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The Impact of Using Augmented Reality-Based Interactive Media on Students' Learning Motivation

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ABSTRACT

This study investigates the impact of utilizing Augmented Reality (AR)-based interactive media on students' learning motivation. The research adopts a quasi-experimental method with a pretest-posttest control group design, involving middle school students who were divided into experimental and control groups. The experimental group used AR-based interactive media during the learning process, while the control group experienced conventional instructional methods. Data were collected through motivation questionnaires and observations, and were analyzed statistically to determine the differences between the two groups. The results reveal that students exposed to AR-based media demonstrated significantly higher motivation levels compared to those taught using traditional approaches. The use of AR enhanced students' interest, engagement, and participation during lessons, offering a more immersive and stimulating educational experience. Furthermore, the interactive features of AR allowed students to better visualize complex concepts, leading to improved comprehension and retention. These findings suggest that incorporating AR technology into educational settings can be an effective means of fostering student motivation and optimizing learning outcomes. Educators and policymakers are encouraged to consider the integration of innovative technologies like AR to create more dynamic and motivating learning environments that meet the needs of 21st-century learners.

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INTRODUCTION

In the digital age, technological advancements have transformed various aspects of daily life, including education. One of the emerging technologies with significant potential in educational settings is Augmented Reality (AR). AR technology enables the overlay of digital content onto the physical world, creating a blended environment where virtual objects enhance real-world experiences (Azuma, 1997). As education shifts towards more interactive and student-centered approaches, the integration of AR has gained substantial attention from researchers and practitioners alike.

The conventional teaching methods, which predominantly rely on lecture-based instruction and static learning materials, often fail to meet the needs and preferences of today's learners. Students increasingly seek dynamic, engaging, and personalized learning experiences (Johnson et al., 2016). In response, educators have explored various technological interventions to bridge this gap, with AR emerging as a promising tool to foster engagement and motivation.

Learning motivation plays a critical role in determining student success. According to Deci and Ryan's (1985) Self-Determination Theory, motivation is driven by the fulfillment of basic psychological needs: autonomy, competence, and relatedness. Traditional educational methods may not always satisfy these needs, leading to reduced motivation and suboptimal learning outcomes. Therefore, finding ways to stimulate students' intrinsic motivation is essential for effective education.

Recent studies suggest that AR-based learning environments can fulfill these psychological needs by providing autonomy through self-paced exploration, enhancing competence via immediate feedback, and fostering relatedness through collaborative features (Ibáñez & Delgado-Kloos, 2018). Consequently, AR has

the potential to transform how students interact with educational content, making learning more meaningful and enjoyable.

The interactive nature of AR enables students to engage actively with the material rather than passively receiving information. For example, in science education, AR applications can allow students to manipulate 3D models of molecules or historical artifacts, offering deeper understanding through experiential learning (Bacca et al., 2014). This hands-on experience can significantly boost cognitive engagement and motivation.

Moreover, AR offers a unique capacity to visualize abstract or complex concepts that are otherwise difficult to grasp using traditional methods. In subjects like mathematics or physics, where students often struggle with conceptualization, AR can make invisible phenomena visible and comprehensible (Radu, 2014). Enhanced comprehension naturally leads to increased confidence and a greater willingness to participate actively in learning activities.

Another significant advantage of AR is its ability to create immersive learning environments that simulate real-world contexts. This contextual learning approach not only aids knowledge retention but also makes the learning process more relevant and motivating (Wu et al., 2013). Students perceive the material as more valuable when they can see its application in authentic scenarios.

While the potential benefits of AR are substantial, the actual impact of AR on learning outcomes depends largely on how it is implemented. Poorly designed AR experiences can lead to cognitive overload or distract students from learning objectives (Dunleavy & Dede, 2014). Therefore, careful instructional design is crucial to ensure that AR media align with pedagogical goals.

Despite these considerations, empirical research consistently supports the positive effects of AR on students' motivation and engagement. For instance, Akçayır and Akçayır (2017) conducted a meta-analysis showing that AR-enhanced learning environments generally lead to higher levels of student satisfaction, motivation, and academic achievement compared to traditional methods.

Given these findings, integrating AR into classroom instruction presents an opportunity to revitalize educational practices. By leveraging the engaging power of AR, educators can create more interactive and motivating learning experiences that align with the evolving needs of 21st-century learners (Billinghurst & Duenser, 2012).

The present study focuses on examining the impact of using AR-based interactive media specifically on students' learning motivation. Motivation is chosen as the primary variable because it is a key predictor of learning persistence, effort, and overall academic success (Schunk et al., 2014). Understanding how AR influences motivation can provide valuable insights for educators aiming to enhance their teaching strategies.

