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Game-based summative assessment in islamic education: Development, Validation and effectiveness of a crossword-based instrument

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Abstract

The rapid development of digital technology has encouraged the transformation of assessment practices toward more interactive and student-centered approaches; however, the use of game-based tools as formal summative assessment instruments remains limited, particularly in Islamic education. This study aims to develop, validate, and evaluate a game-based summative assessment instrument for Qur'an Hadith learning using the Crossword Labs platform. The research employed a Research and Development (R&D) design based on the ADDIE model and adopted a mixed-methods approach involving 92 Grade VII students, 3 teachers, and 5 expert validators. The developed instrument, referred to as the Qur'an Hadith Crossword Labs (QHCL), integrates assessment items into a crossword puzzle format to enhance engagement while maintaining measurement rigor. The results indicate that the instrument achieved high content validity, with Aiken's V values ranging from 0.868 to 0.971, and strong reliability, with a Cronbach's Alpha coefficient of 0.804. Furthermore, the effectiveness test showed a high level of performance, with an average effectiveness score of 3.95 (very effective) and students' achievement scores reaching 91.92 and 96.71 in the respective schools. These findings demonstrate that the QHCL instrument is valid, reliable, and effective as a summative assessment tool. In conclusion, this study provides empirical evidence that game-based digital tools can be systematically developed into rigorous and engaging assessment instruments, offering both theoretical contributions to assessment research and practical implications for improving assessment practices in Islamic education.

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INTRODUCTION

The rapid advancement of digital technology has significantly reshaped educational practices, particularly in the domain of assessment. In contemporary learning environments, assessment is no longer perceived merely as a tool for measuring learning outcomes but as an integral component that supports and enhances the learning process itself (Ajjawi et al., 2020; RADHA, 2023; Shepard, 2019). This transformation is closely associated with the demands of 21st-century education, which emphasize student-centered learning, critical thinking, and the integration of technology into instructional design (Dolezal et al., 2021; Mir, 2025). As a result, educators are increasingly encouraged to adopt innovative assessment approaches that are capable of capturing not only cognitive achievement but also students' engagement and motivation. Within this context, digital-based and interactive assessment methods have emerged as promising alternatives to conventional testing practices. However, the transition toward such approaches remains uneven across educational contexts. Therefore, exploring innovative forms of assessment that align with technological advancements has become an important area of educational research.

Despite these developments, traditional assessment formats, such as multiple-choice and essay-based tests, continue to dominate classroom practices in many educational settings. These

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conventional approaches are often criticized for their limited capacity to represent students' comprehensive understanding and for their tendency to create passive learning environments (Amirova, 2025). Empirical observations indicate that students frequently perceive such assessments as monotonous and stressful, which can negatively influence their motivation and performance. This issue becomes particularly evident among adolescent learners, who tend to respond more positively to interactive and engaging learning experiences (Allen et al., 2019; Cockerham et al., 2021). In addition, traditional assessments often prioritize memorization rather than higher-order thinking skills, thereby limiting opportunities for meaningful learning. These challenges highlight a critical mismatch between existing assessment practices and the characteristics of modern learners. Consequently, there is a growing need to redesign assessment methods to better accommodate students' learning preferences and developmental needs.

The urgency of improving assessment practices is further amplified in the context of Islamic education, particularly in subjects such as Qur'an Hadith at the Madrasah Tsanawiyah level. Islamic education is expected to foster not only cognitive understanding but also moral and spiritual development, making assessment a complex and multidimensional process (Mokmin et al., 2025; Pahlevi & Hafidz, 2025). However, in practice, assessment in this field often remains limited to conventional written formats that may not fully capture the holistic nature of learning. Several studies have indicated that such approaches can reduce students' engagement and fail to reflect their true learning potential (Ribeiro et al., 2019). Moreover, the integration of digital technology into Islamic education assessment is still relatively underdeveloped compared to its use in instructional activities (Jamil et al., 2025). This situation creates a gap between the expected outcomes of Islamic education and the methods used to evaluate them. Therefore, the development of innovative and contextually relevant assessment models is urgently needed.

