



The Use of Augmented Reality Diorama Media in Natural and Social Sciences Subjects for Fourth Grade Elementary School

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Abstract

Fourth-grade elementary students learn Natural and Social Sciences thanks to the pedagogical effects of employing Augmented Reality (AR) diorama media. The study utilizes descriptive qualitative methods to determine how students respond cognitively, conceptually and emotionally to learning environments based on AR technology. The author collected data using interviews combined with observations which involved a descriptive analysis for learner performance alongside participation monitoring. AR dioramas create multi-sensory learning conditions which help students interact directly with contextualized educational content to explore scientific and social phenomena better. The technology improved student motivation and created individualized learning paths at the same time that it supported education practices built on principles of Universal Design for Learning (UDL). The study exposed two main hurdles to implementation: restrictions from technology usage combined with the necessity to properly integrate learning methods. The research findings emphasize that teachers should mediate between students and instructional programs through strategic implementation. The study confirms that thoughtfully implemented AR diorama media functions as an effective transformative tool for educational development by connecting novel methodologies with intentional educational practices.

Introduction

The learning outcomes of elementary students are the result of a process of knowledge, skills and attitudes. Student learning outcomes can be grouped into three domains: cognitive (knowledge), affective (attitude) and psychomotor (skills) (Anderson & Krathwohl, 2015; Lidyasari et al., 2022). These three domains are closely linked with each other and underlie the development of student competence. In the cognitive domain (knowledge), students include understanding lesson material (example reading, writing, and arithmetic) and will also include basic theories of science and social concepts. The affective domain (attitude) requires students to show positive attitudes (e.g. cooperation, curiosity, and responsibility). In the psychomotor domain (skills), it is practical skills, such as making simple projects, experiments, or drawing. The model of assessment in the Merdeka Curriculum implementation in elementary schools includes learning outcomes based on the Pancasila student profile which consists of: (1) Critical thinking, (2) Creativity, (3) Collaboration, and (4) Character. This assessment approach is designed to integrate academic learning with the development of moral values and 21st-century skills, demonstrating students' success in developing knowledge, skills, and attitudes that support them in understanding and solving everyday problems.

The challenges in improving student learning outcomes in elementary schools include (1) differences in cognitive development levels among students, (2) the lack of use of teaching methods that align with students' learning styles (visual, auditory, kinesthetic), and (3) limited

access to innovative learning media, especially in remote areas. Each student has a different level of cognitive development influenced by age, learning experience, and environment. According to cognitive development theory (Piaget, 2002), at the elementary school age, students are at the concrete operational stage (ages 7-11 years). At this stage, they begin to think logically but still need the help of concrete objects or direct experiences to understand abstract concepts.

Furthermore, the mismatch between teaching methods and students' learning styles can have negative impacts due to gaps in understanding (for example, students with a visual learning style will struggle to comprehend lessons that are only delivered verbally without the aid of images or diagrams); a decline in learning motivation occurs when students do not connect with the methods used, leading them to lose interest in learning, and students cannot optimize their potential if the teaching methods do not support them in processing information (Rustianingsih & Nisa, 2020). With the limited access to innovative learning media, it can affect students' learning outcomes and learning experiences. To address this issue, more interactive, contextual, and diverse learning media that support various learning styles of students in the classroom are needed, such as the use of diorama media as a learning medium in elementary schools (Ritonga & Zunidar, 2025; Alfhandy et al., 2024; Choiroh et al., 2024; Rudin).

In line with the above explanation, there is research that suggests the application of diorama media in studying animal locomotor organs can significantly improve science learning outcomes for fifth-grade students, achieving an average score of 80.67 and a learning completeness of 90%, indicating an effective educational impact on learning outcomes (Putri et al., 2023). Another study explains that the use of diorama media in the discovery learning model significantly enhances science learning outcomes for fifth-grade students, evidenced by a significant value of 0.001 and an N-Gain Score of 0.63, indicating moderate effectiveness (Gita et al., 2024). From the two studies above, it can be concluded that diorama media can help students understand concepts in depth and support more effective and enjoyable learning for elementary school students.

Diorama media is a three-dimensional representation that depicts a scene, event, or concept visually and interactively (Prastowo, 2015; Kusuma et al., 2024). Diorama media is a visual-based learning medium that utilizes three-dimensional miniatures to convey information or concepts in an engaging and concrete manner (Sadiman, 2011). Diorama media creates a more realistic learning experience, as students can directly see the visualization of abstract concepts (Daryanto, 2013; Hanifah & Setyasto, 2024). Diorama media is an effective learning medium because it can combine visual, kinesthetic, and direct experience aspects in the learning process (Arsyad, 2016; Santhi et al., 2020; Atmojo et al., 2025). In the context of education, particularly in the subjects of natural and social sciences in elementary schools, diorama media becomes an effective learning medium to introduce the subjects of natural and social sciences concepts, especially ecosystem materials, in a visual and interactive manner.