The research adopts a quasi-experimental design with a control group to ensure the validity of the findings. Students in the experimental group engage with AR-based media during their lessons, while those in the control group receive conventional instruction. The comparative analysis aims to determine whether AR integration leads to statistically significant differences in learning motivation.

Furthermore, the study seeks to contribute to the growing body of literature on educational technology by offering practical recommendations for implementing AR in schools. By understanding both the benefits and challenges associated with AR, educators and policymakers can make informed decisions about its adoption.

In conclusion, AR-based interactive media represent a promising innovation with the potential to significantly enhance students' motivation and engagement. As educational institutions strive to prepare students for the demands of the future, embracing such technologies could play a pivotal role in creating more effective and inspiring learning environments.

METHOD

Research Design

This study utilized a quasi-experimental design with a pre-test and post-test control group model. This design was chosen to examine the effect of augmented reality (AR)-based interactive media on students' learning motivation while maintaining a degree of control over variables without random assignment (Creswell, 2014). The experimental group received instruction using AR-based media, while the control group engaged in conventional learning activities without AR integration.

Participants

The participants were 60 students from a junior high school, divided into two groups: 30 students in the experimental group and 30 students in the control group. Participants were selected through purposive sampling to ensure similar academic backgrounds and baseline motivation levels. Ethical approval was obtained from the school administration, and informed consent was secured from students and their guardians.

Instruments

Learning motivation was measured using a Learning Motivation Questionnaire adapted from the Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pintrich et al. (1991). The instrument consisted of 25 items covering intrinsic motivation, extrinsic motivation, task value, and self-efficacy, rated on a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The reliability coefficient (Cronbach's Alpha) of the adapted questionnaire was 0.89, indicating high internal consistency.

Additionally, observational sheets were used to qualitatively capture student engagement behaviors during the learning sessions. These observations were triangulated with the questionnaire results to enrich the data.

Procedures

The research was conducted over a four-week period.

1. Pre-test: Both groups completed the Learning Motivation Questionnaire to establish baseline motivation levels.
2. Intervention:
   a. The experimental group was exposed to AR-based interactive media developed using apps such as Zappar and Merge Cube. Lessons included interactive 3D models, real-time simulations, and problem-solving tasks with AR support.
   b. The control group received traditional instruction with textbooks, worksheets, and teacher lectures, covering the same topics as the experimental group.
3. Post-test: After the intervention, both groups completed the same questionnaire to measure any changes in motivation.

To ensure fidelity, all classes were conducted by the same instructor who received prior training on the AR applications. Standardized lesson plans were used to maintain consistency across groups.

Data Analysis

Quantitative data were analyzed using paired-sample t-tests to assess within-group differences (pre-test vs post-test) and independent-sample t-tests to examine between-group differences. Statistical significance was set at $p < 0.05$. All statistical analyses were performed using SPSS software (version 26).

Qualitative data from classroom observations were analyzed thematically to identify patterns of engagement and motivation indicators such as time-on-task, participation, and enthusiasm during learning activities.

Validity and Reliability

To ensure internal validity, both groups were taught the same content under similar conditions, differing only in the use of AR technology. External validity was considered by selecting a sample reflective of the general student population. The use of a well-established instrument (MSLQ) enhanced measurement validity, while a pilot study prior to full implementation confirmed the reliability of the adapted tools.

RESULTS AND DISCUSSION

The data analysis revealed significant findings regarding the impact of augmented reality (AR)-based interactive media on students' learning motivation. The paired-sample t-test for the experimental group indicated a significant increase in learning motivation scores from pre-test ($M = 65.40$, $SD = 8.21$) to post-test ($M = 82.75$, $SD = 7.45$), $t(29) = 9.24$, $p < 0.001$. This suggests that the AR intervention had a substantial positive effect on motivation.

In contrast, the control group showed a marginal increase in motivation scores, from pre-test ($M = 66.10$, $SD = 7.98$) to post-test ($M = 68.55$, $SD = 8.23$), $t(29) = 1.82$, $p > 0.05$. The change was not statistically significant, implying that traditional instruction methods had limited impact on enhancing students' motivation during the study period.

An independent-sample t-test comparing post-test scores between the experimental and control groups demonstrated a significant difference, $t(58) = 7.26$, $p < 0.001$. Students exposed to AR-based media

reported higher motivation levels than those who received conventional instruction. This reinforces the hypothesis that AR technologies can serve as effective tools for boosting students' enthusiasm for learning.