In response to these challenges, game-based learning (GBL) has gained considerable attention as an approach that can enhance student engagement and promote active learning. Game-based environments incorporate elements such as challenges, feedback, and interactivity, which are known to foster motivation and deeper cognitive processing (Liao et al., 2019; Plass et al., 2020a). Recent studies have demonstrated that game-based approaches can improve students' learning outcomes, engagement, and retention across various disciplines (Holbrey, 2020; Tavares, 2022). These findings suggest that game elements can be effectively integrated into educational practices to create more meaningful learning experiences. In addition, the use of digital platforms in game-based learning aligns with the broader trend of technology-enhanced education. However, most applications of GBL remain focused on instructional activities rather than assessment. This indicates that the potential of game-based approaches in assessment contexts has not yet been fully explored.

A growing body of literature has examined the effectiveness of game-based learning and digital tools in education, particularly in enhancing engagement and learning outcomes. Studies by Duncan (2020) and Fonseca et al. (2023) highlight that game-based environments can foster collaboration, creativity, and active participation among students. Similarly, research by (Al-Barakat et al., 2025) emphasizes the role of digital games in promoting cognitive engagement and problem-solving skills. In the context of assessment, several studies have explored alternative formats such as technology-enhanced assessments and formative digital tools (Cooney, 2025; Cusi et al., 2024). These studies consistently report positive impacts on student motivation and learning experiences. Furthermore, recent research has begun to explore the integration of gamification elements into assessment practices, suggesting that such approaches can reduce anxiety and improve performance (Bonefont et al., 2022; Pitoyo et al., 2019). Collectively, these findings indicate that game-based and digital approaches hold significant potential for transforming educational assessment.

However, despite these advancements, the majority of existing studies focus on game-based learning as an instructional strategy rather than as a formal assessment instrument. Only a limited number of studies have attempted to develop game-based tools that meet rigorous psychometric standards, such as validity and reliability (Fadillah et al., 2025). In addition, there is a lack of research that systematically integrates game-based formats into summative assessment, particularly within specific subject contexts such as Islamic education. Previous studies often emphasize engagement and motivation but pay less attention to the measurement quality of the assessment tools. This creates a critical gap in the literature, as effective assessment instruments must not only be engaging but also provide valid and reliable evidence of student learning. Furthermore, research on game-

based assessment in Qur'an Hadith learning at the Madrasah level remains scarce. Therefore, there is a need for studies that bridge the gap between innovation and psychometric rigor in assessment design.

Another limitation in the existing literature is the lack of comprehensive development frameworks that guide the creation of game-based assessment instruments. While some studies have utilized instructional design models, few have applied systematic approaches such as the ADDIE model to ensure alignment between learning objectives, assessment design, and evaluation processes. Moreover, empirical validation through field testing is often limited, reducing the generalizability of findings. In many cases, the effectiveness of game-based tools is evaluated primarily through student perceptions rather than objective learning outcomes. This indicates the need for more robust methodological approaches that combine development, validation, and effectiveness testing. Addressing these limitations is essential for advancing the field of educational assessment and ensuring that innovative tools can be implemented in formal educational settings. Consequently, research that integrates systematic development models with rigorous validation procedures is highly valuable.

Based on the identified gaps, this study aims to develop, validate, and evaluate a game-based summative assessment instrument for Qur'an Hadith learning using the Crossword Labs platform. Specifically, the study seeks to (1) design an assessment instrument aligned with curriculum objectives, (2) examine its content validity and reliability using established psychometric measures, and (3) evaluate its effectiveness in real classroom settings. Theoretically, this study contributes to the literature by demonstrating how game-based environments can be transformed into valid and reliable assessment instruments, thereby extending the application of game-based learning beyond instructional contexts. Practically, the study provides educators with an alternative assessment model that is engaging, efficient, and aligned with students' characteristics, particularly in Islamic education. By integrating technological innovation with rigorous assessment principles, this research offers a comprehensive framework for improving assessment practices in the digital era. Ultimately, the findings are expected to support the development of more meaningful, student-centered, and contextually relevant assessment approaches.

