

Needs Analysis of Augmented Reality-Based Learning Media to Support Understanding of *Wudu* Movements among Students with Intellectual Disabilities

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Abstract: Understanding procedural worship practices such as *wudu* remains a significant challenge for students with intellectual disabilities due to limitations in memory retention, sequential processing, and abstract comprehension. This study aims to analyze the need for Augmented Reality (AR)-based learning media to support students' understanding of *wudu* movements in special education settings. A mixed-methods exploratory sequential design was employed involving classroom observations, semi-structured interviews, and questionnaire surveys. The participants consisted of 12 students with intellectual disabilities, 3 Islamic education teachers, and 12 parents at SLBN Pinang Merah selected through purposive sampling. The findings indicate that existing instructional practices relying on demonstrations and static visual media have not adequately supported students' procedural understanding and independent learning. Both qualitative and quantitative results reveal strong demand for interactive, visually structured, and repeatable learning media integrating three-dimensional visualization and simplified instructional guidance. Teachers demonstrated positive readiness toward AR integration, although considerations related to student cognitive diversity and technological accessibility remain important. These findings highlight the importance of user-centered needs analysis as a foundational stage in developing adaptive AR learning media tailored to religious instruction for students with intellectual disabilities. Future studies are recommended to develop and empirically evaluate AR prototypes in real classroom implementation.

Keywords: augmented reality; intellectual disability; Islamic religious education; learning media; inclusive education

INTRODUCTION

Inclusive education is a crucial pillar in realizing educational equity for all citizens, including individuals with disabilities (Michopoulou, 2025; Farizan et al., 2025). In the Indonesian context, the implementation of inclusive education continues to evolve in line with the government's commitment to expanding access to education for students with special needs through various national regulations and policies (Phytanza et al., 2022). Data from (Bodrogini et al., 2021) indicates that, as of 2022, more than 140,000 students with disabilities were enrolled in special schools (SLB), including those with intellectual disabilities (Bruce, 2023). However, the limited availability of learning media that align with the cognitive and affective characteristics of these students remains a major challenge, especially in religious education, which demands both conceptual and practical understanding (Hilman, 2025; Padang et al., 2024).

One essential component of Islamic religious education is the practice of *wudu* (ablution), which is not only ritualistic in nature but also holds deep spiritual and symbolic meaning (Futaqi & Yenuri, 2023). Students with intellectual disabilities often struggle to comprehend the sequential and applicable steps of *wudu* due to limitations in memory, abstract reasoning, and their reliance on concrete visual stimuli (Mirnawati et al., 2021). Conventional learning media such as static images and verbal explanations from teachers are frequently ineffective in bridging these comprehension gaps (Sari et al., 2025). As a result, the learning process becomes less meaningful and fails to facilitate the internalization of religious values optimally (Anwar, 2017; Iswati, 2025).

Advancements in educational technology offer new opportunities to design innovative learning media that are more adaptive to the needs of students with disabilities (Ayeni et al., 2024; Inayah & Prasetyo, 2025). One emerging technology with promising applications in education is Augmented Reality (AR) (Al-Ansi et al., 2023; Asif et al., 2024). AR enables the integration of digital objects into the real world, thereby creating a more interactive and immersive learning experience (Al-gindy et al., 2020). Nonetheless, the application of AR in Islamic religious education for students with intellectual disabilities remains highly limited, particularly concerning practical worship topics such as *wudu* (Ibáñez & Delgado-Kloos, 2018).

Previous studies have demonstrated that Augmented Reality (AR) technology improves student engagement and conceptual understanding across various educational domains, including science learning, language instruction, and inclusive education environments (Westin et al., 2022; Jacob et al., 2026). However, most AR implementations primarily involve general education learners or students with sensory impairments such as hearing loss (Zheng et al., 2024). These studies emphasize technological effectiveness rather than examining how AR design accommodates the cognitive characteristics of students with intellectual disabilities, particularly in procedural learning contexts (Park, 2021; Damri et al., 2023).

Despite the increasing adoption of AR technology in education, limited studies have conducted systematic needs analysis prior to media development for students with intellectual disabilities. Existing research commonly evaluates completed AR products rather than identifying learner needs, instructional barriers, and contextual challenges within special education environments. Moreover, research integrating assistive technology into Islamic religious procedural learning remains scarce, creating a gap between technological innovation and authentic instructional needs in special schools.

This issue is further underscored by on-the-ground challenges, where teachers in special schools often have to create media manually with limited resources (Chourasia et al., 2026; Mittal et al., 2024). Meanwhile, students with intellectual disabilities require visual aids that not only convey information but also provide interactive feedback and multisensory engagement (Ameran & Zainal, 2024). This underscores the urgent need to develop learning tools that serve not only as instructional aids but also as bridges for students' spiritual understanding in meaningful religious contexts (Dzihab et al., 2025).