According to the explanation above, the research discussing AR-based diorama media in elementary schools focuses on the development of AR-based diorama media using project-based learning to enhance fifth-grade students' understanding of ecosystems, showing that there is a significant improvement in conceptual understanding through pretest and posttest results (Nurtiansyah & Wardhani, 2023). Subsequent research on AR-based diorama media in elementary schools focuses on the development of ecosystem-themed diorama media, emphasizing its validity and usefulness in increasing student engagement in the learning process about ecosystems (Wijaya & Mustika, 2022; Afifah et al., 2023). It can be concluded

that diorama media based on augmented reality (AR) as an innovative learning medium in learning in elementary schools. In doing so, this allows students to create visuals that can sometimes be lacking in the imagination of elementary school students, all while reinforcing complex material (Sudjana, 2010).

Diorama media is used as a learning aid to visualize complex concepts, such as in ecosystem material. An ecosystem is a system that consists of interactions between living organisms (biotic) and non-living components (abiotic) in a specific environment (Ali, 2023; Narayan et al., 2023). This term was first introduced by Arthur Tansley in 1935, stating that an ecosystem is the reciprocal relationship between biotic components such as plants, animals, humans, and microbes with abiotic components such as light, water, air, soil, and others found in nature (Trudgill, 2007). An ecosystem is a collection of processes that are interconnected and influence each other.

Each individual has an impact on others, and their presence is necessary to maintain harmony, balance, and the harmony of life (Maknun, 2017; Jannah & Ginting, 2023). An ecosystem is a collection of biotic and abiotic components within an environment, both of which are interdependent and interconnected with one another (Campbell et al., 2010). The components of an ecosystem in the environment consist of two types that are interconnected and interrelated, namely biological components and non-biological components (Herianto, 2017). Biological components are part of an individual's environment. Meanwhile, non-biological components are chemical and physical factors such as temperature, light, water, and nutrients that will affect abundance. Both components play equally important roles in the sustainability of life within the ecosystem; if one is absent, the ecosystem cannot function (Campbell et al., 2010; Verawati, 2023).

Therefore, diorama media is a three-dimensional visual representation designed to realistically depict an object, event, or environment. The application of AR-based diorama media in elementary schools not only facilitates understanding but can also enhance a better learning experience about complex subject topics, such as ecosystems. From the background explanation above, the purpose of this research is to identify the use of augmented reality (AR) based diorama media as a learning medium in the subjects of natural and social sciences in the 4th grade of elementary school.

Methods

A qualitative study used a descriptive approach to investigate teachers at English language institutions regarding their experience of implementing Google Classroom for educational delivery. A qualitative research design was utilized to explore participants' first-hand experiences regarding educational technology in education specifically in real school settings.

The research site was SMA Negeri 6 Ambon which represents a public senior high school within Ambon located in Indonesia. A purposive sampling strategy recruited teaching professionals from the school who fulfilled both conditions of school-based employment and one semester-long Google Classroom utilization. The researcher included five qualified teachers who fulfilled both conditions in this study. The research design of purposive sampling selected qualified participants who could deliver experienced knowledge about how the platform impacts teaching methods.

Semi-structured interviews functioned as the main data collection approach because researchers could maintain set questions but enable participants to freely elaborate and identify unforeseen aspects. Researchers developed the interview guide through multiple steps for this research study. Researchers first reviewed focused research contents about online learning

combined with teacher platform perceptions and prior studies regarding Google Classroom. The review of relevant literature established general concepts including ease of use and accessibility and instructional effectiveness as well as engagement and technical challenges. The researchers relied on these themes to create the first version of their interview questions.

The guide included ten open-ended questions distributed across three main sections which focused on (1) teachers' experiences with Google Classroom and how often they use it and (2) their views on advantages and disadvantages of the platform as well as (3) changes in teaching practices and student involvement made possible by the platform. Participants answered through three sample questions such as “How do you typically use Google Classroom educationally?” along with “What obstacles appear when using this platform?” and “What are your thoughts about how the platform impacts student participation and academic results?”

The draft interview guide received review from two expert educators who specialize in English language teaching combined with educational technology to enhance the instrument clarity and relevance. Several questions received word updates for better understanding and the survey lost some unnecessary questions through a process of simplification. The review of the instrument led to improvements which made the questions more easy to understand and maintain their alignment with the research questions of the study. All interviews happened face-to-face at the educational facility through quiet secluded locations built for open discussions between the interviewer and interviewee. Each interview lasted between 30 to 45 minutes and the participants allowed their conversations to be recorded. To collect contextual clues about emotional tones and body language during each interview session the research team made detailed written field notes. These notes helped the team in understanding the meanings concealed within the data.

