

The Hidden Power of Visual and Digital Language in Education: A Systematic Review

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Abstract

Visual and digital language has emerged as a transformative force in education, offering new opportunities to enhance learning, participation, and digital literacy. This systematic review offers an overview of the current state of evidence on implementing visual and digital language in schools, emphasizing its adherence to Saudi Vision 2030 goals, centered around quality education, digital transformation, and lifelong learning. The studies were selected using PRISMA guidelines. Based on critical synthesis of 13 studies from 2018-2025, retrieved from Scopus, Web of Science, and Google Scholar, the present review considered qualitative and quantitative studies. The findings highlight the significant impact of digital storytelling, augmented reality, and interactive media on students' cognitive skills, motivation, and engagement. Main strategies identified are technology-mediated narrative adoption, collaborative digital projects, and participatory learning environments. Several challenges were observed such as, flawed technological infrastructure, poor teacher training, and curriculum integration problems. This review calls for institutionally legitimate and contextually sensitive frameworks in order to effectively use visual and digital language. It contributes to teaching practice by providing lessons in how such innovations can propel the goals of Saudi Vision 2030 to build a digitally literate and innovative student population prepared to thrive in the 21st-century knowledge economy.

Keywords: Visual, storytelling, digital language, cognition, Saudi vision, teaching.

Introduction

The modern learning environment is revolutionized by the fast pace of technology growth and digital innovation. This transition has prompted the growth of visual and digital language as an indispensable medium for teaching, learning, and knowledge building in the 21st century (Attahakul, 2024). Visual and digital language involve the multimodal communication systems that combine textual, visual, auditory, and interactive components to enable meaning construction in learning settings (Al-Muttairi & Al-Alusi, 2025). These vary from the simplest infographics and data visualizations to sophisticated interactive digital settings and immersive learning environments developed with the help of augmented reality (AR) and artificial intelligence (AI) technologies (Egunjobi & Adeyeye, 2024). The combination of these communication modes has increasingly become integral to educational practices globally, prompting a detailed study of their effect, performance, and potential for reconceptualizing learning settings.

The significance of this process is particularly well illustrated

in the international agenda to use technology to enhance the availability, quality, and performance of education. European Union Digital Education Action Plan (2021–2027), China's Action Plan for Education Informatization 2.0, and their counterparts in most countries reflect an international consensus on the importance of digitalization in education (Yan & Yang, 2021; Yanli & Danni, 2021). These policy initiatives have accelerated the arrival in the classroom of visual languages and digital devices, and a critical investigation into their teaching-learning practice consequences and instructional impact is needed.

From as early utilisations in instructional television and multimedia CD-ROMs through as recent utilisations in virtual reality-based immersive environments and Artificial Intelligence-powered adaptive systems, the amount of visualisation applied in education has risen exponentially (Ahmad & Rana, 2025). The new age learning portals, like Saudi Arabia's "Madrasati" platform, now are examples of how online integrated spaces are capable of providing diversified educational services like asynchronous virtual classspaces, knowledge repositories for learning, test

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modules, and media communications enabling the frequent interactions among the student, instructor, and parent (Rmg, 2025).

Saudi Vision 2030 is a reflection of how national plans are utilizing digital transformation in making the knowledge-based economy and making citizens ready for future challenges within the labour market. Radical transformation emerges as front-center on the agenda within the Vision with the digital transformation rendered as “one among the main basic strategic foundations for the building of a knowledge-based economy and preparing a future-ready generation for global competition” (Rmg, 2025). This strategic focus acknowledges that visual and digital literacy are important in success in the digital age.

Furthermore, visual and online communication has been a driving force in promoting educational access and equity. Digital media can help break geographical and economic borders that otherwise determined educational opportunities (Reich, 2020). With online-distance education systems, distant learners can obtain quality education as it is achieved in large city centers, thus ensuring greater equal distribution of education resources (Garlinska et al., 2023). The capability of the digital technology in catering to multilingual learners has also been a major area of influence, with narrative visualizations and other digital tools enhancing educational content’s availability among multilingual student populations (Meletiadou, 2022).

Several works have explored digital learning technology, but few referred to visual language as a stand-alone aspect within digital communication. The work on narrative visualizations indicates that well-crafted visualization tools possess profound potential in facilitating communication, interaction, and knowledge transfer in educational settings, but more systematic work, is required in establishing the details responsible for making visualizations effective in a broad spectrum of learning activities and course material. As information technology taking place throughout the Gulf states, particularly Saudi Arabia, as part of its Vision 2030 program. There is a need for an empirically grounded description of how visual and digital language tools work in particular cultural and linguistic environments so that culturally appropriate teaching approaches can be developed.

This systematic review addresses the following research question

1. What evidence exists on the application of visual and digital language in education between 2018 and 2025?
2. How does visual and digital language influence

teaching and learning outcomes such as student engagement, critical thinking, and digital literacy?

