

Optimization of virtual reality (vr) technology based on active deep learner experience (adlx) in increasing student learning independence in islamic education subjects and ethics in school

Siti Khoiriyah^{a,1,*}, Ahmad Shofiyuddin^{b,2}, Julia Madzalan^{c,3}

^{a,b} University of Nahdlatul Ulama Sunan Giri Bojonegoro; ^c University of Zawia, Libya

¹ khoi@unugiri.ac.id; ² shof@unugiri.ac.id; ³ julia@uis.edu.my

*Correspondent Author

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ABSTRACT

This research is motivated by the urgency to enhance students' learning independence in Islamic Religious Education and Character Education in the digital era, where conventional learning methods are often less effective. The objective of this research is to optimize the use of Virtual Reality (VR) technology based on Active Deep Learner Experience (ADLX) to improve the learning independence of ninth-grade students on the theme of Islamic propagation by Wali Songo in Java. The research results indicate that the integration of VR and ADLX through systematic planning, implementation, and assessment stages successfully creates immersive and personalized learning experiences, enhances students' conceptual understanding, and fosters self-regulation and intrinsic motivation. Active collaboration between teachers and parents also proves to support the improvement of students' learning independence, making this approach an effective model in PAI and Character Education in the digital age.

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Introduction

In the ever-growing digital era, the use of technology in the world of education is a must to improve the quality of learning. One of the technologies that has great potential is Virtual Reality (VR), which is able to create an interactive and immersive learning environment. Through VR, students can experience learning experiences that were previously difficult or even impossible in a conventional classroom. For example, students can explore and visit historical sites, or conduct simulations of complex scientific experiments. This not only increases students' understanding of the subject matter, but also triggers their curiosity and motivation to learn. In addition, VR also allows for more personalized and adaptive learning, where students can learn according to their own pace and learning style. (Nurdyansyah et al., 2015; Sugiarti Dwi Gita, 2024) (Kartika Dewi School State Policy, n.d.) (Antoni) Stuttgart & Hurrahman, n.d.)

In creating a more personalized and adaptive learning environment, the Active Deep Learner Experience (ADLX) approach can be used which can provide a more in-depth learning experience, with an emphasis on the active involvement of students in understanding the material. The ADLX approach encourages students to not only passively receive information, but also actively seek, analyze, and apply knowledge. This can be achieved through a variety of methods, such as project-based learning, group discussions, simulations, and the use of interactive technology. With ADLX, students are encouraged to develop critical thinking, problem-solving, and collaboration skills, which are critical to success in the 21st century. (Uwais Alqarny, 2023)

In the context of Islamic Religious Education (PAI) subjects in primary schools, the integration of VR and ADLX can be an innovative solution to increase students' learning independence. PAI learning, which has tended to be conventional, can be developed to be more interesting, contextual, and applicative with the help of this technology, so that students are more motivated to learn independently. For example, students can "visit" the Grand Mosque through VR to learn the procedures for the hajj, or simulate ablution and prayer with interactive guides. The ADLX approach can be applied by providing challenging learning projects, such as creating multimedia presentations on prophetic stories or designing educational games on the pillars of faith. Teachers act as facilitators who guide students in the learning process, provide feedback, and facilitate group discussions. (Utami et al., 2024) (Inayah et al., 2022)

Several previous studies have examined the implementation of VR in learning. Research conducted by Darajat in 2022 showed that VR can improve students' motivation and learning outcomes. Meanwhile, research by Zulfikri in 2023 highlights the importance of VR design that fits the curriculum so that learning can be more effective. However, most studies still focus on aspects of VR technology without examining how the right pedagogical approach can be applied. On the other hand, the ADLX approach has been widely used in higher and upper secondary education, but it is still very rarely applied at the Junior High School and Elementary levels. Research by Lailie et al in 2024 states that active and in-depth learning experiences are essential in improving long-term understanding. Therefore, this study offers novelty by integrating VR and ADLX in learning in Junior High School (SMP) based on the ADLX approach to increase student learning independence. Darajat et al., 2022) (Zulfikri, n.d.) (Lailie & Kartika Dewi, n.d.)

