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Enhancing Zakat Learning Outcomes Using Augmented Reality and Virtual Reality Technologies

Muttaqin Choiri[1*], Firman Setiawan[2], Ahmad Shofiyuddin[3]
[1,2]Faculty of Islamic, University of Trunojoyo Madura, Indonesia
[3]Islamic Education, Nahdlatul Ulama Sunan Giri University, Indonesia
[1]muttaqin.choiri@trunojoyo.ac.id, [2]firman.setiawan@trunojoyo.ac.id, [3]shof@unugiri.ac.id
***Corresponding Author**

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ABSTRACT

This research aims to develop a learning module for Zakat material based on AR Technology combined with VR in improving student learning outcomes that are in line with the context of Independent Learning Independent Curriculum. The research **method** uses Research and Development (RnD), which consists of five stages of the process including Analysis, Design, Development, Implementation, and Evaluation (ADDIE). Furthermore, the product (module) was validated by material experts and media experts with scores of 90.8% and 90.5%, respectively, and tested on students at four higher education institutions in East Java, University of Trunojoyo Madura, Nahdlatul Ulama Sunan Giri University, Nahdlatul Ulama Surabaya University, and Al-Khozini Sidoarjo Islamic Religious Institute. The first experiment was applied in a small class with an average result of 85.4% and a large class with an average score of 83.3%. As for the average of the previous test results, the score obtained by students when using the conventional module was 72, and it experienced an increase to an average score of 86 when using the zakat module based on augmented reality technology combined with virtual reality. Thus, the **results** show that the use of AR & VR technology modules in zakat materials has a positive impact on student learning outcomes in higher education institutions.

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1. INTRODUCTION

The integration of modern technology in education has become increasingly crucial, particularly in higher education, where digital tools enhance learning experiences. Augmented Reality (AR) and Virtual Reality (VR) technologies have shown significant potential in making abstract concepts more tangible and engaging. In line with the Merdeka Belajar (Independent Learning) curriculum, which emphasizes technology-based, student-centered learning, there is a growing opportunity to implement AR and VR in religious education, specifically in zakat learning [1, 2]. This study aims to develop an interactive zakat learning module that combines AR and VR to improve student comprehension and engagement. By offering an immersive learning experience, students can better understand zakat's real-world applications, fostering critical thinking, motivation, and deeper conceptual understanding [3].

Despite the increasing adoption of AR and VR in education, their application in Islamic studies, particularly in zakat learning, remains underexplored. Previous studies have primarily focused on AR and

VR's impact on teacher preparation, physics education, and creative learning [4, 5]. However, little research has examined how these technologies can be leveraged to teach religious financial concepts like zakat. This study aims to bridge this gap by developing and evaluating an AR-VR-based zakat learning module tailored to higher education students [6, 7].

Several prior studies highlight the effectiveness of AR and VR in education. For instance, [8] analyzed 158 studies and found that AR and VR enhance classroom simulation and technology-based teaching. While [9, 10] research focused on improving educators' field experience, our study shifts the focus to student engagement in Islamic financial literacy, demonstrating how AR and VR can be adapted for religious education [11, 12].

Another study [13], applied a bibliometric approach to analyze AR and VR trends in physics education. Unlike this research, our study takes a more practical approach by designing, implementing, and evaluating AR-VR-based zakat learning modules, aligning with the Merdeka Belajar curriculum [14].

Additionally, [15] explored AR in fostering creativity and digital empathy. While this work emphasized soft skills, our research is more application-driven, focusing on improving student learning outcomes through AR-VR-based Islamic financial education [16–18].

This study addresses two key research gaps:

- The limited application of AR and VR in religious education, particularly in zakat learning.
- The need for a structured evaluation of AR-VR-based modules to measure their effectiveness in enhancing student comprehension.

To address these gaps, this study investigates the following research questions:

- How effective is the zakat module based on AR technology combined with VR?
- Can the zakat module based on AR and VR technology improve student learning outcomes?

Beyond these contributions, the study also offers practical insights for educators and curriculum developers seeking to integrate immersive technologies into Islamic financial education [13, 19]. The findings demonstrate that AR-VR modules can create a more engaging, interactive, and context rich learning environment, which supports deeper conceptual understanding of zakat principles compared to traditional methods. Moreover, the structured evaluation framework developed in this study can serve as a reference model for assessing other immersive learning tools across different Islamic subjects [20, 21].