Literature Review

Theoretical Framework

The theoretical underpinnings of visual and digital language in education are rooted in multimodal literacy theory and cognitive theories of learning that recognize the human brain’s innate capacity to process visual information more efficiently than textual information alone (Lim & Tan-Chia, 2022; Mayer, 2005). Research in cognitive psychology has consistently demonstrated that visual representations can enhance comprehension, retention, and transfer of knowledge by reducing cognitive load and facilitating the formation of mental models (Wirth et al., 2020). Digital technologies have exponentially expanded the possibilities for visual communication in educational contexts, enabling the creation of dynamic, interactive, and personalized learning experiences that were previously unimaginable (Sun & Zhu, 2022).

Theoretical understandings of digital literacy and visual communication have evolved significantly over the past decade. Early understandings of digital literacy focused predominantly on the technicalities of digital device and software use. However, contemporary conceptual frameworks recognize a much broader set of competencies. Eshet-Alkalai’s (2012) Digital Literacy Framework, for instance, includes photo-visual thinking (interpreting visual information), reproduction thinking (creating new digital content), and social-emotional thinking (understanding cyber-space rules) as essential constituents (Eshet, 2012). Similarly, the European Union’s Digital Competence Framework (DigComp 2.1) identifies five competency areas: information and data literacy, communication and collaboration, digital content creation, safety, and problem solving (Carretero et al., 2017). These frameworks stress the multifaceted nature of digital literacy and the importance of visual and digital language competencies in contemporary education.

Visuals in Education

Visual supports significantly enhance language acquisition by expanding understanding, memory, and interest. Pateşan (2018) underscores their support of detailed information processing and student motivation, particularly foreign language conditions (Pateşan et al., 2018). Burmark’s research substantiates that information is processed 60,000 times faster visually than textually,

easing the cognitive load and supporting dual-coded memory reinforcement (Jaffe & Hurwich, 2018). Colorín Colorado’s library of strategies has demonstrated that for English language students (ELL), visuals make up language deficits by providing non-linguistic cueing and contextual scaffolding (Ibreiseth, 2024).

Educational relevance of visual and digital language extends beyond its technical innovation to including profound insights for learning attainments, educational access, and teaching innovation. Empirical evidence has indicated that visualizations and tools for digital language, when properly designed, significantly enhance learning in many areas of education. In a comprehensive meta-analysis on 30 studies, findings revealed that inclusion of ICT has strong positive significance for student learning, particularly for the achievement in the skills of language (effect size = 0.24) and the acquisition of knowledge in the subject (effect size = 0.59). Such evidence suggests that visual and digital tools for language, when delivered in an appropriate mode, significantly enhance the effectiveness of education (Ruijia et al., 2025).

Even with the expanding corpus on digital literacy and visual communication education, critical gaps for future research remain. Current studies are often narrowed down to individual features of visual or digital language without offering an overall integration of evidence across varying educational levels, disciplines, and learner proficiency. Such narrowness hinders the achievement of unified insights into visual and digital language functioning across educational settings.

Digital Storytelling (DST) and Collaborative Learning

Digital storytelling integrates multimedia elements (e.g., video, sound, graphics) to spur creativity, critical thinking, and collaborative work. A 2019 systematic review exhibits DST complementing social constructivism,

where students collaboratively build knowledge through interactive storytelling. It enhances information literacy and communicative ability by requesting students to connect content between modalities. Lack of teachers’ familiarity with technology and the difficulty of including DST in curricula continue to be hurdles, however. Standard stages – preproduction (scripting, storyboarding), production (multimedia integration), and postproduction (peer review) – collectively facilitate academic achievement and motivation (Moradi & Chen, 2019).

Methodology

A systematic review was used to address the research questions. The review was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement, which offered a structure for a methodical approach to document identification and evaluation (Page et al., 2021).

Search Strategy

The literature search was conducted across various academic databases, including Web of Science, Google Scholar, Eric, Scopus, Jstor, and other relevant educational journals. The search was limited to studies published from 2018 to 2025 to retain material that is recent and relevant to visual language (infographics, diagrams, visual narratives), digital language (digital storytelling, interactive simulations), or multimodal integration. The following terms and keywords are used individually and in combination in the search for relevant studies: “visual language” OR “digital language” OR “multimodal learning” OR “digital storytelling” OR “multimodal communication”. The search was refined using Boolean operators AND and OR to ensure comprehensiveness of coverage for the relevant studies. Table 1 shows the search strategy for selecting studies.

Table 1: Search Strategy

| Search Components | Details |
|--------------------|--|
| Databases searched | Web of Science, Google Scholar, Eric, Jstor, and Scopus |
| Search terms | "digital language," "digital storytelling," "pedagogy," "visual language" |
| Search strings | ("visual language" OR "digital language" OR "multimodal learning" OR "digital storytelling" OR "multimodal communication") AND ("education" OR "learning" OR "teaching" OR "pedagogy" OR "literacy") AND ("impact" OR "outcome" OR "effectiveness" OR "achievement") |

Selection Criteria

Table 2 represents the inclusion and exclusion

criteria for the research, to ensure the most relevant articles in the study.