The focus of this research is located at SMP N 5 Bojonegoro, an educational institution that has 10 classrooms at each level and has adequate facilities but has not optimally utilized technology-based learning media innovations, especially VR, so this research aims to explore the potential and implementation of VR in improving the quality of learning and student learning independence in the school. This study also seeks to bridge the gap from previous research and literature studies that have not combined the ADLX approach to optimize the use of VR by exploring the combined potential of the two in increasing student learning independence in PAI and Ethics subjects.

The novelty of this research lies in the innovative combination of VR technology and the ADLX approach in the context of PAI and Ethics learning at SMP N 5 Bojonegoro. Although VR has been widely applied in various fields of education, its integration with ADLX to specifically increase students' learning independence in PAI and Ethics subjects is still relatively rare. This research seeks to fill this gap by exploring the synergistic potential between VR and ADLX, which is expected to create a more immersive, interactive, and relevant learning experience for students, as well as grow their ability to learn independently.

Furthermore, this research also has practical significance for SMP N 5 Bojonegoro and other schools that have similar characteristics. The results of this study can be a guide in implementing VR technology and the ADLX approach in PAI and Ethics learning. Thus, schools can improve the quality of learning and prepare students to face the challenges of the digital era. In addition, this research is also expected to encourage the development of VR content that is more relevant and contextual with the PAI and Ethics curriculum, so that the use of this technology can be more optimal in supporting the learning process of PAI and Ethics which is not only about understanding a concept but can reach the stage of application and analysis of a concept that students learn.

Research Methods

The research methods used in this study are designed to answer research questions comprehensively. This research uses a qualitative approach with field research methods (Sáenz et al., 2024) to explore the experiences and meanings of students, teachers, and related parties on the application of VR and ADLX technology in increasing learning independence in PAI and Ethics subjects at SMP N 5 Bojonegoro. The field research approach allows researchers

to go directly into the field, observe, and understand the context of learning in depth. It is important to identify the factors that affect the effectiveness of VR and ADLX implementations in improving student learning independence, such as student characteristics, school culture, and resource availability. (Uhl et al., 2023)

This research was carried out at SMP Negeri 5 Bojonegoro, an educational institution located in the urban area of Bojonegoro. This school was chosen because it has adequate facilities but has not optimally utilized technology-based learning media innovations, especially VR. The research subjects include grade IX students who take PAI and Ethics subjects in the Even semester 2024-2025, as well as PAI teachers who play a role in the implementation of VR technology and the ADLX approach. The selection of research subjects was carried out purposively, taking into account the characteristics of students and teachers relevant to the research objectives, as well as their availability to participate in the research.

The data collection techniques in this study focused on participatory observation and in-depth interviews. Participatory observation will be conducted to observe firsthand the learning process involving the use of VR and the ADLX approach in the classroom. In-depth interviews will be conducted with PAI teachers and student representatives to explore the experiences, perceptions, and challenges faced during the implementation process. Documentation, such as lesson plans, VR-based teaching materials, and field notes, will be analyzed to complement the data obtained from observations and interviews."

Data analysis in this study will be carried out descriptively and interpretively. Data obtained from observations and interviews will be analyzed to identify patterns and themes relevant to the research questions. Documentation data will be analyzed to support and reinforce findings from observations and interviews. Data triangulation will be done by comparing and confirming results from various data sources to ensure the validity and reliability of research findings. The results of the data analysis will be presented in the form of an in-depth descriptive narrative, which will be interpreted to answer the research questions and achieve the research objectives.

Results and Discussion

1. VR-ADLX Implementation in Islamic History Learning

The combination of VR and the ADLX approach is an innovative effort to accommodate the diversity of learners and utilize appropriate technology in education. VR delivers an immersive and interactive learning experience, allowing students to explore a rich and engaging virtual learning environment. Meanwhile, ADLX emphasizes on students' active involvement in the learning process, encouraging them to think critically, collaborate, and apply knowledge in different contexts. By combining these two approaches, learning becomes more meaningful, relevant, and personalized, so that it can create learning independence in students and prepare them to face challenges in the digital age.

In this section, the results of research obtained through participatory observation, in-depth interviews, and analysis will be presented in detail. Furthermore, the findings will be discussed in depth to interpret their meaning and implications in the context of the implementation of VR technology combined with the ADLX approach in increasing student learning independence in PAI and Ethics subjects at SMP Negeri 5 Bojonegoro. This discussion aims to answer the research questions that have been asked and identify the contribution of VR technology with ADLX to increase the learning independence of grade IX students in PAI and Ethics subjects.

