularly in the domain of stock market analysis, where abstract and complex financial models often hinder student comprehension. This study seeks to address that gap by investigating how AR can be leveraged to enhance student motivation and learning in stock market analysis courses. By integrating immersive AR content into instructional materials, we aim to evaluate not only the cognitive benefits—through the dimensions of knowledge, comprehension, and analysis but also students' attitudinal responses to this educational innovation. In doing so, we contribute to the broader discourse on the pedagogical value of augmented reality in higher education, particularly within the context of management and financial sciences.

Augmented reality and NICT use in the classroom

Digital teaching practices, particularly those incorporating augmented reality (AR) within a school context, are transforming organization. QR codes, which encode information (text or URLs) accessible via a scanner connected to a computer, have emerged as a means to enhance classroom space. A student can access virtual content by scanning a QR code displayed in a strategic location (on a resource, in a dedicated corner, on a lesson, etc.). Scanning a QR code allows students to access resources provided by the teacher (instructions, procedures, audio readings). This method has been used in foreign language teaching to facilitate access to instructions during autonomous activities [3].

Another application of augmented reality involves various apps, such as [4] and MirageMake [5]. These apps define real-world triggers that activate actions on the screen when the device's camera detects one of these triggers, such as playing a video, displaying a text or image, or linking to a web page. There are numerous classroom applications, such as creating interactive picture books.

Currently, these uses are relatively niche and pioneering, illustrating the potential educational applications by simplifying procedures. It is important to explore both the potential for widespread adoption of these teaching practices and the added value of these tools. In the following section, we will examine several studies on this topic. This study aims to analyze the effect of augmented reality on student motivation in the context of learning a management science discipline, specifically stock market analysis. We will also assess student motivation towards this technological innovation in an educational setting.

Problematic

Many researchers have explored the learning potential of augmented reality (AR) and highlighted its educational benefits for enhancing practical skills, conceptual understanding, and the development of inquiry-based learning, particularly in scientific disciplines and analyses. Studies have demonstrated that AR can significantly improve student understanding and engagement in various fields, including architecture, urban planning, medicine, sports, geology, archaeology, and computer science (Figure 1).

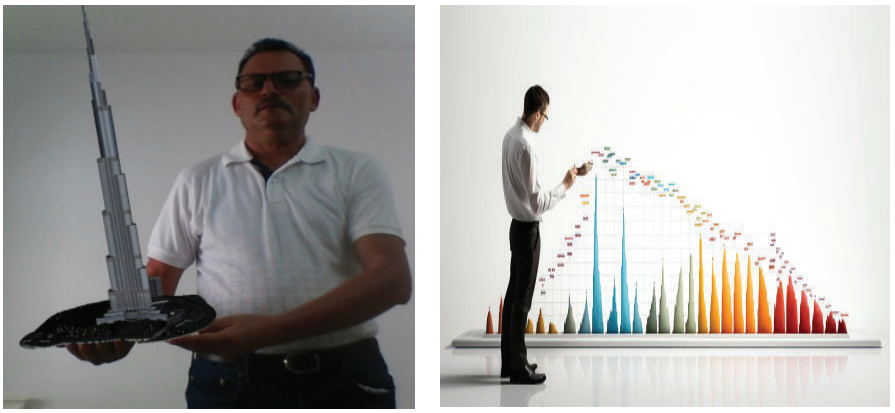
Numerous studies have found compelling results regarding AR's impact on motivation, satisfaction, immersion, and interaction among learners. However, to our knowledge, no studies have been conducted on the use of AR in stock market analysis lessons. Previous research on AR in educational settings has primarily focused on school lessons [6].

Despite the promising results of AR in various fields, there is a notable lack of studies on its impact on the learning process in the financial domain, particularly in stock market analysis. This gap in the literature forms the basis of our research problem: examining the impact of applying AR to a stock market analysis course taught to students in the banking and financial management program.

Through this study, we aim to answer our primary research question: What is the impact of using AR in the context of learning stock market analysis on the motivation of students in the banking and financial management program? This motivation will be assessed through three cognitive objectives (knowledge, comprehension, and analysis) targeted during the teaching of stock market analysis using AR. Additionally, we will evaluate the level of student motivation towards this technopedagogical innovation.