Table 2: Selection Criteria

| Inclusion Criteria | Exclusion Criteria |
|---|---|
| Studies published in peer-reviewed journals or reputable educational sources. | Studies that were not published in peer-reviewed journals. |
| Articles that were related to visual/digital language applications in education | Articles that were not related to visual/digital language applications in education |
| Studies published in English. | Studies that were published in other languages. |
| Studies including review articles, empirical studies, and theoretical papers discussing best practices and strategies related to visual education | Grey literature, such as conference papers, theses, and reports, is not subjected to peer review. |

Study Selection Process

The studies selected for the review articles followed the PRISMA guidelines. A total of 13800 records were obtained using the search strategy. These records

were screened, and 7956 duplicate studies were removed; 1458 studies were found as not eligible after screening abstracts and titles, and 341 studies were removed due to other reasons while leaving 4045 records to be screened.

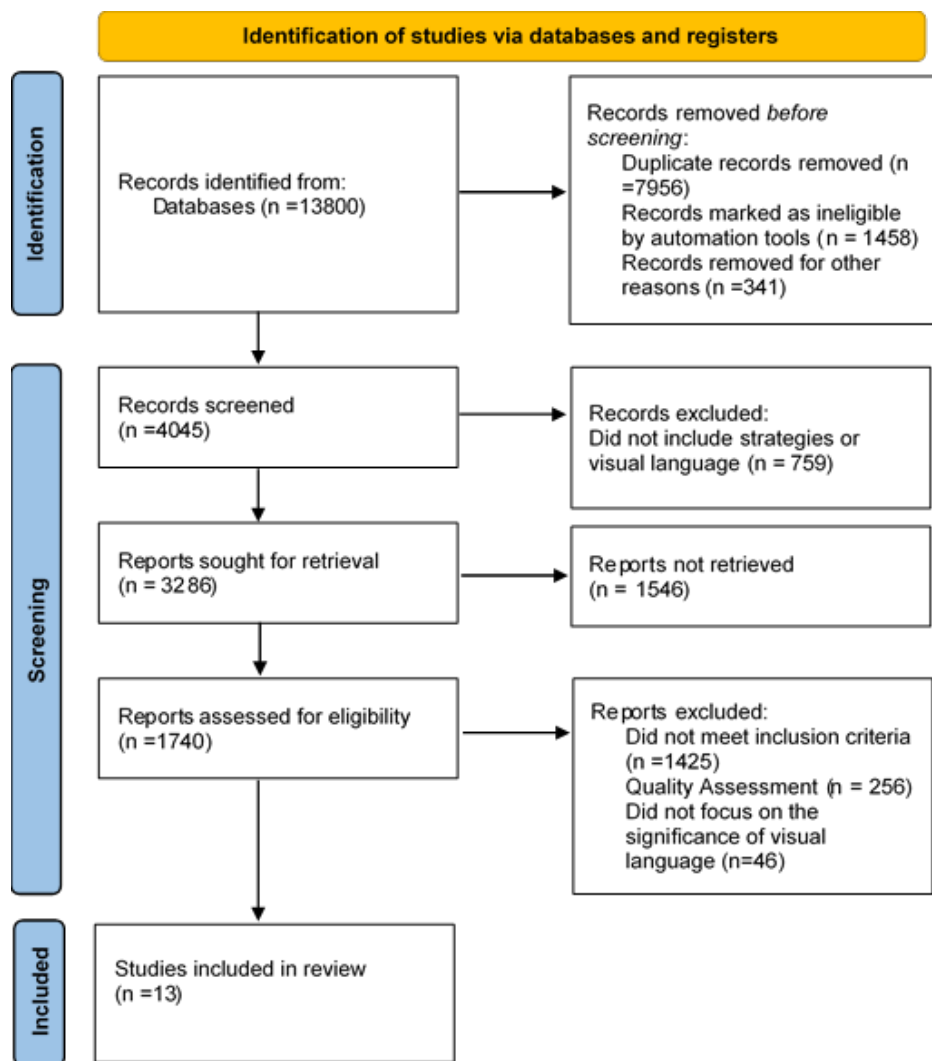


Figure 1: PRISMA

759 studies were further removed due to their limited focus and irrelevancy with the study being conducted, and a further 1456 studies were not retrieved, leaving only 1740 studies eligible for the systematic review. 1425 studies were removed as these did not meet the inclusion criteria for the research, 425 studies were removed due to quality assessment, and 46 studies were removed due to their little focus on the strategies used for visual education. Finally, 13 studies were retrieved for the current study.

Data Analysis

For the systematic review, 14 studies were collected from the preselected databases. The quality of

studies was assessed using the Quality Assessment of Diagnostic Accuracy (QUADAS) questionnaire to assess the risk of bias assessment. It evaluated flow and timing, reference standard, index test, and patient selection.

Risk of Bias Assessment

The risk of bias assessment was calculated using QUADAS. It was calculated against four key domains: Patient selection, index test, reference standard, and flow and timing. The risk of biases indicates the high and low risk of studies against biases. Figure 2 shows the risk of biases for the four domains.