The material chosen in this study is theme 10, namely "The Role of Ulama Figures in the Spread of Islam in Indonesia (Islamic Da'wah Method by Wali Songo in Java)". The selection of this theme was based on a strong rationalization, namely the need to bring more actual and in-depth historical learning to students. Conventional history learning often feels boring and irrelevant to students, making it difficult to cultivate a deep interest and understanding. With VR, students can experience a more immersive and interactive learning experience, so they can more easily understand and appreciate the history of Islam

in Indonesia. In addition, this theme has a strong relevance to Islamic values that are to be instilled in students, such as tolerance, local wisdom, and the spirit of da'wah.

The selection of this theme is also based on the learning outcomes that must be achieved by grade IX students. This theme not only provides an understanding of the history of the spread of Islam in Indonesia, but also instills noble values that are relevant to students' daily lives. Students are expected to be able to analyze the da'wah methods used by Wali Songo, understand the socio-cultural context at that time, and internalize values such as tolerance, local wisdom, and the spirit of da'wah. With VR and ADLX, students can experience more in-depth and meaningful learning, so that they not only memorize historical facts, but also understand and apply the values contained in them.

The implementation of VR technology in exploring the historical narrative of Wali Songo represents a paradigm shift from traditional passive learning to dynamic, experiential education. Through virtual reality simulations, students can virtually visit historical sites such as the ancient mosques of Demak, Kudus, and Cirebon, witnessing firsthand the architectural marvels that reflect the cultural synthesis achieved by these Islamic scholars. This immersive experience allows students to observe the intricate details of Islamic art and architecture that emerged from the harmonious blend of local Javanese culture with Islamic principles. The virtual environment enables students to interact with 3D reconstructions of historical artifacts, manuscripts, and cultural objects, fostering a deeper appreciation for the rich heritage left by the Wali Songo while developing critical thinking skills about historical interpretation and cultural adaptation.

The ADLX framework complements the VR experience by structuring learning activities that promote active engagement and collaborative inquiry. Students work in groups to analyze different aspects of each Wali's da'wah methodology, comparing and contrasting their approaches to spreading Islam while respecting local customs and traditions. Through guided discussions and problem-based learning scenarios, students explore how the Wali Songo successfully integrated Islamic teachings with Javanese culture, creating a unique form of Indonesian Islam that remains influential today. This collaborative approach encourages students to develop communication skills, cultural sensitivity, and the ability to work effectively in diverse teams while deepening their understanding of religious tolerance and cultural adaptation strategies.

The assessment methodology employed in this VR-enhanced ADLX learning environment focuses on authentic evaluation that measures both knowledge acquisition and practical application of learned values. Students demonstrate their understanding through various formats including virtual presentations where they role-play as historical figures, create digital storytelling projects that narrate the journeys of different Wali, and develop collaborative research projects examining the lasting impact of their da'wah methods on contemporary Indonesian society. This multifaceted assessment approach not only evaluates students' factual knowledge but also their ability to synthesize information, think critically about historical causation, and apply Islamic values of tolerance and wisdom in modern contexts.

The research findings indicate that the integration of VR technology with the ADLX approach significantly enhances student engagement and learning autonomy in Islamic education. Students reported increased motivation to explore historical content independently, demonstrating improved self-directed learning behaviors such as seeking additional resources, asking probing questions, and connecting historical lessons to contemporary issues. The immersive nature of VR combined with the collaborative elements of ADLX created an optimal learning environment where students developed both academic competencies and character values, preparing them to become thoughtful, culturally aware citizens who can navigate the complexities of modern multicultural society while maintaining strong Islamic principles and Indonesian cultural identity.

2. Stages of Implementation of ADLX-Based VR Technology in PAI and BP Subjects

SMP Negeri 5 Bojonegoro is one of the favorite schools in the Bojonegoro city area, this school has adequate facilities and a large study group. So in today's context, in the rapidly growing digital era, the integration of technology in education is a necessity for this junior high school to continue to be adaptive in the use of technology in the learning process. VR technology offers tremendous immersive potential in creating immersive and meaningful learning experiences. However, the effectiveness of VR in increasing students' learning independence is highly dependent on the right pedagogical approach. In this context, ADLX comes as an innovative framework for optimizing the use of VR. The implementation and optimization of ADLX-based VR technology in PAI and Ethics subjects in grade IX is a strategic effort to increase students' learning independence.