METHOD

Research Design

This study employed a Research and Development (R&D) design integrated with a mixed-methods approach to develop, validate, and evaluate a game-based summative assessment instrument for Qur'an Hadith learning. The R&D design was selected because the study aimed not only to investigate a phenomenon but also to produce a validated educational product through systematic procedures. The development process followed the ADDIE model, which consists of five iterative stages: analysis, design, development, implementation, and evaluation (Branch, 2009). This model was chosen due to its structured framework that ensures alignment between learning objectives, assessment design, and evaluation outcomes. Furthermore, the mixed-methods approach enabled the integration of quantitative data, used to assess validity, reliability, and effectiveness, with qualitative data that provide deeper insights into usability and implementation processes (Creswell, 2013). This combination allowed for a comprehensive evaluation of both the psychometric properties and practical applicability of the developed instrument.

Research Setting and Duration

The research was conducted in three Madrasah Tsanawiyah located in Palembang, South Sumatra, Indonesia, namely MTs Negeri 1 Palembang, MTs Muhammadiyah 2 Palembang, and MTs PP Qodratullah Putri Banyuasin. These institutions were selected to represent varied educational contexts within Islamic junior secondary schools and to ensure the relevance of the study to Qur'an Hadith instruction. The research was carried out during the 2025/2026 academic year, specifically from August to November 2025. This period covered all stages of the ADDIE model, including needs analysis, product development, expert validation, and field testing. The selection of these schools was based on their readiness to integrate digital tools into learning activities and their alignment with the curriculum targeted in this study. This context provided a suitable environment for examining the feasibility and effectiveness of the developed assessment instrument.

Population and Participants

The population of this study consisted of Grade VII students enrolled in Qur'an Hadith courses, along with Qur'an Hadith teachers and expert validators. The sample included 92 students, 3 teachers, and 5 expert validators consisting of subject-matter experts and educational evaluation specialists. Participants were selected using purposive sampling, based on criteria such as active involvement in Qur'an Hadith instruction, familiarity with basic digital tools, and willingness to participate in the study. This sampling technique was appropriate for development research, as it allows for the selection of participants who can provide relevant and in-depth information (Patton, 2014). Students who did not complete all stages of the assessment were excluded from the analysis to maintain data consistency and validity. The inclusion of multiple participant groups ensured that the instrument was evaluated from both pedagogical and practical perspectives.

Research Instruments

The main instrument developed in this study was a game-based summative assessment tool, referred to as the Qur'an Hadith Crossword Labs (QHCL). This instrument consists of 25 items presented in a crossword puzzle format using the Crossword Labs platform and is designed to measure students' cognitive abilities, including recall, comprehension, and application related to the topic of *Mad Thabi'i*. In addition, several supporting instruments were used to collect data. A validation sheet was employed for expert judgment, containing indicators of content relevance, clarity, and alignment with learning objectives. A student questionnaire using a 4-point Likert scale was used to measure engagement, usability, and perceived effectiveness. An observation sheet was used to assess implementation aspects such as clarity of instructions, ease of use, and student participation. Furthermore, a semi-structured interview guide was utilized to gather qualitative data from teachers and students regarding their experiences with the instrument.