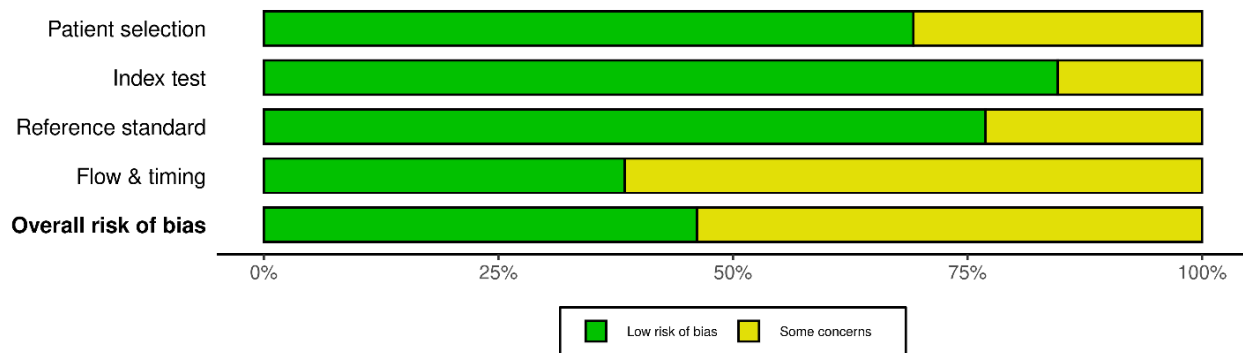


Figure 2: Risk of Bias Assessment

Results

This results section synthesizes selected studies on visual and digital language education using a systematic review. The findings are organized into key themes that underline effective strategies, challenges, and best practices.

Risk of Bias Assessment

A modified QUADAS assessment tool found that there are challenges that exist for teachers' using visual tools for education. It was used to assess the quality of the selected studies. The study examined patient selection, index text, reference standards, flow, and timings, revealing minimal risk. The data demonstrates the impact of visual and digital language on education and the challenges associated with implementing it. Figure 3 shows the quality assessment of the selected studies.

The 13 study selection analysis revealed three overarching themes of the use of digital and visual language of the classroom: digital storytelling (DS), augmented reality (AR), and interactive/immersive storytelling. These three

clusters demonstrate distinct contributions to learning and teaching and also collectively demonstrate the transfigurative quality of the visual and digital modality of enhancing the outputs of learning. Figure 4 shows the visual representation of these themes.

Digital Storytelling in Education

Seven studies (Bilici & Yilmaz, 2024; Leandro et al., 2025; Liu, 2025; Nuroh et al., 2022; Puspitasari et al., 2025; Rosyid et al., 2025; Yigit, 2020) explored the implementation of digital storytelling across diverse teaching contexts. The studies frequently discovered that DS facilitates critical thinking, creativity, reflection, and digital literacy. For example, Rosyid et al. (2025) discovered that the utilization of Adobe Spark and Canva significantly enhanced the analytical capability, construction of argumentation, and inclusion of multimedia of post-secondary-level students (Rosyid et al., 2025). Similarly, Yigit (2020) and Nuroh et al. (2022) presented pre-service teachers' benefit of DS since it improved both reflective practice and digital literacy of the type required by teachers of today (Nuroh et al., 2022; Yigit, 2020).



Figure 3: Quality Assessment of Selected Studies

Table 3: Results

| S. No. | Study | Study Focus | Key Findings | Methodology | Identified Strategies |
|--------|-----------------------|---|--|---|---|
| 1 | (Rosyid et al., 2025) | Use of Adobe Spark & Canva digital storytelling in higher education | Significantly improved students' critical thinking abilities | Qualitative: observations, interviews, document analysis (n=46) | Multimedia integration (text, audio, video, images), collaborative story creation |
| 2 | (Yigit, 2020) | DS experiences of social studies pre-service teachers | DS enhanced creativity, reflection, and engagement; but required scaffolding | Qualitative case study with pre-service teachers | Reflection journals, digital story projects, guided instruction |
| 3 | (Nuroh et al., 2022) | Developing digital literacy through DS in teacher education | DS improved pre-service teachers' digital literacy and confidence | Mixed-methods: needs analysis, intervention, evaluation | Integration of DS into teacher training modules |