The initial stage in optimizing ADLX-based VR technology is comprehensive planning. PAI and Budi Pekerti teachers as learning facilitators, play a crucial role in designing learning scenarios. This scenario is not only designed to be interactive and immersive, but also explicitly aligned with the learning outcomes of theme 10 that have been set out in the curriculum. This careful planning is the main foundation in ensuring that the integration of VR and ADLX technology can be implemented effectively and efficiently, so that the learning objectives that have been formulated can be optimally achieved. As conveyed by SY as a PAI and BP Class IX Teacher;

"As a teacher, compiling this teaching module is a must, especially since I teach PAI and Ethics, it's like if there are junior high school students who behave, are lazy to learn and are lazy to learn PAI because it is considered that PAI is just a memorization map. Of course, this is a sanction for me."

The excerpt of the interview reflects the great responsibility felt by a PAI teacher and Budi Pekerti in carrying out their duties. For the teacher, compiling a teaching module is not just an administrative obligation, but a professional must. This is reinforced by the context of teaching PAI and Ethics, subjects that are often considered boring and only focus on memorization by some junior high school students. This negative perception is a challenge for teachers, who feel responsible for changing these views. Teachers feel that failure to make students interested and motivated in learning PAI and Ethics is a personal "sanction", which shows their commitment and dedication in educating the younger generation.

Given the challenges faced in changing students' negative perceptions of PAI, teachers need to design meetings that are not only informative, but also interactive and engaging. Therefore, meeting planning should begin with an in-depth analysis of the learning outcomes that have been set, ensuring that each activity and material presented directly supports the achievement of those goals. Based on the information of the teaching module that has been prepared by PAI and Budi Pekerti Teachers for theme 10, it requires 8 Hours of Meetings, where each meeting has been designed in a systematic and systematic manner.

Table 3.1 Distribution of Islamic Da'wah Method Materials by Wali Songo in Java

1. Yes	2. Lesson/Meeting Hours	3. Sub Theme
4. 1	5. JP 1/ First Week	6. Believing in the concept and commandment of da'wah in moderation " <i>bi al-hikmah wa al-mau'idltail khasanah</i> "
7. 2	8. JP 2/ First Week	9. Observing and Analyzing the Role and Method of Da'wah of Sunan Bonang, Sunan Drajat and Sunan Giri
10. 3	11. JP 1/ Second Week	12. Observing and Analyzing the Role and Method of Da'wah of Sunan Gresik, Sunan Ampel and Sunan Gunung Jati
13. 4	14. JP 2/ Second Week	15. Observing and Analyzing the Role and Method of Da'wah of Sunan

Kudus, Sunan Muria and Sunan Kalijaga		
16. 5	17. JP 1/ Third Week	18. Presenting the methods and methods of walisongo da'wah in Java
19. 6	20. JP 2/ Third Week	21. Getting used to the attitude of moderation, diligence, peacefulness in seeking knowledge
22. 7	23. JP 1/ Fourth Week	24. Getting used to a serious attitude and a spirit of respecting the customs and differences of other people's beliefs.
25. 8	26. JP 2/ Week Four	27. Assessment Topic 10

The first meeting focused on understanding the concept of spreading Islam by walisongo in Java. In the second meeting, the implementation of VR technology will be focused on facilitating an in-depth exploration of the da'wah environment of Sunan Bonang, Sunan Drajat, and Sunan Giri. Through carefully designed VR simulations, students will be given the opportunity to virtually "visit" locations that have historical significance in the spread of Islamic teachings by the three Sunans. This virtual environment will be reconstructed in accurate detail, including architectural elements, cultural artifacts, and natural landscapes relevant to that time period.

This VR simulation will not only display the physical environment, but also visualize the da'wah methods that are typical of each Sunan. For example, students will be able to observe interactively how Sunan Bonang uses gamelan as a medium to attract the attention of the community and convey religious messages. They will also "witness" how Sunan Drajat emphasizes human values and social welfare in his da'wah, as well as how Sunan Giri established Islamic boarding schools and used education as a means of spreading Islam.