This framework not only strengthens the pedagogical integration of AR-VR but also highlights critical factors such as user experience, cognitive load, and emotional engagement that influence the effectiveness of technology enhanced religious education [22]. Ultimately, the study underscores the potential of immersive technologies to modernize Islamic learning, bridge gaps in student comprehension, and foster a more experiential approach to understanding religious obligations in contemporary educational settings [23–25].

2. LITERATURE REVIEW

2.1. Augmented Reality & Virtual Reality in Teaching and Learning

AR and VR have transformed digital learning by providing interactive and immersive experiences that enhance student engagement and conceptual understanding. AR overlays digital elements onto the real world, allowing users to interact with two-dimensional or three-dimensional objects in real time [26]. This integration of virtual and physical environments fosters an enriched learning experience, making abstract concepts more tangible. Meanwhile, VR creates a fully immersive digital environment, enabling users to explore and engage with virtual simulations as if they were physically present in a different setting [27].

In educational contexts, AR facilitates innovative teaching methods by visualizing complex subjects in an intuitive, interactive format. This technology is particularly effective in subjects that require spatial understanding, such as mathematics, physics, and chemistry [28], where three-dimensional models can illustrate intricate relationships more clearly than traditional two-dimensional representations [29, 30]. Additionally, AR enhances student participation by allowing them to directly interact with virtual objects, thereby increasing motivation and engagement.

On the other hand, VR provides immersive learning environments that allow students to experience realistic simulations [31, 32]. This technology is widely used in medical training, engineering education, and history lessons, where students can conduct virtual experiments, explore historical reconstructions, or practice

real-world procedures in a safe setting [33]. Unlike AR, which supplements reality with digital content, VR replaces real-world experiences entirely, offering an unparalleled depth of interaction that promotes experiential learning.

Despite their differences, both AR and VR contribute significantly to the advancement of digital education. While AR enhances real-world experiences with interactive elements, VR provides fully immersive simulations that allow for experiential learning. The effectiveness of these technologies has been demonstrated in various disciplines, reinforcing their role in fostering critical thinking, improving retention rates, and enhancing student motivation [34].

From a global development perspective, the use of AR and VR in education corresponds directly with several targets of the Sustainable Development Goals (SDGs) [35]. Immersive technologies foster interactive, adaptive, and inclusive learning ecosystems that advance SDG 4.3, which calls for affordable and high quality tertiary education, and SDG 4.7, which emphasizes digital literacy and 21st-century skills [36]. Additionally, employing AR and VR to teach zakat principles carries broader social implications by strengthening students' understanding of financial justice and redistribution areas closely related to SDG 1 No Poverty and SDG 10 Reduced Inequalities [37]. Therefore, integrating AR and VR in Islamic studies not only enhances instructional innovation but also serves as a strategic tool for accelerating progress toward sustainable education outcomes.

2.2. Challenges in Implementing AR and VR in Education

Although AR and VR offer substantial benefits, their implementation in education presents several challenges that must be addressed. One of the primary concerns is the psychological impact on students, particularly anxiety and cognitive overload when interacting with immersive virtual environments. Some students may struggle to adapt to digital interfaces, leading to reduced engagement and learning efficacy. Additionally, excessive immersion in VR may cause discomfort, such as motion sickness or visual fatigue, which can hinder the overall learning experience [38–40].

Technical limitations also pose significant obstacles. AR and VR applications require high performance hardware, such as VR headsets, AR-enabled mobile devices, and powerful computing systems. These technical requirements can be prohibitive, particularly in institutions with limited access to advanced technology [41, 42]. Moreover, the successful deployment of AR and VR in classrooms depends on stable internet connectivity and skilled personnel who can support and troubleshoot technical issues. Without adequate infrastructure and training, educators may struggle to integrate these technologies effectively into their teaching methods [43].