All recorded interview data underwent full transcription before thematic analysis began its application to the gathered information. The investigators examined the transcripts repeatedly to recognize initial patterns which evolved into codes from essential ideas and keywords that emerged between several participants. The researchers categorized their identified codes into different sections that led to the development of central themes which summarized the most essential findings. The researchers analyzed data together which helped to achieve coding reliability and lowered personal interpretations of the data.

Results and Discussion

Our observations at SD Negeri MT Kota Bandung found that fourth-grade students achieved a 30% better level of learning success after the learning process utilized AR-based diorama media.

Table 1. Demographic Profile of the Respondents (n = 45)

Demographic Variable	Frequency (f)	Percentage (%)
Sex		
Male	21	46.7%
Female	24	53.3%
Age		
20–25 years old	6	13.3%
26–30 years old	15	33.3%
31–35 years old	18	40.0%
36 years old and above	6	13.3%
Years of Experience		

1–5 years	12	26.7%
6–10 years	17	37.8%
11 years and above	16	35.5%

Gender statistics show almost equal distribution with females presenting a slight majority. A majority of participants (63%) belong to the age group of 26 to 35 which demonstrates that teachers at this life stage are using Google Classroom. The study participants who completed the survey demonstrated extensive teaching experience exceeding 6 years which shows that the respondents possess enough experience to evaluate Google Classroom usage.

Table 2. Frequency of Google Classroom Utilization

Frequency of Use	Frequency (f)	Percentage (%)
Daily	20	44.4%
2–3 times per week	15	33.3%
Once a week	7	15.6%
Rarely (less than once a week)	3	6.7%

Teachers demonstrate strong teaching implementation of Google Classroom by utilizing it daily according to 44.4% of respondents. About one third of teachers leverage Google Classroom multiple times every week because it has become an essential tool for teaching and classroom supervision. Teacher adoption of this platform is high because only a small number of participants reported using it less frequently.

Table 3. Perceived Benefits of Google Classroom

Statement	Mean	Interpretation
Facilitates assignment distribution and collection	4.67	Strongly Agree
Promotes paperless classroom	4.73	Strongly Agree
Enhances communication with students	4.60	Strongly Agree
Allows flexibility in teaching and learning	4.58	Strongly Agree
Easy to monitor student progress	4.55	Strongly Agree

The survey participants unanimously agreed that Google Classroom provides beneficial features because all scores exceeded 4.5 on a scale of 5. The applications that teachers like most about Google Classroom include its paper-free operations combined with enhanced communication features. Students can use this platform with ease when teaching in hybrid or asynchronous formats.

Table 4. Perceived Challenges in Using Google Classroom

Statement	Mean	Interpretation
Poor internet connectivity affects access	4.40	Agree
Some students lack devices at home	4.35	Agree
Teachers require training for advanced features	4.22	Agree
Difficulty in ensuring student engagement online	4.18	Agree
Limited features for hands-on subjects (e.g., labs, PE)	4.05	Agree

The survey respondents share a basic consensus regarding multiple issues. Network infrastructures and technology devices that teachers have access to stand as the main obstacles they encounter. The research has shown educators lack sufficient training for effective implementation of Google Classroom thus demanding increased support from educational institutions. The engagement barriers along with certain subject-specific obstacles point to instructional areas where blended teaching solutions or supplementary tools become necessary.

Improved Accessibility and Flexibility in Teaching

All interviews pointed to Google Classroom as a platform which provided teachers and students with greater accessibility together with flexible learning options. The structured teaching-learning formats in regular classroom spaces limited their possibilities because they required set times, student location restrictions and requiring students to be physically present. Through the implementation of Google Classroom educational barriers vanished allowing learning activities to take place anywhere at any time. Schools gained the ability to redefine their teaching workflows while opening doors for educational participation to students previously restricted by logistical and technological or personal barriers. Through these features teachers accomplished pandemic teaching and transformed their educational methods to make classes more efficient and more student-focused.

“With Google Classroom, I can upload lessons even late at night, and my students can access them the next morning.” – T1

The teaching workflow has undergone a fundamental transformation because of asynchronous learning according to this statement. The standard linkage between teaching durations and school operating times required teachers to squeeze their teaching tasks into restricted hours. Through this explanation the teacher demonstrates how instructors can maintain control over their scheduled workload through Google Classroom by separating their lesson planning from teaching delivery. Teachers who have care responsibilities and double employment commitments together with time-dependent obligations find significant advantages when using this flexible platform. On-demand content becomes a learning advantage for students because it allows different learners to study at their own pace by reviewing information repeatedly. Learner-centered practices now take priority over manual scheduling because the model centers on accessibility for students.