Cont. Table 3

| S. No. | Study | Study Focus | Key Findings | Methodology | Identified Strategies |
|--------|------------------------------|---|--|--|---|
| 4 | (Leandro et al., 2025) | Podcasts as digital storytelling in higher education | Strengthened institutional identity and student engagement | Mixed-methods: podcast analysis + student surveys | Alumni and student narrative podcasts as engagement tools |
| 5 | (Bilici & Yilmaz, 2024) | Collaborative DS in biology education | Increased academic achievement and skill development | Quasi-experimental with control & experimental groups (n=64) | Group-based DS projects for science learning |
| 6 | (Dilek Eryigit et al., 2025) | AR technology in preschool geometry learning | Improved geometry skills, motivation, and socio-cognitive behaviors | Embedded mixed-methods: tests, observations, interviews (n=30) | AR-based gamified geometry tasks |
| 7 | (Nadzeri et al., 2024) | AR geometry learning apps for lower primary | AR significantly improved pupils' spatial visualization skills | Quasi-experimental pre/post-test design | AR-based geometry tasks with manipulatives |
| 8 | (Salehi, 2025) | Using AR for vocabulary teaching in junior high schools | Teachers reported AR as effective for vocabulary retention and engagement | Qualitative: teacher interviews and classroom reflections | AR-enhanced word learning apps with 3D interactions |
| 9 | (Liu, 2025) | Immersive DS in the new learning ecosystem | Provided a revised concentric circle model; highlighted DS as core to engagement | Conceptual paper with empirical teacher/student perspectives | Immersive DS platforms integrated with curricula |
| 10 | (Puspitasari et al., 2025) | Review of DS in learning (2020–2025) | DS increases enjoyment, effectiveness, critical/media literacy | Literature review of empirical studies | DS integration in reading, writing, and subject learning |
| 11 | (Di Fuccio et al., 2024) | Co-created AR app for foreign language learning | Enhanced vocabulary acquisition and cultural awareness | Mixed-methods: user testing + surveys | Co-design of AR apps with learners |
| 12 | (Caetano et al., 2023) | ARLang app for Portuguese vocabulary learning outdoors | ARLang supported contextual vocabulary retention in real-world settings | Experimental design with student participants | Location-based AR vocabulary tasks |
| 13 | (Roth et al., 2025) | Interactive DS for systems & media literacy (CLASS framework) | Encouraged curiosity, systemic thinking, and media analysis | Conceptual model + case studies | Interactive storytelling + systems mapping |

In addition to student skills development, DS also fortified student engagement and institutional identity. Leandro et al. (2025) also uncovered that storytelling through podcasts cultivated greater identification of students with universities, making DS a strategic intervention to foster a sense of belonging and advocacy (Leandro et al., 2025). Bilici and Yilmaz (2024) also uncovered that collaborative DS in the biological science laboratory significantly improved subject-based learning and the development of skills, justifying its effectiveness in subject-centred learning (Bilici & Yilmaz, 2024). Also, the reviews by Puspitasari et al. (2025) and conceptual constructs by Liu (2025) emphasized DS as the foundation of the transforming learning ecosystem, justifying its promise as a transdisciplinary pedagogical intervention (Puspitasari et al., 2025).

Literacy and STEM through Augmented Reality

Five studies (Caetano et al., 2023; Di Fuccio et al., 2024; Dilek Eryigit et al., 2025; Nadzeri et al., 2024; Salehi, 2025) explored the use of AR apps on STEM learning and literacy. The research identified the immersive

and interactive nature of AR that enhances understanding and engagement. For instance, Dilek Eryigit et al. (2025) confirmed that AR improved preschoolers' geometry skills, motivation, and socio-cognitive practices substantially (Dilek Eryigit et al., 2025). Similarly, Nadzeri et al. (2024) confirmed that AR apps improved the spatial visualization of lower primary students, showing that AR can be used to enhance abstract STEM concepts (Nadzeri et al., 2024). In language acquisition, Salehi (2025) confirmed that teachers saw AR as an effective medium of vocabulary instruction because it might enhance retention and motivation (Salehi, 2025). As a complement, Di Fuccio et al. (2024) confirmed that AR apps that were co-designed improved acquisition of foreign language vocabulary as well as cultural knowledge, and Caetano et al. (2023) confirmed that ARLang improved the acquisition of vocabulary by Portuguese students outside the classroom (Caetano et al., 2023; Di Fuccio et al., 2024). Generally, these studies demonstrate that AR allows multisensory, situated, and immersive learning experiences that enhance linguistic as well as cognitive capacities.