Financial constraints further complicate the adoption of AR and VR in education. The cost of developing and implementing immersive learning technologies is often high [44], encompassing expenses related to hardware procurement, software licensing, and faculty training programs [45]. In developing regions or underfunded educational institutions, these costs can become a significant barrier to widespread adoption [46]. Studies have shown that the disparity in technological access exacerbates educational inequality, limiting the benefits of AR and VR to institutions with sufficient resources [47].

Additionally, the scalability of AR and VR-based learning remains a concern. While these technologies have demonstrated success in controlled environments, their effectiveness across diverse educational settings is still being evaluated. Factors such as class size, subject complexity, and students' prior exposure to digital tools influence the learning outcomes associated with AR and VR [48]. Addressing these scalability issues will be crucial in ensuring that immersive learning solutions are accessible and adaptable across various educational contexts.

Despite these challenges, the continuous advancement of AR and VR technology holds promise for future educational applications. Researchers and educators must focus on cost-effective alternatives, such as web-based AR solutions and cloud-hosted VR simulations, to enhance accessibility and adoption [49, 50]. Furthermore, interdisciplinary collaboration between educators, technologists, and policymakers can facilitate the integration of AR and VR into mainstream education, making immersive learning experiences more inclusive and sustainable.

3. METHODOLOGY

3.1. Research Design

This study employs the ADDIE instructional design model, which consists of five sequential stages: Analysis, Design, Development, Implementation, and Evaluation [51]. The ADDIE model provides a struc-

tured approach to developing an AR-VR-based learning module for zakat education, ensuring its effectiveness and usability in an academic setting. Each stage in the ADDIE model plays a critical role in optimizing the instructional design process, leading to the development of an interactive and immersive learning experience.

Table 1 presents an overview of the research process following the ADDIE framework. The process begins with an analysis phase to identify student learning needs and curriculum requirements. This is followed by the design stage, where structured learning modules are created based on pedagogical principles. During the development phase, interactive AR-VR elements are integrated into the learning content. The implementation stage involves classroom testing to evaluate student engagement and usability. Finally, in the evaluation phase, expert validation and student feedback are analyzed to refine the module further.

Table 1. Research Process Using the ADDIE Model

Phase	**Activities**	**Outcomes**	**Indicators**
Analysis	Needs analysis of curriculum, students, and materials	Identification of key learning objectives and challenges	Defined AR-VR learning needs
Design	Structuring content and defining instructional strategies	Prototype development	Structured learning module
Development	Creating interactive AR-VR content	Integrated multimedia-based module	Functional AR-VR system
Implementation	Testing module in small and large classes	Deployment of AR-VR module	Student engagement and usability feedback
Evaluation	Expert validation and effectiveness testing	Assessment of learning outcomes	Improvement recommendations

Table 1 outlines the ADDIE model phases used in this study, ensuring that the AR-VR learning module is systematically designed, developed, tested, and refined before implementation. The analysis phase identifies learning needs, the design phase outlines the instructional framework, and the development phase transforms these plans into functional digital modules. Classroom trials in the implementation phase provide usability insights, while the evaluation phase offers feedback for improving the module's overall effectiveness.

3.2. Analysis

The analysis phase serves as the foundation for this research, focusing on identifying students' learning needs and the existing challenges in teaching zakat. The study employs multiple data collection methods, including surveys, interviews, and direct classroom observations. These approaches help assess students' prior knowledge of zakat concepts and their familiarity with digital learning tools. Additionally, a literature review is conducted to examine recent advancements in AR and VR technologies in education. The insights gained from this phase guide the development of an interactive zakat learning module, ensuring it aligns with both pedagogical best practices and technological advancements. Through this process, researchers can pinpoint specific areas where AR and VR can enhance student engagement and comprehension.

3.3. Design

During the design phase, the learning module is structured to facilitate an engaging and immersive educational experience. The module is developed based on a curriculum-aligned approach, incorporating structured lesson plans and interactive elements. Key considerations in this phase include defining learning objectives, selecting appropriate instructional strategies, and designing user-friendly interfaces for AR and VR applications. The module is structured to include visual simulations, real-world zakat scenarios, and interactive elements that allow students to explore the subject matter in a hands-on manner. To ensure accessibility, both desktop and mobile platforms are considered for module deployment.