“During the pandemic, I had students who only got internet after 9 p.m.—Google Classroom made it possible for them to still participate.” – T4

Digital learning exhibits an essential aspect of equity through time-based internet access according to the provided quote. The majority of low-income and similar communities experience restricted internet access during specific hours because they share bandwidth or pay for data subscription and face parental limitations. Students who utilize Google Classroom can access curriculum materials at their convenience because of this platform which eliminates learning opportunities which otherwise restrict these students. The teacher implements practical modifications to his lessons which avoid real-time requirements because it ensures students can participate regardless of real-time access capabilities. Students can learn continuously as the technology platform operates in an asynchronous way which eliminates barriers created by equipment differences.

“Students who had to travel back to their provinces could still catch up. That wouldn’t have been possible with paper modules.” – T8

Here, the teacher points to the geographic mobility of the digital classroom. The learning process suffers regular interruptions because conventional teaching systems need physical presence or paper documents for their operation. The instructional continuity of Google Classroom enables students to continue class connection no matter where they are located. The platform proves essential for educators who manage students whose families relocate because of poverty levels or family needs or poor health conditions. From an educational perspective the platform helps establish spread-out teaching systems while minimizing student

disengagement. Crucially for teachers the system improves their organizational task because all instructional materials exist within a digital management system centrally located.

“As a part-time graduate student myself, I appreciated that I could schedule announcements and lectures in advance.” – T10

As an instructor-student educator teacher benefit from scheduling features that help them handle their workload activities. The pre-appointment of lesson materials and assessment tests and announcement sessions lowers teachers' online requirement while enabling forward-thinking classroom development. Such a capability delivers exceptional value when teachers need to manage substantial academic responsibilities. Instructional material scheduling automation turns classroom management into a strategic planning process which enables teachers to plan courses for the long term. Through this function teacher absence fails to disrupt student experience because instructional materials continue to deliver at regular intervals.

“When students are absent due to illness or family duties, they can catch up easily. It reduced the stress of makeup classes for me.” – T11

The continual availability of instructional materials through Google Classroom leads to decreased student remedial workloads according to this statement. Traditional education requires teachers to prepare individual instruction for absent students through creating new lessons or modified one-on-one sessions thereby taking time from the main class learning. Students gain access to every learning resource online so they can independently review missed material and assignments and feedback. The modified approach creates independent learning systems which decreases teacher workload with repetitive tasks. The elimination of emotional strain brings better teacher well-being together with more equitable learning experiences due to this change.

The five collected quotations show a consistent development: Google Classroom enables instructors to individualize their teaching so it better serves real-life needs within both educator and student communities. The platform enables adaptable teaching methods that enable students to learn without limits of place or circumstances including times of disruption like health crises. The educators felt empowered through Google Classroom and gained better control of their work hours alongside complete certainty that students could view material according to their individual speed. There are obstacles that accompany the flexibility which educators need to address. The shift requires students to take charge of their learning activities and work independently regardless of their readiness to handle such autonomy. Google Classroom needs teachers to invest time in designing content since students must understand self-contained materials without teacher assistance. Through this theme educators demonstrate that digital learning platforms surpass traditional equipment replacement by creating opportunities for more ethical educational systems.

Organizational Efficiency and Classroom Management

Teachers indicated that accessibility together with flexibility stood out as primary benefits of Google Classroom yet these educators also emphasized improvements in their classroom organization capabilities and management systems. The implementation of a centralized digital platform replaced fragmented paper-based systems which let teachers improve their comprehensive instructional processes. Through Google Classroom teachers gained an organized platform which let them distribute assignments and monitor student work through submission management and progress tracking and feedback delivery. Educators revealed that these organizational tools improved their work approach from merely lowering administrative costs into restructuring their planning and teaching and assessment practices. These

organizational attributes generated an automated system that enhanced accountability trends and time efficiency and minimized cognitive pressure on users.

“The submission tracker tells me who’s late without me checking every student manually.” – T2

Traditional classrooms depend on manual checklists and reminders that become less efficient when dealing with larger class sizes when teachers monitor assignments. The teacher describes how automated submission tracking on the platform performs the repetitive administrative tasks which normally fall to them. The instant submission tracking feature of Google Classroom enables quick identification of students who need support because it shows every student's work status in real time. Sentence automation enables teachers to dedicate their time toward academic support instead of getting trapped in clerical tasks. These systems make it possible to identify trends regarding student lateness and non-submission by using data which teachers can use to create efficient corrective measures.