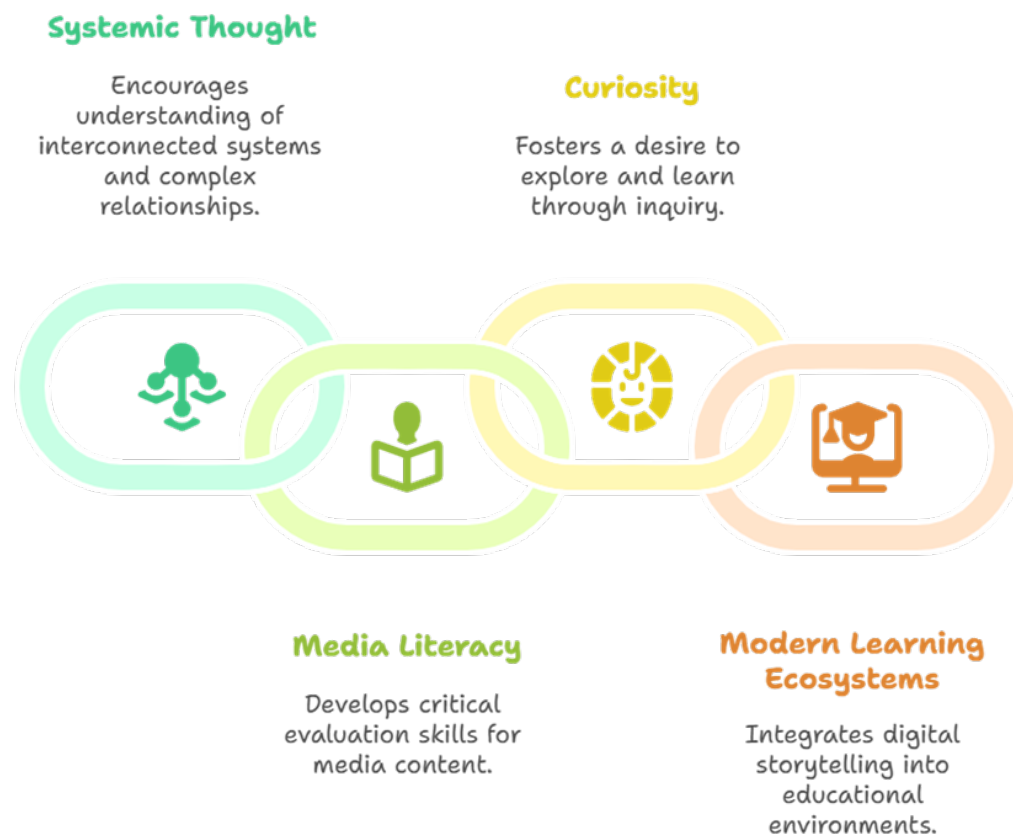


Figure 4: Themes

Interactive and Immersive Storytelling

Interactive and immersive storytelling (Liu, 2025; Roth et al., 2025), continued the facilitation of systemic thought and media literacy. Roth et al. (2025) added that by introducing the CLASS framework, an interactive narrative structure that promotes curiosity, systems thinking, and critical media literacy (Roth et al., 2025). Liu (2025) proposed that by introducing the modern concentric circle model of immersive DS as the central component of modern learning ecosystems for both teachers and students (Liu, 2025). These suggest that interactive DS goes beyond typical literacy skills by providing the student with the capability of interacting with the complex, interconnected social, and information spaces.

Discussion

Visual and digital communication with pedagogies is a significant teaching paradigms, which balanced the traditional foundations and recent technological developments. Theoretical foundation can be traced from the initiation of visual communication research, as in Otto Neurath founding the ISOTYPE system (International System of Typographic Picture Education) (Hartmann, 2017), a pictorially oriented pedagogy that overcome linguistic and literacy boundaries through standardized visual signs, visual education, and popularizing knowledge (Holleran, 2021).

Digital storytelling (DST) and augmented reality (AR) possess significant potential in enhancing spatial visualization, motivation, and engagement particularly in STEM education, their effective integration entail more than access to technology (Francis, 2018; Khalid et al., 2024). Their effective implementation addresses the principal issues among teacher preparedness, curriculum alignment, and infrastructure support in institutions.

This collectively compiled evidence of the systematic review shows consistent patterns within implementation environments and visual and digital impact of language. Digital story telling has been proved as significantly effective in development of higher-order intellectual capabilities such as critical thinking, creativity, and metacognitive capabilities (Rosyid et al., 2025). Studies have indicated children involved in creating digital stories are needed to incorporate information, make aware multimodal choices, and build rich stories containing their knowledge (Dilek Eryigit et al., 2025). This facilitates improved knowledge retention through emotionally and personally connecting with material, as constructivist and

connectivist theories of learning validate.

This is best applied in areas where visual and spatial education is needed. AR has the ability to render abstract objects tangible and can significantly reduce cognitive load on processes of transformation and rotation of the mind (Slijepcevic, 2013). This is beneficial in STEM education in which hard to understand spatial relations are potential learning barriers among students. In spite of this, a study by Caetano et al. (2023) indicated that AR's potential in facilitating learning is greatest in places where such technology is bundled with enough instructional scaffolding and ranges from before and after AR activities, connecting experiences in the virtual world, and general learning targets (Caetano et al., 2023; Nadzeri et al., 2024). This systematic review is also connected with the Saudi Vision 2030 plan, which revolves around digital transformation and development of human capacity as national development drivers. The 2030 Vision strategic plans, e.g., curriculum reform, learning space improvement, and professional development of teachers, are all substantially aligned with the potential role of digital and visual language technologies (Rmg, 2025).

Direct human capability development is a central pillar of Vision 2030 through the use of visual and digital language technologies to prepare citizens with skills that will help meet future labor market needs. They enhance content literacy alongside other beneficial 21st-century abilities like digital literacy, critical thinking, creativity, and collaborative problem-solving (Alrashedi, 2025). These abilities are consistent with Vision 2030 emphasis on constructing a knowledge-based economy and preparing a generation to compete in the international scene in rapidly changing technology-influenced environments (Rmg, 2025). Such approaches also have the potential to enhance education equity through simplifying learning for numerous groups of learners, including rural students and students with varying learning needs.