3.4. Development

The development phase transforms the conceptual framework into a functional AR-VR learning module. The AR component is designed using Unity with Vuforia SDK, implementing marker-based tracking for

interactive learning. The VR component is developed as a WebVR-based experience, allowing students to engage with immersive 3D environments without requiring high-end VR hardware. In addition to integrating AR and VR functionalities, special attention is given to User Experience (UX) and User Interface (UI) design to ensure smooth navigation and ease of interaction. Preliminary testing is conducted with a small group of students, allowing for refinements based on usability feedback.

3.5. Implementation

The implementation phase involves classroom deployment of the AR-VR module. The study is conducted at four higher education institutions:

- University of Trunojoyo Madura
- Nahdlatul Ulama Surabaya University
- Nahdlatul Ulama Sunan Giri University
- IAI Al Khazini Sidoarjo

A small-scale trial was conducted at the Islamic Religious Education Study Program on August 10, 2024, followed by a large-scale deployment from September 12-21, 2024. This step allows researchers to assess the module's usability and effectiveness in a real-world classroom setting.

3.6. Evaluation

The evaluation phase assesses the module's quality and effectiveness through expert validation and student feedback. Data is collected using pre-test and post-test assessments, along with structured questionnaires measuring student engagement and usability. The evaluation focuses on:

- Content validity, ensuring accuracy and alignment with curriculum objectives.
- Technical performance, examining responsiveness and system stability.
- Pedagogical effectiveness, measuring knowledge retention and student comprehension.

These evaluation components collectively ensure that the AR-VR module meets the required academic, technical, and pedagogical standards. Feedback from experts and students validates the accuracy of the learning content, confirms system stability during use, and demonstrates the module's ability to improve comprehension of zakat concepts. The results from this phase also help identify areas that require refinement, ensuring the module is fully optimized before broader classroom implementation.

3.7. Data Collection and Analysis

This study employs a mixed-methods approach for data collection, integrating both quantitative and qualitative data. Quantitative data is derived from pre-test and post-test scores, measuring improvements in student performance. Statistical analysis, including paired t-tests and ANOVA, is conducted to determine the significance of learning gains. Meanwhile, qualitative data is gathered through student feedback and expert interviews, which are analyzed using thematic coding to identify key themes related to usability and learning engagement. The eligibility of the AR-VR module is evaluated using a percentage-based assessment formula:

$$\text{Percentage of eligibility} = \left(\frac{\text{Score obtained}}{\text{Maximum score}} \right) \times 100\%$$

The percentage-based eligibility formula provides a quantitative measure to evaluate how well the AR-VR learning module meets established instructional, technical, and usability standards. By converting expert and user assessment scores into a standardized percentage, this approach allows researchers to objectively determine the module's feasibility level and compare its performance across different evaluation criteria. This calculation also ensures consistency in interpreting validation outcomes, enabling a clear distinction between modules that are ready for implementation and those requiring improvement prior to classroom deployment.

Table 2. Judgment Criteria for Learning Module Evaluation

Percentage Range	Interpretation
81 - 100%	Highly Feasible
61 - 80%	Feasible
41 - 60%	Moderately Feasible
21 - 40%	Less Feasible
1 - 20%	Not Feasible

Table 2 presents the evaluation criteria used to determine the feasibility of the AR-VR-based learning module. Modules scoring above 81% are deemed highly feasible, while those below 40% require significant revisions. This classification ensures objective assessment and identifies areas for further improvement.

4. RESULTS AND DISCUSSION

4.1. Validation of the Learning Media

This study evaluates the validity of the zakat learning module through expert assessments and student trials. The validation process involves material and media experts who assess the feasibility, content accuracy, and instructional effectiveness of the module. Following this, small and large-scale trials were conducted to evaluate the module's practical applicability and usability.

4.1.1. Material Expert Validation

The material expert validation assesses the content quality and alignment of the AR-VR-based zakat learning module with curriculum requirements. The evaluation focuses on five key aspects: self-instruction, self-contained learning, stand-alone usability, adaptability, and user-friendliness. The results are presented in Table 3.