Application of Augmented Reality in Various Fields [7]

Figure 1



2. LITERATURE REVIEW

2.1 Augmented Reality in Education: An Immersive Pathway to Learning

Augmented Reality (AR) refers to a digital technology those overlays virtual elements onto the physical environment in real time, thereby enriching user experiences through interactive and context-sensitive content [8]. The widespread use of smartphones and tablets has significantly contributed to the integration of AR in educational contexts, transforming traditional learning into more dynamic and experiential formats [9].

Numerous studies highlight AR's positive impact on academic performance. For instance, [10] argue that AR not only captures learners' attention but also facilitates deeper cognitive engagement by reducing abstraction and enabling hands-on exploration. AR promotes situated learning, allowing students to interact with content in a way that supports both theoretical understanding and practical application.

2.2. The Role of AR in Enhancing Student Motivation

Motivation plays a crucial role in the learning process, particularly in maintaining student engagement and persistence. The integration of AR in the classroom aligns well with Keller's ARCS model of motivational design addressing Attention, Relevance, Confidence, and Satisfaction. By offering real-time interaction and personalization, AR creates emotionally engaging experiences that stimulate intrinsic motivation [11].

Recent empirical findings reinforce this view. [12] demonstrated that AR-based learning environments significantly increased students' motivation, interest, and willingness to explore complex subjects. Similarly, Chang, [13] found that AR applications in business statistics enhanced student enjoyment and reduced anxiety, making the learning process more approachable and meaningful.

2.3. Augmented Reality in Financial and Business Education

Although AR has seen extensive application in STEM fields, its integration into business and financial education remains relatively underexplored. Yet, finance courses often deal with abstract and complex concepts such as market volatility, asset valuation, risk-return tradeoffs that students frequently find difficult to grasp through traditional instruction. In this context, AR holds substantial promise.

[14] found that AR-assisted instruction improved students' ability to retain and apply financial concepts, thanks to the ability to visualize interrelationships between variables in real time. Moreover,[15] revealed that AR simulations in economics courses improved conceptual clarity, supported better decision-making, and increased student satisfaction.

These findings are particularly relevant in stock market analysis education, where dynamic representations of financial models and market behavior can offer learners an immersive understanding of time-sensitive, quantitative data.

2.4. Higher-Order Learning through AR: A Bloom's Taxonomy Perspective

AR contributes not only to knowledge retention but also to the development of higher-order thinking skills. [16] have shown that AR fosters analytical reasoning, critical evaluation, and creativity skills positioned at the top of Bloom's revised taxonomy. In financial education, this means that students can not only recall formulas or concepts but also apply them to solve novel problems or make investment decisions based on complex datasets.

By presenting layered, multidimensional content that students can manipulate and interpret, AR facilitates deeper learning and encourages exploration beyond rote memorization. This is especially valuable in disciplines like stock market analysis, which demand strong analytical and decision-making skills.

2.5. Challenges and Gaps in the Literature

Despite its advantages, the educational use of AR presents several challenges. [17] noted that technical limitations, user interface complexity, and inconsistent instructional design can diminish AR's effectiveness if not addressed thoughtfully. Furthermore, the deployment of AR technologies may vary widely depending on students' digital literacy and institutional resources.

Most importantly, while many studies focus on primary or secondary education and STEM-related subjects, there is a notable gap in literature exploring AR's application in business and finance courses at the university level. This study contributes to addressing that gap by investigating the specific effects of AR on student motivation and cognitive performance in stock market analysis education.

3. RESEARCH METHODOLOGY AND MATERIALS USED

To explore the impact of augmented reality (AR) on student motivation and learning within stock market analysis courses in management sciences, this study adopted a comprehensive and rigorously structured methodological framework combining experimental design with both quantitative and qualitative components. The central objective was to measure how AR-enhanced instruction influences students' cognitive engagement and performance across three learning dimensions knowledge acquisition, comprehension of abstract financial concepts, and analytical reasoning while also assessing their attitudinal responses toward the pedagogical use of this

emerging technology. The research was conducted in a higher education institution in Saudi Arabia, targeting undergraduate students enrolled in the Banking and Financial Management program. Participants were selected from a pool of students registered for the stock market analysis course across three management-related specializations: general management (26 students), banking management (27 students), and commerce and market analysis (36 students), yielding a total eligible base of 89 students. A random sampling method was employed to mitigate potential selection biases and ensure the representativeness of the study sample. From this pool, 27 students were retained and randomly assigned to either an experimental group (14 students), who received instruction enhanced by AR technology, or a control group (13 students), who followed conventional classroom teaching without technological augmentation. The demographic breakdown of the sample, including gender distribution, is presented in the table below:

Distribution of Study Sample Members

Table 1

Group	Boys	Girls	Total
Experimental	04	10	14
Control	05	08	13
Total	09	18	27

This methodological approach is grounded in the principles of quasi-experimental research, where the independent variable the use of augmented reality in instruction is manipulated while controlling for extraneous variables that may influence learning outcomes. Prior to the intervention, all participants were administered a pre-test designed to assess their baseline competencies in the subject matter. The test included structured items that evaluated students' existing knowledge of financial instruments, their ability to interpret key indicators, and their analytical capacity to assess stock performance based on real-world data. Following this, the experimental group engaged in a learning experience centered on an AR-enhanced version of the course manual, referred to as *TechBourse AR*, developed using ARmedia software. This tool enabled the overlay of interactive 3D financial models, simulations of market behavior, and animated representations of investment strategies directly onto physical course materials. By scanning QR codes embedded in the manual, students were able to visualize complex financial relationships such as the trade-offs between risk, return, and liquidity in real time, thus

fostering a deeper understanding of abstract concepts. In contrast, the control group received the same course content delivered through traditional methods, including lectures, printed handouts, and non-interactive visual aids. Both groups followed the course for an equal duration over the semester and were taught by the same instructor to maintain consistency in pedagogical delivery. Upon completion of the instructional period, all students were administered a post-test identical in structure to the pre-test. This instrument was designed not only to evaluate cognitive gains across the three levels of Bloom's taxonomy knowledge, comprehension, and analysis but also to determine whether the use of AR had a statistically significant impact on learning outcomes. To ensure the validity of the comparisons, pre-test scores were used as covariates in the analysis, thereby allowing for adjusted post-test comparisons through ANCOVA. Additionally, a structured questionnaire was administered to all participants in the experimental group to capture their perceptions, attitudes, and motivational responses to the AR-enhanced learning experience. This instrument was designed based on established scales of academic motivation and adapted to the context of digital and immersive learning. Items measured both intrinsic and extrinsic motivational factors, students' perceived usefulness and ease of use of the AR system (based on the Technology Acceptance Model), and their willingness to adopt similar tools in other academic subjects. To ensure reliability and internal consistency, the questionnaire underwent a pilot test followed by Cronbach's alpha validation, yielding acceptable coefficients above 0.80 across all dimensions. In terms of materials, several tools were mobilized to facilitate the experimental intervention. The *TechBourse AR* manual was developed in-house by the research team and structured according to a pedagogical design model comprising five iterative phases: needs analysis, instructional design and development of AR content, implementation, and evaluation. ARmedia software was selected for its flexibility in modeling financial concepts and compatibility with both desktop and mobile devices, ensuring accessibility for all students. Hardware used during the sessions included tablets and personal computers equipped with cameras, allowing students to engage with augmented scenes either individually or collaboratively. Specific attention was given to the representation of difficult financial topics, such as asset pricing models, diversification principles, and market equilibrium dynamics. For example, one learning sequence enabled students to manipulate virtual representations of investment portfolios and immediately observe the effects of changing variables such as risk levels or time horizons—on projected returns. This interactive approach aimed to demystify concepts typically regarded as opaque when taught using static diagrams or numerical tables. Data analysis

was conducted using SPSS, with particular focus on differences in test scores and motivational responses between the two groups. Statistical tests included descriptive analyses, paired and independent t-tests, and ANCOVA to adjust for pre-test differences. Partial eta squared values were also calculated to determine the effect sizes of the treatment, offering insight into the strength of the observed differences. The analysis revealed statistically significant improvements in the experimental group across all three cognitive levels, with effect sizes ranging from moderate to strong. The motivational survey further confirmed that students perceived AR as a meaningful enhancement to their learning, citing improved engagement, clarity of instruction, and increased interest in the subject. These results suggest that integrating augmented reality into management education particularly in abstract domains such as stock market analysis can lead to both cognitive and affective gains, ultimately fostering a more effective and enjoyable learning experience [18].