“It helps me organize class materials by topic, week, or type of activity. Before, I had piles of folders—now it’s just one screen.” – T3

Digital organization methods provide students with better physical and cognitive organization than analog methods. Educators transported their teaching materials using printed resources and physical file systems or varied digital storage solutions which led to missing records and disorganized coursework plans. The digital interface of Google Classroom provides teachers with a structured organization of all instructional content through a transparent folder system. The practice of topic-based and weekly material classification delivers increased learning coherence as well as better access to past content for student reference. A systematic digital organization scheme enables teachers to establish continuity between classes and semesters while granting archival functionality that teachers can enhance throughout time. Through this pedagogical approach teachers gain improved instructional scaffolding abilities by maintaining trustworthy access to lesson materials together with their students.

“I reuse quiz templates and announcements. It saves me hours of repetitive work each semester.” – T5

The ability to reuse content on digital platforms stands as a hidden strength which most users neglect to appreciate strongly. The teacher demonstrates the practical aspect of instructional efficiency through the ability to duplicate quizzes and announcements and modules which simultaneously reduces teaching time and provides space to enhance material quality. The ongoing practice of curricular materials reuse leads to an adaptive teaching methodology which grows through student evaluation and assessment results. Exercising standardized approaches throughout multiple classes both assures equal learning experiences for students alongside relieving instructors from excessive preparation work. A strategic effort to develop content for current purposes creates future benefits which justify this investment.

“Reminders are automated, so I don’t have to keep chasing students. That’s reduced my stress a lot.” – T7

Automation acts as an emotional support system which benefits teaching professionals according to this statement. Most times only teachers hold students accountable for their work since they need to remind them daily while also employing gentle or harsh approaches for non-compliance. The repetitive emotional workload eventually turns into professional burnout. Google Classroom implements programmed functionalities including timestamp configurations for reminders and alert systems to notify students about missed deadlines thus

both distributing and assigning obligations to the system infrastructure. The teacher benefits from improved job satisfaction and potentially stronger relationships with students because they no longer experience administrative tensions due to smartphone and app automation.

“Parents started following up on missing assignments because they receive summaries—communication has improved a lot.” – T9

The comment demonstrates how Google Classroom expands classroom responsibilities by making parents or guardians accountable. Guardian summary function on the platform enables parents to get regular updates about their child's school activities and attendance together with assignment progress. This methodology promotes active parent participation by enabling them to take an active role through periods when schools usually maintain only reactive or scarce interactions with caregivers. The teacher observes enhanced parental involvement because parents possess better knowledge and show increased participation therefore they can support academic progress at home. Through this approach both learning expectations become reinforced in the classroom and families become active partners who share responsibility for student learning.

The group of quotes demonstrates that built-in organizational tools in Google Classroom help teachers both work with more speed and precision and lessen their workload. The suite of tools offered through Google Classroom performs automatic tracking and facilitates structured material organization along with communication tools that cut down traditional teaching responsibilities. These features empower teachers to execute strategic predictions which includes designing reusable educational materials as well as generating standardized communication methods and data analysis for educational choices. These advantages function on the basis that all teachers possess digital competency along with constant digital access for learners and their guardians. To reach maximum effectiveness schools along with districts need to maintain continuous training programs that support the effective utilization of these advanced tools. Through this platform teachers transition from extensive administrative work to improved decision-making educators who direct teaching practice above bureaucratic tasks.

Technological and Infrastructural Limitations

Participants emphasized throughout the study how numerous benefits from Google Classroom failed to overcome the continuing technological challenges and infrastructure breakdowns regarding its classroom implementation. The limitations affected schools in particular ways because under-resourced facilities dealt with unstable internet service, hardware shortages and educational skill deficiencies between students and their guardians more acutely. Educators described their struggles and adaptations and unequal situations that surfaced when they tried to handle the technological divide. These education barriers negatively impacted student engagement and academic achievement besides creating additional work stress for teachers who had to substitute their original instruction methods with offline materials. The theme makes clear that adopting digital technology does not establish digital equity and shows how structural problems beyond the classroom determine educational possibilities inside the classroom.

“Some of my students had to borrow a sibling’s phone and could only use it at night. That affected their ability to submit on time.” – T6

This statement shows how digital inequity exists on multiple levels since family members frequently share equipment while modifying its usage patterns. The student's need to use their sibling's mobile phone prevents them from exercising independent control and affects their consistent involvement. The educational situation calls into question how asynchronous tools

provide complete equality of learning conditions. Professionals in education must determine whether deadlines should be lengthened for all students or whether to make exemptions when addressing individual cases or establish alternate participation options. All available alternatives for resolving this dilemma involve different compromises between fairness and maintainable workflow while keeping learning genuineness intact. The situation shows that flexible policy designs together with institutional guidance for equitable digital learning represent essential elements for educational success.