Table 3. Validation of Material Experts

No.	Aspect	Eligibility Percentage
1	Self Instruction	89.5%
2	Self Contained	91.8%
3	Stand Alone	87%
4	Adaptive	88.5%
5	User Friendly	91%

Table 3 shows that all aspects received high feasibility scores, with an average of 90.85%. The highest rating is observed in the "Self-Contained" (91.8%) and "User-Friendly" (91%) categories, indicating that the module effectively provides comprehensive learning content that can be accessed independently by students. These results suggest that the AR-VR-based module is well-structured, easy to navigate, and enhances independent learning.

4.1.2. Media Expert Validation

The media expert validation assesses the design quality of the learning module, focusing on aspects such as cover layout, typography, content layout, and illustration quality. The results are summarized in Table 4.

Table 4. Validation of Media Experts

No.	Aspect	Eligibility Percentage
1	Cover Layout	85%
2	Cover Typography	88%
3	Content Layout	86%
4	Content Typography	89%
5	Content Illustration	88%

Table 4 indicates that all media aspects received high validation scores, with an average feasibility rating of 90.5%. The highest rating was given to typography (89%), highlighting the clarity and readability of

the module. This validation confirms that the visual and interactive elements of the module enhance the overall learning experience, making it engaging and accessible for students.

4.2. Small and Large Class Trials

Following expert validation, the module was tested in classroom settings to evaluate its usability and effectiveness. The trials were conducted in small and large classes across four higher education institutions.

4.2.1. Small Class Trial Results

The small class trial aimed to test the module in a controlled environment with a limited number of students. Table 5 presents the feasibility results.

Table 5. Small Class Trial Results

Aspect	Eligibility Percentage	Category
Software Performance	85%	Valid
Learning Effectiveness	87%	Valid
Visual Communication	84%	Valid

As shown in Table 5, the highest rating was given to ”Learning Effectiveness” (87%), indicating that students found the module helpful in understanding zakat concepts. The ”Software Performance” rating (85%) suggests smooth functionality, with minor improvements needed for optimization.

4.2.2. Large Class Trial Results

The large class trial tested the scalability and robustness of the module in a broader learning environment. Table 6 summarizes the results.

Table 6. Large Class Trial Results

Aspect	Eligibility Percentage	Category
Software Performance	84.3%	Valid
Learning Effectiveness	82.7%	Valid
Visual Communication	83%	Valid

Table 6 shows that all aspects remain valid, although scores slightly decreased compared to the small class trial. The decline in feasibility ratings suggests that while the module functions well, further optimization is needed for larger-scale use.

4.3. Effectiveness of AR-VR Learning

To assess the impact of the AR-VR module, a comparative analysis was conducted between students using traditional learning methods and those using the AR-VR-based module. The test results are presented in Figure 1.

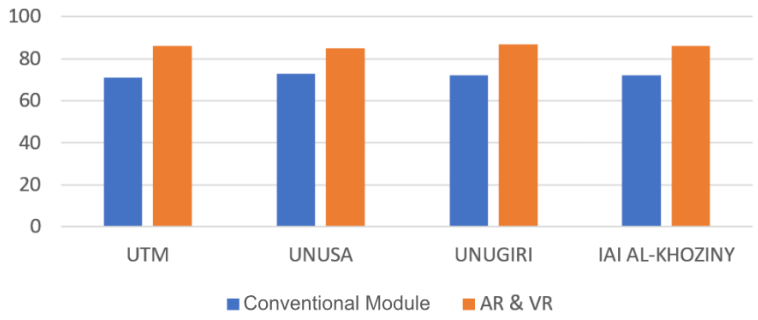

Figure 1. Diagram Student Learning Test Result

Figure 1 illustrates a significant improvement in student performance, with an increase in average test scores from 72 (traditional method) to 86 (AR-VR method). This suggests that the AR-VR module enhances comprehension by providing an interactive and immersive learning experience.

Figure 2. Use of AR & VR media

The test results after using the AR and VR modules in Figure 2 show a significant improvement in student comprehension, with the average score increasing to 86. The AR and VR-based modules not only present the content visually and interactively, but also integrate simulation elements that allow students to ”feel” zakat-related processes in more real and practical situations. In the four higher education institutions that became the research location, University of Trunojoyo Madura, Nahdlatul Ulama Surabaya University, Nahdlatul Ulama Sunan Giri University, and Al Khoziny Islamic Religious Institute, students showed higher enthusiasm and greater involvement in the learning process.