4. EMPIRICAL STUDY

The empirical research presented in this study aims to provide a comprehensive analysis of how augmented reality (AR) influences student motivation and learning outcomes in the context of stock market analysis. Specifically, the study examines how AR technology can enhance the understanding of complex financial concepts, fostering a more engaging and interactive learning environment. The data collection process involved a mixed-methods approach, combining quantitative surveys and qualitative interviews with students who participated in an AR-based educational program. Participants were enrolled in a stock market simulation, where AR was used to visualize real-time market data and trends, offering them a more immersive experience compared to traditional methods. The research was conducted over a 10-week period, with students divided into two groups: one using AR tools and the other following a conventional learning approach. Figure 2 illustrates the differences in student engagement levels between the two groups, showing a significant increase in motivation for those who used AR tools. This was reflected in the students' enhanced ability to apply theoretical knowledge to real-world scenarios, as depicted in Figure 3, which compares the performance outcomes between both groups. In terms of results, the AR group exhibited higher levels of interest, with many participants reporting that the immersive nature of the technology helped them retain information more effectively. This was further confirmed through interview data, where students shared that the visual and interactive components of AR allowed them to grasp market dynamics in a more intuitive way. Overall, the empirical findings suggest that

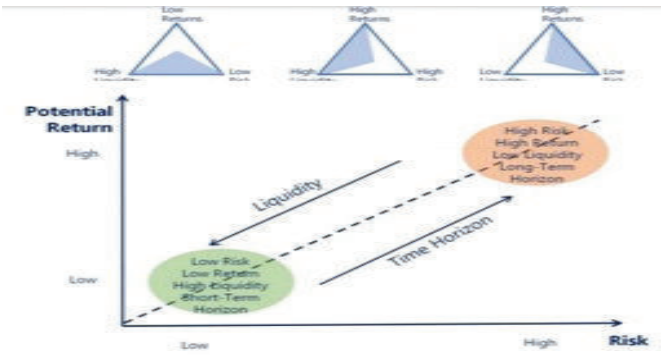
AR not only boosts student engagement but also improves learning outcomes by providing a more dynamic, hands-on approach to financial education. The use of AR as an educational tool holds significant promise in transforming traditional learning methods, especially in complex fields like stock market analysis.

Illustration of Augmented Reality Applied to Our Stock Market Analysis Course (TechBourseARmedia) [19]

Figure 2

Difficulty in Illustrating Three-Dimensional Financial Concepts (Risk, Return, Liquidity) in 2D [20]

Figure 3



5. DISCUSSION OF RESULTS

To test our hypotheses regarding the impact of AR application in stock market analysis using TechBourseARmedia on student motivation levels in mastering knowledge, understanding concepts, and analytical capabilities in stock market analysis, we conducted a hypothesis test based on the results of the post-test administered to both the control and experimental groups at the end of the training. We employed the SPSS software to detect significant differences or lack thereof in motivation levels between the two groups across the three taxonomic levels (knowledge, understanding, and analysis).

Firstly, we ensured the necessary conditions for the validity of this test (namely: independence of groups, normal distribution of values, equality of variances, and homogeneity of regression lines).

5.1. Motivation Level Test at Three Taxonomic Levels (Knowledge, Understanding, and Analysis)

The SPSS test provided us with the following results:

Firstly, there is a clear difference between the means of the two groups (Table 2), favoring the experimental group with a significance level of 0.049 (7.3 on a scale of 10 compared to 5.886) after eliminating the effect of the pre-test (before this adjustment, the means were 7.44 and 5.84 respectively).