This systematic review has established evidence in support of visual and digital language in restoring education while mentioning implementation challenges that need to be overcome in realizing the potential. The study showed that interactive storytelling, virtual reality, and interactive storytelling technologies are required in different areas of education to build critical thinking, creativity, interest, and conceptual knowledge. Such advantages come in close alignment with national development plans' priorities such as Saudi Vision 2030, emphasis on a digital transformation, a human capacity building, and a preparation for

participation in knowledge-based economies.

Conclusion

This systematic review explored the transformative potential of visual and digital language in education, particularly through digital storytelling, augmented reality, and interactive media. The findings revealed increasingly enhanced levels of students' motivation, critical thinking, and digital literacy, which are strongly coordinated with the targets of Saudi Vision 2030 for education innovation and digital transformation. Nevertheless, challenges such as inadequate infrastructure, limited teacher training, and incorporation of curriculum constraints remain. Closing these gaps requires contextually responsive strategies and institutional policy. Through digital literacy and innovation, visual and digital language have an important role to play in readjusting students for the knowledge-oriented future.

Limitations and Strengths

One of the strengths of the present study is the systematic compilation of recent empirical research studies (2018–2025) of qualitative, quantitative, and mixed-method evidence to provide a richly integrated explanation of visual and digital language in education. The study also critically connects findings to Saudi Vision 2030 objectives, providing context-specific insights. Several limitations exist as the review was restricted to 13 studies that may not have reflected global diversity appropriately. Publication bias, differences in methodology, and limited availability of Saudi Arabian region-specific studies also limit generalizability. Future research should include longitudinal and large-scale experiments.

Recommendations

Future research should examine large-scale and longitudinal studies for better evaluation of visual and digital language's long-term impact on learning achievement. Increased attention should be given to context-specific Saudi Arabian and Middle Eastern studies to more directly inform Saudi Vision 2030 targets. Teacher training, institutional considerations, and locally appropriate models of integration must be examined by researchers to facilitate successful integration. Expanding research to cover cross-disciplinary applications, emerging technologies such as virtual reality and artificial intelligence, and their influence on creativity, collaboration, and digital literacy will provide more enriching findings for advancing education in the digital era.

References

- Ahmad, M. K., & Rana, R. (2025). Integrating Virtual Reality with Artificial Intelligence for Immersive Learning. *International Journal of Web of Multidisciplinary Studies*, 2(2), 15-20.
- Al-Muttairi, F. Z. S., & Al-Alusi, A. H. S. H. (2025). Multimodal communication in ESL learning: Examining the integration of visual, auditory, and textual elements in digital media with a focus on quality Education (SDG 4). *Journal of Lifestyle and SDGs Review*, 5(3), e04773-e04773.
- Alrashedi, A. K. (2025). Future workforce skills for Saudi Arabia: APLS-SEM analysis of vision 2030 readiness. *Information Development*, 02666669251357311.
- Attahakul, P. (2024). Revolutionizing Learning: The Transformative Role of Technology in Modern Education. *Journal of Asian Language Teaching and Learning (Online)*, 5(3), 15-26.
- Bilici, S., & Yilmaz, R. M. (2024). The effects of using collaborative digital storytelling on academic achievement and skill development in biology education. *Education and Information Technologies*, 29(15), 20243-20266.
- Caetano, A., Lawson, A., Liu, Y., & Sra, M. (2023). ARLang: An outdoor augmented reality application for portuguese vocabulary learning. *Proceedings of the 2023 ACM Designing Interactive Systems Conference*.
- Carretero, S., Vuorikari, R., & Punie, Y. (2017). The digital competence framework for citizens. *Publications Office of the European Union*, 21(5), 222-235.
- Di Fuccio, R., Kic-Drgas, J., & Woźniak, J. (2024). Co-created augmented reality app and its impact on the effectiveness of learning a foreign language and on cultural knowledge. *Smart Learning Environments*, 11(1), 21.
- Dilek Eryigit, C., Kucuk, S., & Tasgin, A. (2025). Impact of augmented reality technology on geometry skills and motivation of preschool children. *Education and Information Technologies*, 1-26.
- Egunjobi, D., & Adeyeye, O. J. (2024).

Revolutionizing Learning: The Impact of Augmented Reality (AR) and Artificial Intelligence (AI on Education). ResearchGate, Oct.

Eshet, Y. (2012). A Revised Model for Digital Literacy: Thinking in the Digital Era. *Issues in informing science & information technology*, 9(31), 267-276.

Francis, M. F. (2018). Digital storytelling with project-based learning: Engaging high school males in space science to improve academic achievement [Northcentral University].

Garlinska, M., Osial, M., Proniewska, K., & Pregowska, A. (2023). The influence of emerging technologies on distance education. *Electronics*, 12(7), 1550.