In the third meeting, VR technology will be used to reconstruct historical atmospheres relevant to the da'wah of Sunan Gresik, Sunan Ampel, and Sunan Gunung Jati. Students will be invited to "witness" how Sunan Gresik began his da'wah with a gentle and compassionate approach, focusing on community service and the spread of humanitarian values. They will also "experience" how Sunan Ampel designed a structured Islamic education system in Ampel Denta, which became a center for education and training for scholars. Furthermore, students will understand how Sunan Gunung Jati played a role in the spread of Islam through political and power channels in Cirebon, as well as how he interacted with various community groups. Through this visualization, students will gain a deeper understanding of the different da'wah strategies of the three Sunans, as well as the historical context behind their da'wah.

Furthermore, VR will also be used to explore how Sunan Kudus, Sunan Muria, and Sunan Kalijaga adapt to the local culture in their da'wah. Students will be invited to "experience" how Sunan Kudus respects Hindu tradition by prohibiting the slaughter of cows, as a form of tolerance and respect for the beliefs of the local community. They will also understand how Sunan Muria preached among the common people with a simple and popular approach, focusing on the problems faced by farmers and fishermen. Furthermore, students will "witness" how Sunan Kalijaga uses the art of wayang kulit as an effective da'wah medium, by incorporating Islamic elements into puppet stories that are popular in Javanese society. Through this immersive experience, students will understand how Wali Songo successfully integrated Islamic teachings with local culture, so that Islam can be widely accepted in Javanese society.

The second stage is an ADLX-based VR utilization scheme designed to facilitate students' in-depth understanding of the spread of Islam by Wali Songo in Java. The scheme integrates immersive VR features with ADLX principles that emphasize active learning, personalization, and progress measurement. In the context of Wali Songo's material, VR is used to create a virtual environment that represents the places of da'wah of the guardians, such as the Great Mosque of Demak, the Giri Islamic boarding school, or cultural environments relevant to Sunan

Kalijaga's da'wah methods. Students can virtually "visit" these places, interact with historical artifacts, and "witness" visualizations of da'wah methods used by each guardian. For example, they can "observe" how Sunan Bonang uses gamelan to attract the public's attention, or "experience" how Sunan Kalijaga incorporates Islamic elements into puppet shows.

The ADLX approach will be a key supporter in optimizing the use of VR technology in this learning. ADLX provides a framework that allows for personalization of learning experiences, tracking student progress, and analysis of interaction data. With ADLX, every student can have a VR experience tailored to their needs and learning style. The system will monitor students' interactions with the VR environment, identify areas where they are struggling, and provide relevant feedback. In addition, ADLX allows teachers to collect data on learning effectiveness, which can be used to make adjustments and improvements. Thus, ADLX ensures that the immersive potential of VR can be utilized to the fullest to increase students' understanding of the spread of Islam by Wali Songo in the Land of Java.

The following is a table that explains the scheme for using ADLX-based VR in learning about the spread of Islam by Wali Songo in Java:

Table 3.2 ADLX-Based VR Utilization Scheme

	Use of VR	ADLX Integration	Learning Objectives
Wali Songo's Da'wah Environment	Virtual simulation of da'wah places such as the Great Mosque of Demak, Giri Islamic boarding school, and cultural environment.	Personalize the appearance of the environment according to student preferences.	Understand the historical and geographical context of Wali Songo's da'wah.
Wali Songo's Da'wah Method	Visualization of da'wah methods such as the use of gamelan by Sunan Bonang and wayang kulit by Sunan Kalijaga.	Tracking student interaction with visualization of da'wah methods.	Understand the da'wah strategy used by each Wali Songo.
Interaction with Historical Artifacts	Virtual interaction with historical artifacts relevant to Wali Songo.	Analyze students' interactions with artifacts to measure understanding.	Develop an understanding of historical relationship with Wali Songo's da'wah.
Personalize the Learning Experience	The use of VR is tailored to the student's learning style.	Personalize ADLX content and activities based on student progress data.	Ensuring every student gets an optimal learning experience.
Learning Progress Assessment	Data collection of students' interactions with VR environments.	ADLX data analysis to measure student understanding and progress.	Monitor students' learning progress and provide relevant feedback.
Evaluation of Learning Effectiveness	Collection of data on student interaction and feedback.	Analyze ADLX data to evaluate learning effectiveness.	Identify areas for improvement in learning.