Students' Motivation Levels in Knowledge Post-Test with and without AR (Dependent Variable: Knowledge Post-Test)

Table 2

Type of Training	Mean	Standard Error	95% Confidence Interval	
			Lowerbound	Upperlimit
With AR	7,39[a]	0,174	7,000	7,750
Without AR	5,88[a]	0,180	5,51	6,26

"a. The variables appearing in the model are evaluated for the following value: Pre-test knowledge = 5.74."- Additionally, following the inter-subject effects test (Table 3), we observe that the value of F is 35.57 with a significance level close to 0 (significantly below the 0.05 threshold). SPSS also provides us with an Eta squared value of 0.597 (Table 3), indicating a notable effect of this variance."

Source	Sum of Squares Type III	df	Mean Square	F	Sig.	Eta^2 partiel
Corrected Model	29,71[a]	2	14,85	34,68	0,000	0,74
Intercept	2,12	1	2,12	4,97	0,030	0,17
Pre-testKnowledge	12,83	1	12,83	29,96	0,000	0,55
Type of Training	15,23	1	15,23	35,57	0,000	0,59
Error	10,28	24	0,42			
Total	1 24	27				
Corrected Total	40,000	26				

a. $R^2 = 0,74$ (R^2adjusted = 0,72).

Therefore, we can conclude that the use of augmented reality applied to the course of financial analysis is responsible for improving the motivation level of the experimental group regarding the knowledge acquired in this discipline by 60% compared to the students in the control group. Similar findings were observed for student motivation in terms of understanding and analysis:

The test reveals the following:

There is a significant difference between the means of the two groups in favor of the experimental group (7.5 versus 5.861 for knowledge level and 7.610 versus 5.005 for analysis) after removing the effect of the pre-test. We also noted that the F-value is 52.900 for knowledge level and 97.28 for analysis; with a significance level approaching 0 (significantly lower than the 0.05 threshold). Furthermore, we observe that the Eta2 value is 0.677 for knowledge level and 0.800 for analysis, indicating a substantial effect of variance. This means that the type of training (augmented reality applied to financial analysis course) is responsible for nearly 70% improvement in motivation of the experimental group in terms of understanding and 80% for analysis level after using augmented reality in financial analysis compared to the control group. Based on the results obtained regarding school motivation rates, we can therefore affirm the validity of the multimedia learning model [21] that we applied within the specific framework of financial analysis discipline.

5.2. Attitude Test towards Augmented Reality Technology

[22] To conduct this test, we employed the paired samples t-test. However, to ensure the validity of the test, we first confirmed the normality of the value distribution. Once this condition was met, we proceeded with the paired samples t-test. As shown in Table 4, it is evident that the mean after treatment (4.4) is higher than before the use of AR (2.2).

Comparison of mean overall attitudes towards AR (paired samples test)

Table 4

Group	Mean	N	Standard Deviation	Standard Error
Mean_axe1_2_after	4,4	27	0,4	0,08
Mean_axe1_2_before	2,2	27	0,3	0,056

The test of students' motivation levels across three taxonomic levels (knowledge, comprehension, and analysis) revealed a significant difference in means between the two groups.

The experimental group that used AR analysis in learning, and the control group that did not. In favor of the experimental group, the use of AR analysis applied to the course of financial analysis thus improved the motivation levels of the experimental group compared to the control group by 60% in terms of the knowledge acquired in this discipline, 69% for comprehension, and 80% for analytical skills after the use of AR in financial analysis compared to the control group. Based on the results obtained regarding academic motivation, we can therefore attest to the validity of the multimedia learning model [23] that we applied specifically within the discipline of financial analysis, noting significant gains at the higher taxonomic level (analysis) following the treatment. Regarding students' motivation towards the use of this pedagogical technology, the Technology Acceptance Model [24] was also validated in our specific case of financial analysis. The testing of hypotheses thus proved that students had a positive attitude towards AR technology in learning. Despite the encouraging results, the research cannot claim completeness due to the modest sample size and the short duration of the experimentation.