This study offers novelty by positioning needs analysis as a foundational stage for designing Augmented Reality-based learning media specifically tailored to students with intellectual disabilities in religious learning contexts. Unlike previous studies that focus on evaluating AR effectiveness after implementation, this research integrates cognitive characteristics, instructional challenges, and cultural religious learning contexts into a mixed-methods needs assessment framework. Therefore, this study aims to analyze the need for AR-based learning media to support students' understanding of *wudu* movements among students with intellectual disabilities at SLBN Pinang Merah.

METHOD

This study employed a mixed methods approach using an exploratory sequential design (Kusumastuti et al., 2025), which integrates qualitative and quantitative methods in a sequential manner to obtain both an in-depth understanding and structured measurement of the learning media needs based on Augmented Reality (AR) for students with intellectual disabilities. This approach was selected for its capacity to accommodate the exploration of complex phenomena while systematically verifying initial findings through quantitative data (Creswell & Clark, 2017). The qualitative phase was used to explore the perspectives of

teachers, students, and parents regarding their experiences in *wudu* instruction, while the quantitative phase was applied to measure their perceptions and needs related to innovative AR-based learning media. The exploratory sequential design was selected to ensure that qualitative findings informed quantitative measurement in identifying authentic instructional needs prior to media development.

The participants of this study consisted of 12 students with mild to moderate intellectual disabilities, 3 Islamic education teachers, and 12 parents at SLBN Pinang Merah. Participants were selected using purposive sampling to ensure that respondents possessed direct experience related to *wudu* instruction. Grade V students were intentionally selected because *wudu* learning is formally introduced and practiced consistently at this level within the special education Islamic curriculum, allowing students to demonstrate prior exposure to procedural worship learning. Teachers involved in the study were responsible for delivering Islamic religious instruction, while parents participated to provide complementary perspectives regarding students' learning needs at home.

Ethical approval for this study was obtained from the institutional research ethics committee of Universitas Negeri Padang. Prior to data collection, informed consent was obtained from teachers and parents, while student participation was conducted with parental permission and teacher supervision. All procedures ensured voluntary participation, confidentiality of responses, and protection of students with intellectual disabilities throughout the research process.

Data were collected using three primary techniques: direct observation, in-depth interviews, and questionnaires (Sugiyono & Lestari, 2021). Observations were conducted during *wudu* learning sessions in the classroom, focusing on procedural accuracy, movement comprehension, and student engagement. The observation instrument was developed based on indicators from the special education Islamic curriculum. Semi-structured interviews were conducted with teachers and parents to explore their perceptions of media needs. Meanwhile, a Likert-scale questionnaire (1–4) was employed to measure perceptions regarding the availability, effectiveness, and demand for AR media. The content validity of the questionnaire was reviewed by experts in special education and educational technology before distribution. The questionnaire instrument demonstrated acceptable internal consistency with a Cronbach's Alpha coefficient of 0.87, indicating high reliability for measuring participants' perceptions regarding AR-based learning media needs.

Qualitative data were analyzed through thematic analysis involving data familiarization, coding, categorization, and theme development. The coding process was conducted independently by two researchers to ensure analytical consistency. Intercoder reliability was calculated using percentage agreement, achieving a consistency level of 85%, indicating reliable qualitative interpretation (Tashakkori et al., 2020). Quantitative data were analyzed descriptively using mean scores and standard deviation to represent variations in participant responses. Integration of qualitative and quantitative findings was conducted during the interpretation phase to strengthen mixed-methods triangulation.

FINDING AND DISCUSSION

Finding(s)

This The qualitative data analysis using NVivo revealed that *wudu* instruction in special education schools (SLB) remains predominantly reliant on conventional media, such as live demonstrations and 2D posters. These methods are insufficient for meeting the needs of students with intellectual disabilities, who often struggle to comprehend verbal instructions and retain the sequential steps of *wudu*. Teachers reported that students tend to

become easily bored and face challenges in engaging with lecture-based or one-way explanations. These findings indicate that procedural religious instruction requires learning support that extends beyond verbal explanation, emphasizing structured visualization and repeated practice to accommodate students' cognitive processing limitations.

Through the coding process in NVivo, several key themes emerged, including students' cognitive barriers in understanding the sequence of *wudu* movements, their dependence on teacher guidance, and the need for media that can be accessed independently. The students' dominant learning styles visual and kinesthetic underscore the importance of employing simulation-based, visual, and interactive media. Additionally, teachers reported difficulties in conducting individual assessments due to time constraints and the limited availability of supporting instructional tools. Teachers further reported that students with varying levels of cognitive functioning demonstrated different levels of dependence during *wudu* practice, indicating that instructional media must accommodate diverse learning speeds and levels of independence within the same classroom environment.