Instrument Validity and Reliability

The validity and reliability of the instruments were systematically evaluated to ensure their quality and suitability. Content validity was assessed through expert judgment, involving five validators who evaluated each item based on relevance, clarity, and representativeness. The results were quantified using Aiken's V coefficient, with values ranging from 0.868 to 0.971, indicating a high level of agreement among experts. Reliability testing was conducted using Cronbach's Alpha, resulting in a coefficient of 0.804, which reflects high internal consistency. Prior to the main implementation, a pilot test was conducted with a small group of students to identify potential issues related to item clarity and difficulty level. Feedback from this stage was used to refine the instrument. These procedures ensured that the developed instrument met accepted psychometric standards and was appropriate for use in the main study.

Data Collection Procedures

Data collection was conducted in several stages following the ADDIE model. In the analysis stage, data were gathered through interviews, observations, and document analysis to identify existing assessment practices and student needs. The design stage involved developing a test blueprint, constructing items, and determining scoring criteria aligned with learning objectives. During the development stage, the instrument was created using the Crossword Labs platform and validated through expert review and focus group discussions. The implementation stage included both small-group and large-group trials conducted in classroom settings, during which students completed the assessment instrument. In the evaluation stage, data were collected through test results, observation sheets, questionnaires, and interviews to assess the effectiveness and practicality of the instrument. All data collection activities were carefully documented to ensure transparency and replicability.

Data Analysis Techniques

Data analysis was conducted using both quantitative and qualitative approaches. Quantitative data were analyzed using descriptive statistics, including mean scores, standard deviations, and percentage distributions, to evaluate validity, reliability, and effectiveness. The effectiveness of the instrument was interpreted based on Likert scale criteria, with higher scores indicating greater effectiveness. Statistical analysis was performed using SPSS version 26, with a significance level of $\alpha = 0.05$ where applicable. Qualitative data obtained from interviews and observations were analyzed

using the Miles and Huberman (1994) framework, which includes data reduction, data display, and conclusion drawing. Coding techniques were applied to identify themes related to student engagement, usability, and implementation challenges. The integration of quantitative and qualitative findings was conducted during the interpretation stage to provide a comprehensive understanding of the research results.

RESULTS AND DISCUSSION

Results

Development and Validation of the Game-Based Summative Assessment Instrument

The development of the game-based summative assessment instrument in this study was conducted systematically using the ADDIE model, ensuring that the resulting product was not only innovative in form but also rigorous in terms of psychometric quality (Darwis et al., 2024). This section presents the results of the development process alongside a critical discussion of its validity and feasibility as an assessment instrument in Qur'an Hadith learning (Fatiha et al., 2026).

The analysis stage revealed several important findings related to existing assessment practices in Madrasah Tsanawiyah. Data obtained from interviews, observations, and document analysis indicated that assessment in Qur'an Hadith subjects was still predominantly conducted through conventional written tests, particularly essay and multiple-choice formats (Elwy et al., 2020). These methods were perceived by both teachers and students as monotonous and less engaging, which in turn affected students' motivation during assessment activities. This finding is consistent with prior studies suggesting that traditional assessment formats often fail to foster active engagement and meaningful learning experiences (Brown, 2022). Furthermore, the analysis highlighted the developmental characteristics of Grade VII students, who tend to prefer interactive and game-like activities, reinforcing the need for a more engaging assessment approach.

Based on these findings, the design stage focused on constructing an assessment instrument that aligns with both curriculum requirements and students' characteristics. The instrument was designed in the form of a crossword puzzle using the Crossword Labs platform, integrating assessment items into an interactive format (Veena et al., 2025). The development of the test blueprint (kisi-kisi) was guided by the learning objectives of Qur'an Hadith subjects, particularly the topic of Mad Thabi'i. Each item was carefully formulated to measure students' cognitive abilities, including understanding, recall, and application of concepts. The crossword format was selected not merely as a variation of assessment form but as a strategic approach to incorporate elements of game-based learning, which have been shown to enhance cognitive engagement and motivation (Plass et al., 2015).