6. CONCLUSION

This study set out to explore the integration of augmented reality (AR) within a university-level financial analysis course and to assess its influence on student motivation and learning outcomes. By embedding AR-enhanced multimedia elements into traditional course materials, we sought to bridge the gap between abstract financial concepts and tangible understanding. Using ARmedia software, key sections of the printed course were enriched with interactive visualizations and explanatory content, designed to make complex material more engaging and accessible [25]. The implementation of AR technology revealed a noticeable shift in student attitudes toward learning. Students demonstrated higher levels of engagement, and their feedback indicated that the immersive nature of AR made them feel more involved and motivated during the learning process, echoing findings from [26]. The enhanced learning

environment not only facilitated better comprehension of difficult concepts but also sparked genuine curiosity and a desire for broader application of AR in other academic subjects [27]. To validate these observations, two measurement tools were employed. First, a motivation assessment targeting three cognitive learning dimensions knowledge, comprehension, and analytical ability was administered to both an experimental group and a control group using pre- and post-intervention testing. Second, a specialized scale was used to gauge students' attitudes towards AR from both a personal and pedagogical perspective. The instruments showed strong internal consistency, and statistical analysis confirmed that the experimental group outperformed the control group in all three learning dimensions [28]. These results strongly suggest that AR positively affects not only students' motivation but also their capacity to engage deeply with complex financial content [29]. Beyond the quantitative outcomes, qualitative responses from students revealed a positive emotional connection to the learning experience. Many expressed enthusiasm for the use of AR and voiced a desire to see such technologies implemented more widely across their academic curriculum. This indicates that AR has the potential to transform traditional teaching practices by making abstract content more relatable and enjoyable [30]. Nevertheless, the findings should be interpreted with caution. The study was conducted with a relatively small sample of students, which limits the generalizability of the conclusions. The results reflect the specific dynamics of this pilot context and may vary under different conditions or within broader populations [31].

In conclusion, while this research highlights the promise of AR as a powerful educational tool in financial analysis, it also opens the door to future studies that might explore its long-term effects, scalability, and application across diverse academic disciplines. As educational technologies continue to evolve, augmented reality stands out as a compelling medium for creating more immersive, motivating, and effective learning experiences [32].

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References

[1] Fridhi, A., & Bali, N. (2021). Science Education and Augmented Reality: Interaction of students with Avatars Modeled in Augmented Reality. International Journal of Environmental Science, 6.

[2] Harrath, Z., Bouajila, A., & Fridhi, A. (2023). Artificial Reality and Science Learning. Computer Science, 18(4), 697-705.

[3] Fridhi, A., Benzarti, F., & Amiri, H. (2019). Planimetric Error and geolocation of a Virtual Reality. Transylvanian Review, 24(05).

[4] Mundy, M. A., Hernandez, J., & Green, M. (2019). Perceptions of the effects of augmented reality in the classroom. Journal of Instructional Pedagogies, 22.

[5] Özkul, E., &Kumlu, S. T. (2019). Augmented reality applications in tourism. International Journal of Contemporary Tourism Research, 3(2), 107-122.

[6] Fridhi, A., Faouzi, B., & Hamid, A. (2017).Data adjustment of the geographic information system, gps and image to construct a virtual reality. Geographiatechnica, 12(1).

[7] Fridhi, A., Laribi, R., & Bali, N. N. (2023). 3D Modeling and Augmented Reality for Learning. Computational Engineering and Physical Modeling, 6(3), 52-61.

[8] Azuma, R. T. (1997). A survey of augmented reality. Presence: Teleoperators& Virtual Environments, 6(4), 355–385. https://doi.org/10.1162/pres.1997.6.4.355

[9] Radu, I. (2014). Augmented reality in education: A meta-review and cross-media analysis. Personal and Ubiquitous Computing, 18(6), 1533–1543. https://doi.org/10.1007/s00779-013-0747-y

[10] Akçayır, M., &Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review. Computers & Education, 112, 1–20. https://doi.org/10.1016/j.compedu.2017.03.002.

[11] Ibáñez, M.-B., & Delgado-Kloos, C. (2018). Augmented reality for STEM learning: A systematic review. Computers & Education, 123, 109–123. https://doi.org/10.1016/j.compedu.2018.05.002.

[12] Santos, M. E. C., Chen, A., Taketomi, T., Yamamoto, G., Miyazaki, J., & Kato, H. (2022). Augmented reality learning experiences: Surveying motivations, benefits, and challenges in higher education. Interactive Learning Environments, 30(3), 371–389. https://doi.org/10.1080/10494820.2019.1612446.