Hartmann, F. (2017). Visualizing social facts: Otto Neurath's ISOTYPE project. In *European modernism and the information society* (pp. 279-293). Routledge.

Holleran, S. (2021). Better in Pictures: Visual Literacy and the Cosmopolitan Imaginary. *M/C Journal*, 24(4).

Jaffe, M., & Hurwicz, T. (2018). *Worth a thousand words: Using graphic novels to teach visual and verbal literacy*. John Wiley & Sons.

Khalid, I. L., Abdullah, M. N. S., & Fadzil, H. M. (2024). A systematic review: Digital learning in STEM education. *Journal of Advanced Research in Applied Sciences and Engineering Technology*, 51(1), 98-115.

lbreiseth. (2024). Using Visuals. . <https://www.colorincolorado.org/teaching-ells/ell-classroom-strategy-library/using-visuals>

Leandro, A., Morais, J., & Silva, E. (2025). Digital Storytelling in Higher Education: The Use of Podcasts in Building Institutional Identity and Engagement. *Innovative Higher Education*, 1-20.

Lim, F. V., & Tan-Chia, L. (2022). *Designing learning for multimodal literacy: Teaching viewing and representing*. Routledge.

Liu, Y. (2025). Immersive digital storytelling to understand the new learning ecosystem: the revised concentric circles model from both teacher and students' perspective. *Smart Learning Environments*, 12(1), 39.

Mayer, R. E. (2005). Cognitive theory of multimedia learning. *The Cambridge handbook of multimedia learning*, 41(1), 31-48.

Meletiadou, E. (2022). Using educational digital storytelling to enhance multilingual students' writing skills in higher education. *IAFOR Journal of Education*, 10(2), 111-130.

Moradi, H., & Chen, H. (2019). Digital storytelling in language education. *Behavioral sciences*, 9(12), 147.

Nadzeri, M. B., Musa, M., & Ismail, I. M. (2024). The Effects of Augmented Reality Geometry Learning Applications on Spatial Visualization Ability for Lower Primary School Pupils. *International Journal of Interactive Mobile Technologies*, 18(16).

Nuroh, E. Z., Kusumawardana, M. D., & Destiana, E. (2022). Developing Digital Literacy Skill for Initial Teacher Education through Digital Storytelling. *KnE Social Sciences*, 475-496.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., & Brennan, S. E. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *bmj*, 372.

Pateşan, M., Balagiu, A., & Alibec, C. (2018). Visual aids in language education. *International conference Knowledge-based Organization*,

Puspitasari, H. R., Widiarti, N., & Subali, B. (2025). Digital Storytelling For Enjoyable and Effective Learning in the Technological Era (2020–2025). *Pedagogia: Jurnal Pendidikan*, 14(2), 161-173.

Reich, J. (2020). *Failure to disrupt: Why technology alone can't transform education*. Harvard University Press.

Rmg. (2025). *Digital Transformation in Saudi Education: A Vision 2030 Era*. RMG.

<https://www.rmg-sa.com/en/the-digital-transformation-in-saudi-education/>

Rosyid, A., Fauzia, N., Darma, D. B., Abida, F. I. N., & Iye, R. (2025). The impact of digital storytelling applications on enhancing critical thinking abilities in higher education students. *Room of Civil Society Development*, 4(1), 79-89.

Roth, C., Bender-Salazar, R., & Pitt, B. (2025). *Stories and Systems: Educational Interactive Storytelling to Teach Media Literacy and Systemic Thinking*. arXiv preprint arXiv:2508.11059.

Ruijia, Z., Wenling, L., & Xuemei, Z. (2025). The impact of Information and Communication Technology (ICT) on learning outcomes in early childhood and primary education: a meta-analysis of moderating factors. *Frontiers in Psychology*, 16, 1540169.

Salehi, N. (2025). Teaching vocabulary with augmented reality: voices from junior high school English teachers. *Discover Education*, 4(1), 230.

Slijepcevic, N. (2013). The effect of augmented reality treatment on learning, cognitive load, and spatial visualization abilities.

Sun, Q., & Zhu, Y. (2022). Teaching analysis for visual communication design with the perspective of digital technology. *Computational and Mathematical Methods in Medicine*, 2022(1), 2411811.

Wirth, J., Stebner, F., Trypke, M., Schuster, C., & Leutner, D. (2020). An interactive layers model of self-regulated learning and cognitive load. *Educational Psychology Review*, 32(4), 1127-1149.

Yan, S., & Yang, Y. (2021). Education informatization 2.0 in China: Motivation, framework, and vision. *ECNU Review of Education*, 4(2), 410-428.

Yanli, X., & Danni, L. (2021). Prospect of vocational education under the background of digital age: Analysis of European Union's "Digital Education Action Plan (2021-2027)". 2021 International Conference on Internet, Education and Information Technology (IEIT),

Yigit, E. Ö. (2020). Digital Storytelling Experiences of Social Studies Pre-Service Teachers. *International Journal of Technology in Education*, 3(2), 70-81.