During the development stage, the instrument was constructed and refined through iterative processes. Questions and answers were systematically input into the Crossword Labs application, resulting in a structured crossword puzzle that reflects the intended learning outcomes (Ke et al., 2016). To ensure the quality of the instrument, a Focus Group Discussion (FGD) was conducted involving subject-matter experts and educational practitioners. The FGD provided valuable feedback on the clarity of items, relevance of content, and appropriateness of the format. Revisions were made based on these inputs, demonstrating the iterative nature of the development process (Plass et al., 2020b).

The instrument was subsequently subjected to expert validation, which is a critical step in ensuring the content validity of an assessment instrument. Validation involved both subject-matter experts and evaluation experts who assessed the relevance, clarity, and representativeness of each item. The results of the validation process were analyzed using Aiken's V coefficient, which measures the degree of agreement among experts (Li & Tsai, 2013). The findings indicated that the instrument achieved a very high level of validity, with Aiken's V values ranging from 0.868 to 0.971 and an average value of 0.939. These results suggest that the items included in the instrument are highly relevant and appropriately represent the intended learning objectives.

The high validity scores indicate strong agreement among experts regarding the quality of the instrument. This finding supports the argument that game-based formats, when carefully designed, can meet rigorous assessment standards and should not be viewed merely as supplementary tools.

In addition to validity, the reliability of the instrument was assessed using Cronbach's Alpha coefficient to determine its internal consistency. The results showed a reliability coefficient of 0.804, which falls into the category of high reliability (Zaibon & Shiratuddin, 2010). This indicates that the instrument produces consistent results and can be considered stable for use in assessing students' learning outcomes. Reliability is a crucial requirement for any assessment instrument, as it ensures that the results obtained are dependable and reproducible (Kiili, 2005).

The development process also included a small-group trial, which served as an initial testing phase to evaluate the practicality and usability of the instrument. The results of this trial indicated that students were able to understand the instructions and complete the crossword tasks without significant difficulty (Ramani et al., 2012). Moreover, the interactive nature of the instrument appeared to enhance students' engagement during the assessment process. These findings align with the principles of game-based learning, which emphasize the importance of interaction, challenge, and feedback in promoting meaningful learning experiences (Plass et al., 2020b).

From a theoretical perspective, the successful development and validation of the QHCL instrument demonstrate that game-based assessment can be systematically designed to meet established psychometric standards (Bley, 2017). This challenges the traditional dichotomy between "serious" assessment and "playful" learning tools, suggesting that the two can be effectively integrated. The use of crossword puzzles as an assessment format also reflects constructivist learning principles, where learners actively construct knowledge through interaction and problem-solving (Udeozor et al., 2024).

Furthermore, the integration of technology through the Crossword Labs platform enhances the practicality of the instrument. Teachers can easily create, modify, and administer assessment tasks, while students benefit from a more engaging and less stressful assessment environment. This is particularly important in the context of Islamic education, where assessment practices should not only measure learning outcomes but also support students' holistic development.

Overall, the findings of this section indicate that the developed QHCL instrument is valid, reliable, and feasible for use as a summative assessment tool in Qur'an Hadith learning. The integration of game-based elements into assessment does not compromise its rigor; instead, it enhances its effectiveness by aligning with students' characteristics and contemporary educational demands. This contribution is significant, as it provides empirical evidence supporting the use of game-based approaches in formal assessment contexts, particularly within Islamic education, where such innovations remain limited.

Effectiveness of the Game-Based Summative Assessment in Qur'an Hadith Learning

The effectiveness of the developed game-based summative assessment instrument, namely the Qur'an Hadith Crossword Labs (QHCL), was evaluated through a comprehensive implementation process involving large-group trials in authentic classroom settings. This stage aimed to examine not only the measurable learning outcomes of students but also their engagement, participation, and overall response to the assessment experience. The findings of this stage provide critical evidence regarding the practical value of integrating game-based elements into summative assessment within Islamic education (Abas Hidayat et al., 2021; Telner et al., 2010).