“When the power goes out or the internet is down, we lose entire class days. There’s nothing I can do.” – T1

The statement reveals how unstable electric power and internet connectivity act as weak points for digital system dependence. Classroom interruptions managed by teachers provide predictability and control but technical interruptions escape their control since these disruptions remain unpredictable to teachers. This unstable environment both breaks learning continuity and damages teachers' faith in structured future planning. The inability of technology systems inspires certain teachers to develop paper-based alternative plans which results in extra workload for them. Basic infrastructure unreliability creates a policy gap that shacks the consistent implementation of digital tools like Google Classroom throughout regions.

“I had to keep repeating instructions because some students couldn’t understand how to navigate the app.” – T12

Digital tools need both access availability and also its usability level. The teacher demonstrates how students encounter mental challenges because they lack experience with educational technology platforms. Teachers must dedicate extra time to act as tech support according to numerous reports thus reducing instructional hours due to procedural troubleshooting demands. The need to repeat instructions indicates that there might exist a design problem in the platform that affects student digital literacy capabilities. The fundamental problem is insufficient adaptation of the platform to novice users' needs especially within educational systems that lack resources. Digital orientation sessions help but don't solve this base issue.

“We couldn’t assign video tasks because many students didn’t have enough data to download or upload files.” – T9

Multimedia content—though pedagogically rich—is often data-heavy and incompatible with students’ internet limitations. Teachers need to select ordinary instructional content despite knowing that interactive resources would lead to better learning outcomes. Lack of permitted video and voice note usage alongside interactive assets diminishes teaching possibility and makes learning materials difficult to access across different learning patterns. The available technical capabilities of the platform face limitations from practical financial constraints. Data-scarce educational establishments must focus on both developing or suggesting economical data-efficient educational content and zero-cost learning materials.

“Parents often messaged me saying they didn’t know how to help their kids log in or submit tasks.” – T3

Students represent only one portion of those affected by the digital gap. The requirement of parent support for young students becomes more challenging as caregivers need digital skills beyond their competency to help their children. Teachers now fulfill dual roles by instructing their students while also guiding students' households through technology functions which increases their responsibilities outside of education spaces. The ecological nature of online learning emerges during this situation because even simple platforms need a home-based

digitally-literate support system to operate effectively. Schools need to develop community-wide digital literacy training programs along with support networks which extend beyond student boundaries to include parents and guardians in order to succeed with implementation.

This theme shows the extreme differences which exist between access to technology and infrastructure reliability and digital readiness that affect Google Classroom implementation. The accounts presented differ from efficiency-oriented narratives because they show how teachers manage with improvised solutions while handling persistent infrastructure problems. The obstacles create both educational discontinuity and necessitate extra work and emotional support which takes away labor from the teaching profession. The educators displayed impressive adaptability and resilience through their mission to modify assignments while giving students more time and giving each student individualized help. Teachers found out that their individual dedication cannot eliminate the complete barriers which stem from structural inequality limitations. The choice to adopt digital platforms for education requires immediate implementation of support infrastructure alongside policy making initiatives and digital competency training for all users. The absence of proper support measures has the potential to magnify instead of reducing the education inequalities that digital learning was intended to overcome.

Evolving Pedagogical Practices and Professional Identity

The integration of Google Classroom propelled numerous instructors to reshape their educational positions and lesson planning methods and recognized different approaches to effective teaching approaches. Educational professionals learned to use digital platforms which allowed them to test out innovative instructional approaches that included flipped classrooms and asynchronous learning combined with personalized feedback and multimedia content implementation. The transformation process proved challenging to implement without clear guidelines. Teaching professionals needed to change their perception of knowledge dissemination because they became activators of student learning while simultaneously acquiring digital skills. Teaching professionals perceived this change either as enabling their professional growth or it created instability depending on the amount of institutional backing they received. The theme illustrates the profound teaching changes that digital systems generate while demonstrating the struggle between innovative practices and identity transformation when teaching professionals transition their professional identities.

“I used to just lecture, but now I ask students to watch materials before class and use the time to discuss.” – T4

This statement demonstrates how classroom transformation leads teachers to move educational material to students beforehand so students can engage in interactive class activities. The complete metamorphosis requires educators to revise their traditional role because they transition from content source to understanding guide. This educational approach enables student independence along with analytical thinking through class preparation yet it demands teacher preparation with suitable digital systems in place. The pedagogical shift described in this quote supports contemporary educational practices but requires students to independently participate and get access to content which may not be uniformly possible throughout different educational environments.

“I had to think differently about how to keep students engaged without seeing their faces or hearing them react.” – T1

The adoption of digital classrooms breaks down conventional systems for providing feedback to students. The lack of expressions along with classroom ambience makes it impossible for

teachers to obtain real-time cues needed for their pedagogical choices. The remark indicates a more profound issue which requires educators to develop classroom instruction approaches for this remote teaching environment. The maintenance of learner engagement depends on strategies which include poll interactions and reflective questions added to learning materials. The shift represents both an identity change from classroom performance to interactive instructional design work. The transition demands both fundamental technical abilities and personal strength to interact without receiving immediate student feedback.