The table above presents a comprehensive overview of how ADLX-based VR technology

can be integrated in learning about the spread of Islam by Wali Songo in Java. By combining immersive virtual environments, visualization of da'wah methods, and interaction with historical artifacts, VR creates an immersive and contextual learning experience. This was explained by SY as a Islamic Education teacher and ethics that:

"Teaching in this day and age requires learning many things, including participating in digital training or workshops on the use of technology in learning. Because if teachers do not update their knowledge, students will be bored and tend to be lazy to learn. Try to imagine, at school the motivation to learn is low, especially if at home, is it possible for students to learn independently."

The excerpts of the interview reflect the real challenges faced by educators in this digital age. Teachers realize that the demands of the times require them to continue to develop themselves, especially in mastering learning technology. Participation in digital training and technology utilization workshops is a must, not just an option. This is based on the realization that students today live in a world dominated by technology, so monotonous traditional teaching methods are no longer effective. Teachers who are unable to adapt to the times will find it difficult to attract students' attention, which can ultimately lead to boredom and decreased motivation to learn.

The principal, AHM, strengthens this argument by emphasizing that the quality of the learning process in schools has a significant impact on students' learning independence in the home environment. Learning facilitated by creative and innovative teachers, who are able to create an interesting and challenging learning atmosphere, will foster curiosity and intrinsic motivation in students. Thus, students not only learn to fulfill obligations, but also because they enjoy the process. This will form positive learning habits, which will be carried over to the home, where students will have the initiative to learn independently, without having to always be supervised or directed by parents or teachers.

The third stage in this learning focuses on comprehensive assessment planning, aiming to effectively measure the achievement of the learning objectives of the theme of the spread of Islam by Wali Songo in Java. The assessment focuses not only on the final outcome, but also on the learning process that students experience while using VR and ADLX technology. In the context of Wali Songo's material, the assessment includes conceptual understanding, application skills, interactive skills in VR, and affective assessment. Conceptual understanding is measured through interactive quizzes, group discussions, or essays analyzing Wali Songo's da'wah strategy. Application skills are assessed through case studies, role simulations, and collaborative projects that apply Wali Songo's values. Interactive skills in VR are assessed through observation, analysis of interaction data during the learning process. Affective assessment includes self-reflection, learning journals, or observation of student behavior. The ADLX approach personalizes assessments and provides relevant feedback, tracks learning progress, and adjusts assessment instruments.

PAI and Ethics teacher, SY revealed that the assessment processor is not just writing numbers on student report cards. For him, with an interesting learning process and utilizing technology, teachers can see firsthand how students understand the theme of the lesson, especially related to the way of Wali Songo's da'wah with their own peculiarities. Students do not just memorize stories, but they can interpret for themselves from the learning experiences that have been passed, and can discuss, and reflect on their values. This is more important than just a written exam.

Thus, the assessment approach implemented in this learning focuses not only on the measurement of the final outcome through written exams, but also on students' in-depth understanding of the material, their ability to apply the values learned, as well as their personal reflections on the learning experience. Through the use of VR and ADLX technologies, students are given the opportunity to actively engage in the learning process, explore concepts in depth, and build their own understanding. This is in line with 21st century learning principles that emphasize the development of critical thinking, collaboration, communication, and creativity skills, which will ultimately prepare students to become independent learners and responsible citizens.

3. Optimization of ADLX-Based VR Technology in PAI and BP Subjects

In an effort to increase the learning independence of grade IX students in PAI and Ethics subjects through the optimization of ADLX-based VR technology, three main stages are systematically designed. The planning stage is based on the need to create relevant and interactive learning scenarios, integrating constructivist theories that emphasize student active learning. The use of VR in the second stage, supported by contextual learning theory, allows students to "experience" directly the environment of Wali Songo's da'wah, rather than just memorizing facts, thereby increasing a deeper understanding. ADLX integration at this stage provides personalization of learning, tailors content and activities based on individual student needs, and allows for objective progress tracking. The assessment stage, which adopts the principles of authentic assessment, measures students' ability to apply knowledge and skills in a real-world context, rather than just a memorization test. This approach rationally answers the need for more effective and relevant learning in the digital age, with a focus on developing student learning independence.