The implementation was conducted in two Madrasah Tsanawiyah, namely MTs Negeri 1 Palembang and MTs Muhammadiyah 2 Palembang, involving Grade VII students. The assessment was administered at the end of a learning unit, consistent with the function of summative assessment as a tool to measure students' achievement after completing a specific instructional phase. The use of QHCL in this context reflects a shift from conventional assessment formats toward more interactive and student-centered approaches, aligning with contemporary perspectives on assessment as an integral part of the learning process (Earl, 2012; Mehra et al., 2018).

Observation data collected during the implementation revealed that the QHCL instrument achieved a high level of effectiveness, with an average score of 3.95 on a Likert scale, categorized as "very effective" . This result indicates that the instrument performed well across multiple evaluation aspects, including clarity of instructions, ease of use, student engagement, and alignment with learning objectives. The high effectiveness score suggests that the integration of crossword-based game elements into assessment can enhance the overall quality of the assessment experience.

These findings demonstrate that the QHCL instrument is not only functional but also capable of creating a positive assessment environment. Students were observed to be more attentive, enthusiastic, and actively involved in completing the assessment tasks. This level of engagement is consistent with the principles of game-based learning, which emphasize the role of interaction, challenge, and immediate feedback in enhancing learners' motivation and cognitive involvement (Johnson & Kim, 2021).

In addition to observational data, the effectiveness of the instrument was further supported by students' achievement scores. The results showed that students in MTs Negeri 1 Palembang achieved an average score of 91.92, while students in MTs Muhammadiyah 2 Palembang achieved an average score of 96.71, both categorized as very high . These outcomes indicate that the use of the QHCL instrument did not hinder students' ability to demonstrate their knowledge; rather, it appears to have facilitated better performance.

The improvement in students' achievement can be explained through several theoretical perspectives. From a cognitive standpoint, the crossword format requires students to recall, understand, and connect concepts in a structured manner, thereby promoting deeper cognitive processing (Tan et al., 2023). Unlike conventional tests that often rely on recognition-based responses, crossword puzzles encourage active retrieval and problem-solving, which are essential for meaningful learning (Hassoulas et al., 2025). This aligns with constructivist learning theory, which posits that knowledge is actively constructed through engagement and interaction.

Furthermore, from a motivational perspective, the game-based nature of the QHCL instrument appears to reduce anxiety commonly associated with summative assessment. Traditional assessment formats are often perceived as stressful, which can negatively affect students' performance. In contrast, the crossword-based format creates a more relaxed and enjoyable atmosphere, enabling students to approach the assessment with greater confidence. This finding supports previous research indicating that game-based approaches can enhance intrinsic motivation and reduce test anxiety (Cattik & Odluyurt, 2017).

Qualitative data obtained from post-implementation interviews with students further reinforced these findings. Students reported that the assessment was more enjoyable and less monotonous compared to conventional tests (Hung, 2018). They expressed a preference for the crossword format, noting that it made them feel more engaged and motivated to complete the tasks. This positive response highlights the importance of considering students' perspectives in designing assessment instruments, as engagement plays a crucial role in learning effectiveness.

Similarly, teachers' responses indicated that the QHCL instrument was practical and efficient in its implementation (Partovi & Razavi, 2019). Teachers noted that the format allowed for easier administration and reduced the time required for scoring compared to essay-based assessments. This efficiency is particularly important in educational contexts where teachers are required to manage large classes and multiple assessment tasks (Bayram & Caliskan, 2019). The ability of the QHCL instrument to combine effectiveness with practicality makes it a valuable alternative to traditional assessment methods.

From an assessment perspective, the effectiveness of the QHCL instrument demonstrates that game-based assessment can fulfill the primary functions of summative assessment, namely measuring learning outcomes and providing reliable evidence of student achievement. At the same time, it extends the role of assessment by incorporating elements that support learning and engagement (Abdullah, 2017). This dual function reflects a more holistic view of assessment, where evaluation and learning are interconnected processes.