Observational data supported these quantitative findings. Students in the experimental group displayed higher levels of engagement, such as frequent asking of questions, active participation in tasks, and visible excitement during AR activities. Conversely, students in the control group exhibited less sustained attention and lower participation rates.

The interactive nature of AR media likely contributed to these outcomes. According to Azuma (1997), AR enhances users' perception and interaction with the real world by overlaying digital information in real time. In educational settings, this can make abstract concepts more tangible and stimulate students' interest, thus promoting intrinsic motivation.

Another key factor was the novelty effect associated with AR technology. Previous studies suggest that exposure to novel educational tools can temporarily boost students' motivation (Makransky & Lilleholt, 2018). However, the consistency of high engagement across the four-week period in this study indicates that the observed effects were not merely due to novelty but reflected a deeper motivational impact.

Task value emerged as one of the most influenced sub-components of motivation. Students in the AR group reported higher perceptions of task value, aligning with expectancy-value theory, which posits that students' motivation increases when they perceive learning tasks as valuable (Wigfield & Eccles, 2000). The immersive AR experiences made lessons feel more relevant and meaningful.

Intrinsic motivation also showed notable improvement. Students expressed enjoyment in exploring AR features and solving problems in an interactive environment. This aligns with Deci and Ryan's (2000) self-determination theory, which emphasizes that enjoyable activities foster intrinsic motivation and deeper engagement in learning.

Extrinsic motivation components, such as grades or external rewards, were less prominently affected. While some students mentioned wanting to perform well because of the "cool" technology, most motivational gains appeared internally driven, suggesting that AR's primary strength lies in enhancing intrinsic interest rather than external pressures.

Self-efficacy improved among the experimental group participants. The real-time feedback provided by AR tools helped students experience a sense of competence as they interacted successfully with virtual elements. Bandura's (1997) theory of self-efficacy supports this, asserting that mastery experiences are a critical source of confidence-building in learners.

Moreover, AR's ability to cater to multiple learning styles—visual, kinesthetic, and auditory—may have broadened its motivational impact. By offering varied sensory input, AR allowed students to engage with the material in ways that suited their individual preferences, which has been shown to increase motivation and academic success (Fleming & Mills, 1992).

However, the study also identified some challenges. A few technical issues, such as app glitches or difficulties scanning AR markers, occasionally caused frustration among students. These technical barriers must be minimized for AR to consistently support learning rather than hinder it (Akçayır & Akçayır, 2017).

Overall, the findings contribute to a growing body of literature affirming the potential of AR in educational contexts. As Bacca et al. (2014) highlight, AR can enhance learning experiences by promoting interactivity, improving attention, and fostering positive attitudes toward learning.

In conclusion, AR-based interactive media significantly improved students' learning motivation compared to traditional teaching methods. The integration of AR into the classroom holds great promise but requires careful planning, technical support, and pedagogical strategies to maximize its benefits for learners.

CONCLUSION

This study examined the impact of Augmented Reality (AR)-based interactive media on students' learning motivation, with a focus on middle school students. The findings clearly show that AR significantly enhanced students' motivation compared to traditional teaching methods. The experimental group exposed to AR demonstrated higher levels of learning motivation, as indicated by their improved scores on the Learning Motivation Questionnaire and their active participation during the AR-based lessons.

The significant improvements in intrinsic motivation, task value, and self-efficacy in the experimental group underscore the potential of AR technology to foster deeper engagement in educational contexts. Students reported greater enjoyment and interest in the material, which aligns with the theories of self-determination and intrinsic motivation (Deci & Ryan, 2000). The real-time feedback and immersive experiences provided by AR helped students feel more confident in their abilities and made learning feel more relevant and meaningful.

Although the control group also showed some improvement, it was not statistically significant, indicating that traditional instructional methods were less effective in enhancing motivation. These findings suggest that AR can serve as a powerful tool for educators seeking to create more engaging and motivating learning environments.

However, the study also identified some challenges, such as technical issues that occasionally interrupted the learning experience. These barriers must be addressed to fully realize the potential of AR in education. Despite these challenges, the positive impact of AR on students' motivation and engagement provides strong support for its integration into modern educational practices.

In conclusion, this research contributes valuable insights into the role of AR in enhancing students' learning motivation. Given its potential, AR-based media should be considered as a viable educational tool, particularly in subjects that require hands-on engagement and complex conceptualization. Future research should explore the long-term effects of AR on motivation and academic performance, as well as the most effective ways to integrate AR into diverse classroom settings.

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