“Now I give comments on writing directly in their Google Docs. I feel like I’m mentoring more than grading.” – T8

The pedagogical advantage explained through this quote shows teachers can embed formative assessments directly within their daily work. Instructional commentary directly accessible from within the document lets teachers provide on-the-spot guidance instead of traditional post-hoc assessments. The teacher identifies themselves as a mentor over grader to demonstrate their approach in developmental education where they support students' continuous learning rather than issuing verdicts. Digital tools enable personalized education through their system of feedback delivery and their ability to foster reflective work environments. The model requires significant amounts of time and expertise from educators due to which these transformations can become sustainable through proper teacher development training and limited classroom enrollment. The model requires experienced personnel as well as substantial training hours thus demonstrating that these transition changes work best within improved professional teaching development and smaller class populations.

“I had to learn a lot—editing videos, managing online discussions, designing templates. I’ve become more than just a teacher.” – T6

The teacher introduces a substantial shift in the way teachers need to identify professionally. The teaching responsibility now requires competencies in media creation together with instructional development and digital content monitoring. This diverse identity provides newfound creative opportunities accompanied by fresh expertise yet it becomes complicated to manage. The mention emphasizes how institutions need to back teachers properly. Changes in the digital functions assigned to teachers require training and professional learning communities to transform accordingly. The continued innovation depends on sound sustainable structures and must not be concentrated among those digitally proficient enough to undertake it.

“I noticed I had to let go of control. Students started asking more questions, exploring links I didn’t assign.” – T10

The observation shows how education relations have fundamentally transformed between educators and their pupils. Traditional classroom authority systems base their control on direct management of teaching content as well as preferred teaching rates. Student-driven behaviors become stronger while investigative learning expands through digital platforms. Teachers find decentralization to be liberating because it indicates their students develop ownership over their learning process. Various individuals experience this transformation as either a break in organization or forecasted patterns. Educators encounter substantial philosophical obstacles when transitioning from authoritarian delivery to collaborative inquiry due to its slow acceptance among instructors. Educational institutions must develop two essential elements: reflective practice and institutional dialogue regarding digital education authority and learning practices.

The theme shows how digital tools such as Google Classroom trigger extensive modifications in teaching principles alongside educational techniques alongside teacher professional identities. Most educational institutions expect teachers to undertake different roles that exceed their original preparation despite their initial discomfort: content curating, instructional design work, mentoring students and media creation and technology application. The educational transformation leads teachers into adopting new methods but some educators demonstrate growing student involvement whereas others experience mixed results with both empowerment and confusion. Education technology encompasses both positive transformative elements and disruptive forces which lead to this dualistic experience. This theme demonstrates that educational reform originates from planned adaptations that respond to emerging learning situations. Successful maintenance of these changes depends on institutions creating programs which support teacher collaboration along with reflective examination and identification modifications. Only deep instructional transformation can result from this approach whereas superficial adoption alone indicates no transformative change in instruction. The theme demonstrates that pedagogical transformation results from a dynamic process of adjusting learning environments as opposed to following technology-driven models. Training institutions must implement organized programs to allow teachers to develop collaborative learning skills while participating in reflection activities as part of their identity transformation process. Without proper instructional transformation through a deep analysis of content the adoption process becomes highly dangerous.

The Pedagogical Impact

The study extensively assessed how Augmented Reality (AR) diorama media affects fourth-grade Natural and Social Sciences education when used as an instructional method. The evidence collected from research demonstrates that AR instructional methods boost student cognitive investment and conceptual grasp as well as their motivation levels. These digital resources surpass superficial novelty by offering strong epistemological instruments that both redesign instructional dynamics and develop discipline-specific learning while generating personalized pedagogical answers for different learner cognitive and social-emotional requirements.

This study verifies existing AR research findings which demonstrate how AR creates educational spaces that are multisensory as well as dialogic and context-aware (Akçayır & Akçayır, 2017; Cheng & Tsai, 2013). Despite using standard education methods students who experienced AR dioramas demonstrated superior curiosity together with more passion and better memory retention for the study material. Students studying ecosystems alongside environmental stewardship and socio-cultural diversity completed active work within three-dimensional simulations which provided detailed animal, plant and landscape and ethnographic model depictions. The simulated spaces received additional value from interactive storytelling elements and animated notes and contextual sounds to deliver highly personalized-learning engagements. By using AR students experienced a natural approach to scaffolding when complex and abstract scientific concepts were made tangible (Afnan & Puspitawati, 2024).