Moreover, the findings of this study contribute to the broader discourse on digital assessment in education. While the integration of technology in teaching has been widely explored, its application in assessment remains relatively limited, particularly in Islamic education contexts. The successful implementation of the QHCL instrument provides empirical evidence that digital tools can be effectively adapted for assessment purposes, thereby supporting the ongoing transformation of educational practices in the digital era (Abusharif, 2020).

However, it is important to acknowledge that the effectiveness of the instrument may be influenced by several contextual factors, such as students' familiarity with technology, teachers' readiness to adopt innovative approaches, and the availability of technological resources. Therefore,

future research should explore the scalability of this approach across different educational settings and subjects.

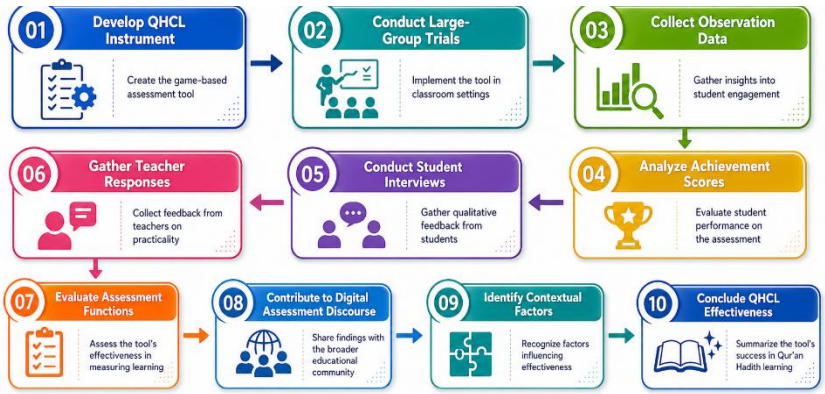

Figure 1. Qur'an Hadith Crossword Labs (QHCL) Implementation Process

In conclusion, the findings of this study demonstrate that the QHCL instrument is highly effective as a game-based summative assessment tool in Qur'an Hadith learning. The instrument not only improves students' learning outcomes but also enhances their engagement and motivation during the assessment process. By integrating game-based elements into formal assessment, this study provides a novel contribution to the field of educational assessment, particularly within Islamic education, where such innovations are still emerging.

CONCLUSION

This study demonstrates that the development of a game-based summative assessment instrument using the Crossword Labs platform provides a valid, reliable, and effective approach for evaluating students' learning in Qur'an Hadith. Through a systematic Research and Development process guided by the ADDIE model, the Qur'an Hadith Crossword Labs (QHCL) instrument was successfully designed in alignment with curriculum objectives and students' characteristics. The results confirmed high content validity and strong internal consistency, indicating that the instrument meets essential psychometric standards required for formal assessment.

Furthermore, the implementation of the QHCL instrument in classroom settings showed a high level of effectiveness, reflected in both students' achievement and their engagement during the assessment process. The integration of game-based elements not only maintained the rigor of measurement but also enhanced students' motivation and participation, addressing the limitations of conventional assessment formats. These findings suggest that game-based assessment can serve as a viable alternative to traditional methods, particularly in contexts where engagement and meaningful learning are critical. Theoretically, this study contributes to the advancement of educational assessment by extending the application of game-based learning into formal summative assessment with empirical validation. Practically, it offers educators an innovative and efficient assessment model that is adaptable to digital learning environments, especially within Islamic education. Overall, this study highlights the potential of integrating technological innovation with sound assessment principles to create more engaging, valid, and student-centered evaluation practices in the digital era.

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AUTHOR CONTRIBUTIONS STATEMENT

SA contributed to the conceptualization of the study, research design, data collection, data analysis, and manuscript drafting. FA was responsible for supervision, methodological validation, and critical revision of the manuscript. Both authors reviewed and approved the final version of the manuscript.

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