Students expressed high interest in technology-based media, such as videos and applications on smartphones or tablets. They showed greater enthusiasm and focus when presented with animations or other dynamic visual formats. Interviews also revealed a desire for independent learning, provided that the media are engaging, user-friendly, and allow for repeated use. This qualitative tendency toward technology preference corresponds with questionnaire results indicating high agreement on the need for interactive and repeatable learning media, demonstrating convergence between student experiences and teacher perceptions.

Quantitative data from teacher questionnaires, analyzed using SPSS, supported the qualitative findings. The item "interactive media that can be repeated" received a high mean score of 3.67, indicating strong demand for flexible learning features. The item addressing the alignment of content with the curriculum received the highest possible mean score (4.00), signifying that media development must integrate competency standards appropriate for special education.

Support for AR-based media development was further evidenced by teachers' willingness to participate in training (mean = 3.67), the perceived accessibility of AR via smartphones (mean = 2.67), and their confidence in guiding students in using AR (mean = 3.00). Conversely, concerns over student distraction (mean = 2.00) and internet connectivity issues (mean = 2.00) were relatively low. These findings suggest that offline and simplified implementation of AR in SLB contexts is both feasible and likely to face minimal barriers.

Table 1. Teachers' Perceptions of AR-Based *Wudu* Learning Media Needs

Dimension	Indicator	Mean	SD	Interpretation
Learning Media Need	Interactive repeatable media	3.67	0.577	Very High
Content Relevance	Curriculum alignment	4.00	0.000	Essential
Visualization Support	3D visual requirement	3.00	0.000	High
Technology Readiness	Teacher confidence using AR	3.00	0.000	Moderate-High
Accessibility	Device accessibility in school	2.67	0.577	Moderate
Training Readiness	Willingness to attend AR training	3.67	0.577	Very High
Implementation Concern	Student distraction risk	2.00	0.000	Low
Infrastructure Constraint	Internet limitation	2.00	0.000	Low

The descriptive statistical analysis demonstrates that teachers expressed a very high need for interactive and repeatable learning media ($M = 3.67$, $SD = 0.577$), indicating limitations of current instructional approaches in supporting procedural understanding among students with intellectual disabilities. Curriculum alignment obtained the highest possible score ($M = 4.00$), emphasizing that religious learning media must remain consistent with special education instructional standards.

Moderate variation in responses related to technological accessibility ($SD = 0.577$) suggests differences in institutional readiness, while low concern regarding distraction and internet limitations indicates that pedagogical benefits are perceived to outweigh technological barriers. These quantitative findings reinforce qualitative evidence highlighting the necessity of structured, visual, and independently accessible AR-based learning media.

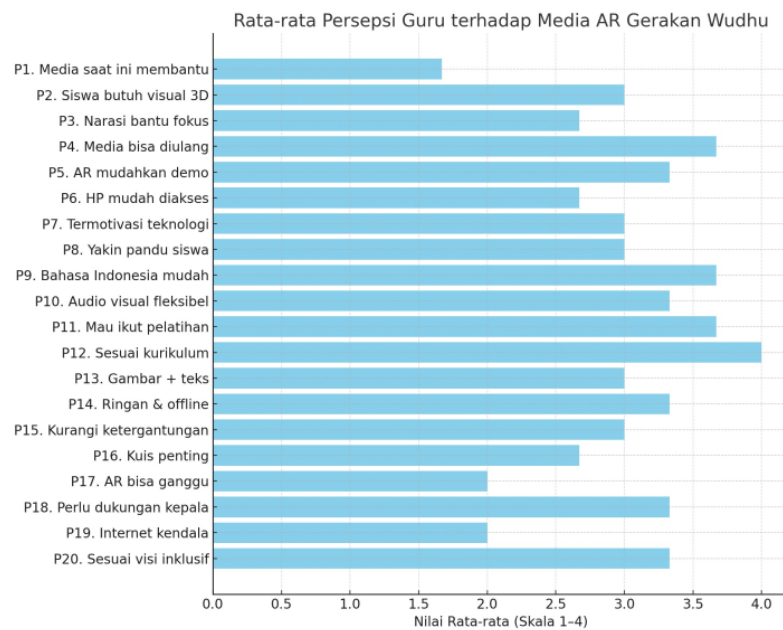


Figure 1. Teachers' Average Perceptions of AR-Based *Wudu* Instructional Media (Scale 1-4)

The graphical representation demonstrates that pedagogical relevance and interactivity were perceived as the most critical components of AR-based learning media. Conversely, technological concerns such as internet dependency received lower scores, suggesting that pedagogical suitability outweighs technical barriers in determining adoption readiness within SLB environments.