4.4. Discussion

The results confirm that the AR-VR-based zakat learning module is highly effective and feasible for educational use. Expert validation ratings, ranging from 90.5% to 90.8%, highlight the module's strong content accuracy and design quality. Additionally, student trials demonstrate positive learning outcomes, with high feasibility scores in both small and large class settings.

Despite these promising results, some challenges remain. The slight decrease in feasibility ratings during large-scale implementation suggests that improvements are needed in system performance and scalability. Technical factors such as internet connectivity and hardware limitations may affect module accessibility in broader applications. Moreover, while AR-VR enhances engagement and retention, the cost of implementation remains a barrier for some institutions. Future research should explore cost-effective alternatives, such as cloud-based AR-VR applications that reduce dependency on high-end devices.

This study demonstrates that the AR-VR-based zakat learning module significantly enhances student comprehension and engagement. The module received high validation scores from both experts and students, confirming its feasibility and effectiveness. However, to ensure broader adoption, further optimization in performance, cost-efficiency, and accessibility should be explored in future studies.

5. MANAGERIAL IMPLICATIONS

This study offers several managerial implications for educational institutions, curriculum designers, and policymakers aiming to integrate immersive technologies into Islamic education. First, institutions should allocate strategic resources such as training, infrastructure, and digital content development to support the adoption of AR-VR learning tools, as these technologies have demonstrated the potential to improve student comprehension and engagement. Second, curriculum managers need to incorporate structured evaluation frameworks, similar to the assessment model used in this study, to ensure that immersive learning modules

maintain content accuracy, technical stability, and pedagogical relevance. Third, education leaders should foster collaboration between instructional designers, subject-matter experts, and technology developers to create scalable and context-appropriate AR-VR modules for broader subjects within Islamic studies. Finally, policymakers and school administrators are encouraged to integrate immersive technology initiatives into long-term strategic planning, enabling sustainable innovation and ensuring that digital transformation aligns with national education directives, such as Merdeka Belajar. Through these actions, institutions can enhance the quality, accessibility, and modernization of religious education in the digital era.

6. CONCLUSION

This study developed an AR and VR-based learning module for zakat education, aiming to enhance student engagement and comprehension through immersive technology. The validation process, which included assessments from material and media experts, as well as trials in both small and large classroom settings, confirmed the feasibility and effectiveness of the developed learning media. Material and media experts rated the module with feasibility scores of 90.8% and 90.5%, respectively, while small and large class trials demonstrated feasibility percentages of 85.4% and 83.3%. The overall validation score of 86.2% indicates that the module is well-suited for educational use, offering a structured and engaging alternative to conventional learning methods.

In addition to expert validation, the effectiveness of the AR-VR module was reflected in student learning outcomes. Students using the conventional learning module achieved an average test score of 72, while those utilizing the AR-VR-based module attained a significantly higher average score of 86. This substantial improvement demonstrates that immersive learning technology can enhance conceptual understanding, reinforce knowledge retention, and provide a more engaging and interactive educational experience. The ability to visualize zakat concepts in a three-dimensional environment contributed to deeper comprehension and a more meaningful learning process.

The findings of this study underscore the potential of AR and VR technologies to transform traditional learning approaches, particularly in religious education. While the results affirm the feasibility and effectiveness of this learning media, further research is needed to optimize scalability, cost-effectiveness, and accessibility across diverse educational settings. Future studies should focus on refining technical performance, improving user adaptability, and exploring alternative implementation strategies to ensure that AR-VR-based learning can be widely adopted and integrated into broader curricula.

7. DECLARATIONS

7.1. About Authors

Muttaqin Choiri (MC) https://orcid.org/0000-0002-8734-7474

Firman Setiawan (FS) https://orcid.org/0000-0001-7276-3291

Ahmad Shofiyuddin (AS) https://orcid.org/0000-0001-6831-678X

7.2. Author Contributions

Conceptualization: MC and FS; Methodology: AS; Software: FS; Validation: MC; Formal Analysis: FS and AS; Investigation: AS; Resources: FS; Data Curation: AS; Writing Original Draft Preparation: MC and FS; Writing Review and Editing: MC; Visualization: FS; All authors, MC, FS, and AS, have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

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