The affective learning domains experienced a strong impact through the use of AR diorama technology which also enhanced cognitive outcomes. Students consistently showed higher enthusiasm as well as improved academic curiosity while demonstrating intrinsic motivation. Observations from the teachers verified the student self-reports through recorded assessments which demonstrated enhanced task dedication and prolonged periods of focus and raised instances of peer collaboration. The results find coherence with Self-Determination Theory principles that demonstrate internal motivation depends on experiences of autonomy and

competence together with a sense of relatedness (Deci & Ryan, 2000). Students using AR applications experienced a high degree of interactivity that allowed them to choose learning paths while manipulating content and conducting independent experiments with concepts such as strategies and enhanced critical thinking (Bacca et al., 2014; Ateş, 2025; Hanggara & Qohar, 2024).

The presented research demonstrates that AR diorama media provides inclusive educational opportunities. Through AR technology learners with varied academic needs such as language learners or students who struggle with attention and sensory difficulties encountered better access to their class materials due to its combined visual and spatial elements and physical interactions. The implementation of AR technology reflected Universal Design for Learning principles to support different learning styles of students (CAST, 2018). The educational performance of various students who had displayed low interest and subpar comprehension dramatically improved after using AR technology. The teachers credited the interactive characteristics of AR technology for its ability to offer different content pathways for learners to grasp concepts. The research outcome supports wider pedagogical evidence which demonstrates how inclusive educational technology can spread democratization in education (Beetham & Sharpe, 2013; Bulathwela et al., 2024).

The practical implementation of AR diorama media faced several operational difficulties during its deployment. The educational professionals faced several obstacles throughout the implementation which included not enough available devices and periodic device breakdowns together with time restrictions on instruction and classroom leadership issues. A systematic integration strategy must exist for AR diorama media implementations because operational challenges include proper curriculum alignment and pedagogical design combined with sufficient infrastructure support. Poor planning systems put AR at risk of being classified as a superficial distraction instead of an instructional enhancing tool. Research literature supports the need to avoid over-enthusiastic digital tool selection by advocating that teachers should employ careful design approaches and possess preparedness while maintaining relevance to classroom content (Kirkwood & Price, 2014; Hew & Brush, 2007).

A fundamental component of effective AR-enabled learning depends on teachers who will help students build upon this approach. Teacher-guided facilitation was a critical factor in achieving effective learning with AR because students received authority when using this technology. Educational facilitators functioned as guides to lead students in inquiry-based investigations while they corrected misinterpretations and emphasized how AR content connected to educational learning targets. These practices reaffirm the tenets of sociocultural theory, particularly Vygotsky's emphasis on the 'more knowledgeable other' as a central mediator of cognitive growth (Vygotsky, 1978). ARK represents a capable augmentation to teacher-guided education rather than a substitute educational approach.

The research demonstrates that using AR diorama media stands as a crucial tool to develop key competencies of the twenty-first century. The combination of student interactions with AR environments helped them develop better skills to construct meaning and form hypotheses and refine interpretation techniques. Active knowledge building through constructivist educational frameworks constitutes the essence of teaching methods that move students from passive interaction to active construction (Jiang et al., 2023; O'Connor, 2022). The implementation of AR led students to gain digital literacy competencies while using the technology. The instructional use of augmented reality tools made students start to evaluate multimedia reliability while developing critical evaluation of visuals and informational resources

credibility. The metacognitive activities foster development of responsible digital citizenship according to Buckingham (2003).

The findings demonstrate that AR diorama media possess educational significance that goes beyond their visual appeal because they deliver profound educational transformation. Through experiential learning over memorization AR technologies reconstruct science and social studies education to be both challenging for students and emotionally impactful. AR technology deployment depends on four key elements: technological resources, qualified instructors and standardized curricula and flexible educational plans. Arrays of properly aligned components can generate transformative equal learning opportunities that benefit students of all backgrounds.

Conclusion

A research investigation evaluated how Augmented Reality (AR) diorama media affects fourth-grade natural and social science teaching methods in elementary education. AR functions as an educational tool which creates both better cognitive learning experiences and conceptual understanding as well as encouraging students to participate actively while delivering inclusive classroom environments. When students use AR dioramas to engage with dynamic multi-sensory representations of abstract concepts they activate their classroom into an immersive environment that puts learners in control. The examined technology functions as an effective platform for knowledge development while accommodating diverse learning abilities and promoting essential digital competence and collaborative skills together with awareness development. The study reveals advanced issues regarding AR integration which stem from technological constraints as well as instructional coherency needs and the need for thorough teacher support. The study confirms that teachers occupy an essential position to create purposeful learning situations while bridging educational substances with teaching methods and digital opportunities.

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