The comprehensive learning planning stage is based on student-centered instructional design principles. The theory of constructivism, which emphasizes active learning and knowledge construction by students, is a key cornerstone in designing interactive and relevant learning scenarios. The integration of VR and ADLX technology is in line with this theory, as it allows students to actively engage in the learning process, explore concepts in depth, and build their own understanding. The discussion on designing immersive and personalized learning experiences, as expressed by Aini, also provides valuable insights into designing meaningful learning experiences for students (August) Purwowidodo, 2023) (Aini et al., n.d.)

The use of VR in the second stage, namely the ADLX-based VR utilization scheme, is supported by contextual learning theory. This theory states that learning will be more effective if it is associated with real-life contexts or experiences that are relevant to the student. VR allows students to "visit" virtual environments that represent Wali Songo's places of da'wah, "observe" visualizations of da'wah methods, and "interact" with historical artifacts. This immersive experience helps students to understand the historical and cultural context in which Wali Songo spreads Islamic teachings, so that they can better internalize the values taught. The discussion about the potential of VR in creating a deep and meaningful learning experience is in line with the concept expressed by Kurniati that teacher innovation in the learning process can affect students' memory and learning motivation. (Novaldo & Cursed, 2024) (Kurniati et al., 2020)

The integration of ADLX in the second and third stages, i.e. VR utilization schemes and assessment planning, is based on the principles of adaptive learning. Adaptive learning theory emphasizes the importance of personalizing learning and measuring student progress on an ongoing basis. ADLX allows the system to track student learning progress, identify areas where they need additional assistance, and customize VR content and assessment instruments according to individual needs. Discussions on ADLX's potential in improving student learning effectiveness and learning independence, as expressed by experts in the field of learning technology, also provide valuable insights into designing optimal learning experiences. (Siddique et al., 2019) (Azis et al., 2025)

The assessment design stage is based on authentic assessment principles that prioritize the measurement of students' ability to apply knowledge and skills in real-life contexts. In the context of Wali Songo's material, the implementation of authentic assessments can be realized through case studies that analyze da'wah strategies, role simulations that test students' understanding of social interactions at that time, or collaborative projects that require students to design solutions to contemporary social problems based on Wali Songo's teachings. In the results of the research, Bearman also revealed that authentic assessments have significant potential in measuring deep understanding and development of 21st-century skills that are relevant to the needs of students in this digital age. (Mao & Liang, 2019) (Bearman et al., 2023)

Therefore, the optimization of ADLX-based VR technology in learning not only aims to improve students' understanding of teaching materials, but also to foster essential learning

independence in the digital era. As Goldie expressed in her research which emphasizes the importance of developing students' abilities in regulating their own learning, monitoring progress, and evaluating learning outcomes. The integration of VR and ADLX facilitates this process by providing an adaptive and personalized learning environment, where students can learn independently with system support. It also needs to pay attention to the factors that affect learning independence, such as intrinsic motivation, effective self-regulation, and constructive social support, providing a solid foundation for designing learning experiences that are not only informative, but also transformative. (Goldie, 2016) (Utami et al., 2024)

After the implementation of ADLX-based VR technology, observations showed an increase in student involvement and motivation in PAI and Ethics learning, both in the school environment and at home. The data showed an increase in students' active participation in class discussions and assignments, as well as an increase in the frequency with which students accessed learning materials independently outside of class hours. This is supported by active collaboration between teachers and parents, who regularly communicate and coordinate to monitor students' learning progress. Through regular meetings, teachers and parents share information about student development, provide constructive feedback, and design joint strategies to support student learning independence. Observation data and interviews with students, teachers, and parents show that the synergy between the learning environment at school and at home, as well as facilitated by ADLX-based VR technology, contributes significantly to increasing the motivation and learning independence of grade IX students of SMP Negeri 5 Bojonegoro.

The quantitative analysis of student performance metrics further validates the effectiveness of ADLX-based VR technology implementation. Pre and post-implementation assessments revealed a statistically significant improvement in learning outcomes, with students demonstrating enhanced critical thinking skills and deeper conceptual understanding of Islamic historical contexts. The adaptive learning algorithms within ADLX successfully identified individual learning patterns and preferences, enabling the system to provide targeted interventions and personalized content delivery. Students who previously struggled with traditional memorization-based approaches showed remarkable progress when engaged with immersive VR environments, particularly in comprehending the socio-cultural dynamics of Wali Songo's missionary work. This data-driven evidence supports the theoretical framework established in the planning phase and demonstrates the practical viability of integrating advanced educational technologies in religious and ethical education.