Overall, the integration of qualitative and quantitative findings demonstrates strong convergence between observed classroom challenges, stakeholder perceptions, and measured instructional needs. While qualitative data highlight students' dependence on guided demonstrations, quantitative results confirm teachers' demand for interactive and repeatable media. This convergence strengthens the validity of AR-based learning media as a contextually relevant solution for procedural religious instruction among students with intellectual disabilities.

Discussion(s)

The findings of this study reveal a significant gap between the learning needs of students with intellectual disabilities and the teaching methods and media currently employed in *wudu* instruction. Traditional approaches such as lectures and direct demonstrations appear to be insufficient in helping students grasp the procedural aspects of religious rituals. These results support Mayer's (2022) assertion that learning becomes more effective when information is presented visually and processed through multimodal channels. This finding suggests that procedural religious learning requires instructional mediation that accommodates cognitive processing limitations rather than relying solely on imitation-based teaching practices.

Data analysis also indicates that teachers face limitations in conducting individualized assessments and providing media that students can use independently. This opens up considerable opportunities for the integration of Augmented Reality (AR) technology, which offers flexible, interactive, and easily accessible solutions via simple devices. These findings align with the work of Kokkinidis & Folina (2024), who emphasize that AR enhances learning motivation and improves the understanding of procedural concepts among students with special needs. However, the integration of AR technology should not be interpreted as a replacement for teacher-guided instruction. Students with intellectual disabilities may still require scaffolding, repetition, and direct assistance to ensure correct understanding of worship procedures.

Teachers' positive perceptions of AR-based media are evident in the high average scores on aspects such as willingness to participate in training, confidence in guiding students, and alignment of AR content with the curriculum. This indicates a relatively high level of readiness for technology integration within the SLB (special school) context, provided that the tools are user-friendly and accompanied by appropriate support. Teachers view AR not merely as a supplementary aid, but as a strategic component in fostering student autonomy in learning.

In the context of Islamic religious instruction, learning *wudu* involves not only motor sequences but also spiritual intention and behavioral discipline. Therefore, technological media must function as instructional support rather than substituting the experiential and value-based aspects of worship learning. Cultural sensitivity and religious appropriateness remain essential considerations when integrating emerging technologies into faith-based education.

Furthermore, the low levels of concern regarding digital distraction and internet limitations suggest that technical barriers are not the primary issue. Therefore, developing lightweight AR media that can be accessed offline presents an ideal solution. A combination of features such as 3D visualization, simplified narration, and interactive assessments (e.g., quizzes) can enhance media effectiveness while promoting active student engagement in the learning process.

Despite its potential benefits, several implementation challenges must be considered within special education settings. Variations in students' cognitive abilities, limited technological infrastructure, and teachers' differing levels of digital competence may influence the effectiveness of AR-based instruction. Without adequate training and gradual adaptation, technology integration may increase instructional complexity rather than reduce learning barriers.

Theoretically, this study reinforces the principles of Cognitive Load Theory and Multimedia Learning, wherein the cognitive burden on students with intellectual disabilities can be reduced through structured, concrete, and repeatable information delivery (Lee & So 2022). The practical implications extend beyond media development, offering a foundation for more adaptive inclusive education policies in response to technological advancement. Future studies are recommended to develop AR prototypes and test them in real classroom settings to obtain more comprehensive data on their effectiveness.

From a theoretical perspective, the findings extend Cognitive Load Theory and Multimedia Learning principles by demonstrating that structured visual interaction may reduce procedural learning difficulties among students with intellectual disabilities in religious contexts. Nevertheless, the effectiveness of AR-based media remains dependent on instructional design quality, contextual adaptation, and teacher facilitation. These findings highlight that technology alone does not guarantee learning improvement but must be integrated within inclusive pedagogical practices.

CONCLUSION

This study identified a substantial need for Augmented Reality (AR)-based learning media to support students with intellectual disabilities in understanding procedural *wudu* movements within special education settings. The integration of qualitative and quantitative findings indicates that current instructional practices relying on demonstrations and static visual aids have not fully accommodated students' cognitive and learning characteristics. Teachers expressed strong demand for interactive, repeatable, and visually structured media aligned with the Islamic education curriculum, highlighting the relevance of AR as a potential instructional support tool rather than a replacement for teacher-guided learning. Nevertheless, this study has several limitations. The research was conducted in a single special school with a relatively small number of participants, which may limit broader generalization of findings. In addition, data were primarily based on participant perceptions and self-reported responses rather than experimental implementation of AR media. Therefore, the findings should be interpreted within the contextual boundaries of needs analysis research. Practically, the results provide an empirical foundation for developing adaptive AR-based religious learning media tailored to students with intellectual disabilities. Educational institutions and policymakers are encouraged to consider teacher training, infrastructure readiness, and culturally appropriate instructional design when integrating emerging technologies into special education environments. Future research is recommended to develop AR prototypes and examine their effectiveness through classroom-based experimental or longitudinal studies.

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