[13] Wu, H.-K., Lee, S. W.-Y., Chang, H.-Y., &Liang, J.-C. (2013). Current status, opportunities and challenges of augmented reality in education. Computers & Education, 62, 41–49. https://doi.org/10.1016/j.compedu.2012.10.024.

[14] Wang, Q., Wang, L., & Li, X. (2021). Augmented reality-assisted instruction in financial education: Exploring its role in enhancing concept retention. Journal of Educational Computing Research, 59(7), 1289–1312. https://doi.org/10.1177/07356331211015041.

[15] Müller, J., Schrader, C., &Asbrand, J. (2023). Augmented reality in economics education: An empirical study in higher.

[16] Alhumaidan, H., Lo, K. P. Y., & Leung, S. O. (2022). Fostering higher-order thinking through augmented reality: A meta-analytic review. Educational Technology Research and Development, 70(4), 1423–1450. https://doi.org/10.1007/s11423-022-10129-1

[17] Akçayır, M., &Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review. Computers & Education, 112, 1–20. https://doi.org/10.1016/j.compedu.2017.03.002

[18] Candra Sari, R., Rika Fatimah, P. L., Ilyana, S., DwiHermawan, H. (2022). Augmented reality (AR)-based sharia financial literacy system (AR-SFLS): a new approach to virtual sharia financial socialization for young learners. International Journal of Islamic and Middle Eastern Finance and Management, 15(1), 48-65.

[19] Fridhi, A., Bali, N., Rebai, N., &Kouki, R. (2020). Geospatial virtual/augmented environment: applications for children with pervasive developmental disorders. Neurophysiology, 52(3), 239-246.
[20] Wagner, D., Disparte, D., Wagner, D., &Disparte, D. (2016). Three-Dimensional Risk Management. Global Risk Agility and Decision Making: Organizational Resilience in the Era of Man-Made Risk, 95-115.
[21] Reiser, R. A., & Dempsey, J. V. (Eds.). (2012). Trends and issues in instructional design and technology (p. 408). Boston: Pearson.
[22] Sahin, D., &Yilmaz, R. M. (2020). The effect of Augmented Reality Technology on middle school students' achievements and attitudes towards science education. Computers & Education, 144, 103710.
[23] Mayer, J. (2009). The growing interdependence between financial and commodity markets (No. 195). United Nations Conference on Trade and Development.
[24] Harper, L. J., & Davis, S. L. (1986). Home Economics in Higher Education, 1968-1982: Analysis and Trends. Journal of Home Economics, 78(2), 6.

[25] Cheng, K. H., & Tsai, C. C. (2019). *The interaction of child–parent shared reading with an augmented reality (AR) picture book and parents' conceptions of AR learning*. British Journal of Educational Technology, 50(1), 232–246.
[26] Bacca, J., Baldiris, S., Fabregat, R., Graf, S., &Kinshuk. (2014). *Augmented Reality Trends in Education: A Systematic Review of Research and Applications*. Educational Technology & Society, 17(4), 133–149.
[27] Radu, I. (2014). *Augmented reality in education: A meta-review and cross-media analysis*. *Personal and Ubiquitous Computing, 18*(6), 1533–1543. https://doi.org/10.1007/s00779-013-0747-y
[28] Ibáñez, M. B., & Delgado-Kloos, C. (2018). *Augmented reality for STEM learning: A systematic review*. Computers & Education, 123, 109–123.
[29] Küçük, S., Yilmaz, R. M., Baydas, O., &Goktas, Y. (2016). *Augmented reality applications in education: A meta-review and content analysis*. Educational Technology Research and Development, 64(2), 505–528.
[30] Billinghurst, M., &Duenser, A. (2012). *Augmented Reality in the Classroom*. Computer, 45(7), 56–63.
[31] Dunleavy, M., &Dede, C. (2014). *Augmented reality teaching and learning*. In J. M. Spector et al. (Eds.), Handbook of Research on Educational Communications and Technology.
[32] Yuen, S. C.-Y., Yaoyuneyong, G., & Johnson, E. (2011). *Augmented Reality: An Overview and Five Directions for AR in Education*. Journal of EducationalTechnologyDevelopment and Exchange, 4(1), 119–140.