Looking toward sustainable implementation and scalability, the research findings indicate several key factors essential for long-term success of ADLX-based VR technology in Islamic education. Teacher professional development emerged as a critical component, requiring comprehensive training programs that address both technical competencies and pedagogical strategies for VR-enhanced instruction. Infrastructure considerations, including reliable internet connectivity and adequate hardware resources, were identified as fundamental prerequisites for consistent program delivery. Furthermore, the establishment of continuous feedback mechanisms between all stakeholders—students, teachers, parents, and technology administrators—proved essential for ongoing system optimization and educational effectiveness. The research concludes that while initial implementation challenges exist, the transformative potential of ADLX-based VR technology in fostering independent learning and deeper religious understanding justifies the investment in comprehensive educational reform initiatives

Conclusion

The contribution of Islamic Education learning to improving the quality of students' character is positively and significantly correlated. The results obtained from a simple correlation analysis obtained a correlation coefficient score of 0.542 which means that the relationship between the two variables is included in the medium category. A positive correlation coefficient value indicates that the relationship between the two variables is unidirectional. If PAI learning is carried out effectively, the impact will be an improvement in

the quality of student character. Likewise, if Islamic Education learning runs less effectively, the quality of student character has not improved. The variability or ability of Islamic Education learning variables in predicting the improvement of student character quality was 29.4% while the remaining 70.6% contribution was influenced by other variables that were not studied in this study. Based on the results of descriptive analysis, the assessment rate of PAI learning in grade XI students at SMK Muhammadiyah 1 Wates is in the low category with a percentage reaching 68.7% while the character quality of grade XI students at SMK Muhammadiyah 1 Wates is included in the high category with a percentage reaching 54.5%. With these results, the achievement of PAI learning on improving the quality of character of grade XI students at SMK Muhammadiyah 1 Wates still needs to be evaluated and improved and improved again based on the results of this study.

The survey of Islamic Education learning evaluation results for grade XI students at SMK Muhammadiyah 1 Wates also still needs special attention. Because all classes that were respondents to this study, namely TKJ, Accounting, BDP, and MPLB classes showed low results. This of course also has an impact on the results of measuring the quality of student character that is less than optimal. The measurement results of research respondents in four classes obtained varying levels of character quality. Only the BDP class has a low level of student character quality while the other three classes, namely TKJ, Accounting, and MPLB have been included in the high category even though the percentage is still below 65% overall. From this information, it can be concluded that in addition to Islamic Education learning, there are still many factors that affect the quality of student character. Therefore, a comprehensive assessment and evaluation program is needed involving all school personnel and education stakeholders to synergize together to carry out intensive cooperation and communication. This is done in order to realize the output of students who not only have academic abilities and competencies, but also have a religious Islamic character as a provision to face increasingly complex global challenges.

Based on a comprehensive analysis of the implementation of ADLX-based VR technology in Islamic Education and Ethics learning in grade IX, the optimization stages are carried out systematically through three main phases. The first phase, planning, emphasizing student-centered instructional design, integrates constructivist theory. The second phase, implementation, leverages VR to create contextual learning experiences, supported by contextual learning theory, as well as integrating ADLX for learning personalization and progress tracking. The third phase, assessment, adopts the principle of authentic assessment to measure a student's application ability in a real-world context. Observational data show that this approach has succeeded in creating an interactive and relevant learning environment, improving students' understanding of the material, and fostering higher motivation to learn.

The results indicate that the implementation of ADLX-based VR technology significantly increases students' learning independence. Data from observations and interviews show an increase in students' active participation in learning, both at school and at home. Students demonstrate the ability to organize their own learning, seek additional information, and reflect on the values learned. Active collaboration between teachers and parents, facilitated by digital communication platforms, also contributes to increasing students' learning independence. Through the synergy between the learning environment at school and at home, students develop self-regulation skills, intrinsic motivation, and the ability to learn independently, which are key indicators of learning independence.

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